CHAPTER 12

Noise

This chapter evaluates the potential noise impacts caused by construction and operation of proposed Project. The chapter summarizes the relevant existing setting and regulatory framework, identifies the thresholds of significance, and identifies impacts and mitigation measures as applicable related to potential noise generation.

12.1 Fundamentals of Acoustics

Acoustics is the study of sound, and noise is defined as unwanted sound. Airborne sound is a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure creating a sound wave. Acoustical terms used in this section are summarized in **Table 12-1**.

Table 12-1. Definitions of Acoustical Terms
Underground Flow Equalization System Project, Environmental Impact Report

Term	Definition
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise or sound at a given location. The ambient noise level is typically defined by the L_{eq} level.
Background Noise Level	The underlying ever-present lower level noise that remains in the absence of intrusive or intermittent sounds. Distant sources, such as traffic, typically make up the background. The background level is generally defined by the L_{90} percentile noise level.
Intrusive	Noise that intrudes over and above the existing ambient noise level at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, time of occurrence, tonal content, the prevailing ambient noise level as well as the sensitivity of the receiver. The intrusive level is generally defined by the L_{10} percentile noise level.
Sound Pressure (Noise) Level Decibel (dB)	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals (20 micronewtons per square meter).
A-Weighted Sound Pressure (Noise) Level (dBA)	The sound level in decibels as measured on a sound level meter using the A-weighted filter network. The A-weighted filter de-emphasizes the very low and very high-frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. All sound (noise) levels in this report are A-weighted.
Equivalent Noise Level (L_{eq})	The average A-weighted noise level, on an equal energy basis, during the measurement period.
Percentile Noise Level (L_n)	The noise level exceeded during n percent of the measurement period, where n is a number between 0 and 100 (for example, L_{90})
Day-Night Noise Level (L_{dn} or DNL)	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels from 10:00 p.m. to 7:00 a.m.

The most common metric of sound is the overall A-weighted decibel (dBA), a sound level measurement adopted by regulatory bodies worldwide. The A-weighting network measures sound similar to how a person perceives or hears sound. There is consensus that A-weighting is appropriate for estimating the hazard of noise-induced hearing loss. With respect to other effects, such as annoyance, A-weighting is acceptable largely if middle- and high-frequency noise is present; however, if the noise is unusually high

at low frequencies or contains prominent low-frequency tones, the A-weighting may not give a valid measure.

A-weighted sound levels are typically measured or presented as equivalent noise level (L_{eq}), which is defined as the average noise level on an equal-energy basis for a stated period of time and is commonly used to measure steady-state sound or noise that is usually dominant. Statistical methods are used to capture the dynamics of a changing acoustical environment. Statistical measurements are typically denoted by $L_{xx,}$ where xx represents the percentile of time the sound level is exceeded. The L_{90} measurement represents the noise level that is exceeded during 90 percent of the measurement period, which typically represents a continuous noise source. Similarly, L_{10} represents the noise level exceeded for 10 percent of the measurement period.

Some metrics used in determining the impact of environmental noise consider the different response that people have to daytime and nighttime noise levels. During the nighttime, exterior background noises are generally lower than the daytime levels. However, most household noise also decreases at night and exterior noise becomes more noticeable. Furthermore, most people sleep at night and are sensitive to intrusive noises. To account for human sensitivity to nighttime noise levels, the day-night sound level (L_{dn} or DNL) was developed. L_{dn} is a noise index that accounts for the greater annoyance of noise during the nighttime hours.

L_{dn} values are calculated by averaging hourly L_{eq} sound levels for a 24-hour period and apply a weighting factor of 10 decibels to nighttime L_{eq} values. The weighting factor, which reflects the increased sensitivity to noise during nighttime hours, is added to each hourly L_{eq} sound level before the 24-hour L_{dn} is calculated. For the purposes of assessing noise, the 24-hour day is divided into two time periods, with the following weightings:

- Daytime: 7 a.m. to 10 p.m. (15 hours) weighting factor of 0 dB
- Nighttime: 10 p.m. to 7 a.m. (9 hours) weighting factor of 10 dB

The two time periods are averaged to compute the overall L_{dn} value. For a continuous noise source, the L_{dn} value is computed by adding 6.4 dBA to the overall 24-hour noise level (L_{eq}). For example, if the expected continuous noise level from a noise source is 60.0 dBA, the resulting L_{dn} from the facility would be 66.4 dBA.

The effects of noise on people can be listed in three general categories:

1. Subjective effects of annoyance, nuisance, and dissatisfaction
2. Interference with activities such as speech, sleep, and learning
3. Physiological effects such as startling and hearing loss

In most cases, environmental noise produces effects in the first two categories only. However, workers in industrial plants may experience noise effects in the third category. No completely satisfactory way exists to measure the subjective effects of noise or to measure the corresponding reactions of annoyance and dissatisfaction. This lack of a common standard is primarily due to the wide variation in individual thresholds of annoyance and habituation to noise. Thus, one way of determining a person's subjective reaction to a new noise is by comparing it to the existing, ambient environment to which that person has adapted. In general, the more the level or the tonal (frequency) variations of a noise exceed the previously existing ambient noise level or tonal quality, the less acceptable the new noise will be, as judged by the exposed individual.

Table 12-2 shows the relative A-weighted noise levels of common sounds measured in the environment and in industry for various sound levels.

Table 12-2. Typical Sound Levels Measures in the Environment and Industry
Underground Flow Equalization System Project, Environmental Impact Report

Noise Source at a Given Distance	A-Weighted Noise Level (dB)	Noise Environments	Subjective Impression
Shotgun (at shooter's ear)	140	Aircraft carrier flight deck	Painfully loud
Civil defense siren (at 100 feet)	130		
Jet takeoff (at 200 feet)	120		Threshold of pain
Loud rock music	110	Rock music concert	
Pile driver (at 50 feet)	100		Very loud
Ambulance siren (at 100 feet)	90	Boiler room	
Pneumatic drill (at 50 feet)	80	Noisy restaurant	
Busy traffic; hair dryer	70		Moderately loud
Normal conversation (at 5 feet)	60	Data processing center	
Light traffic (at 100 feet); rainfall	50	Private business office	
Bird calls (distant)	40	Average living room, library	Quiet
Soft whisper (at 5 feet); rustling leaves	30	Quiet bedroom	
	20	Recording studio	
Normal breathing	10		Threshold of hearing

Source: Beranek, 1998.

12.2 Existing Setting

12.2.1 Existing Noise Levels and Sensitive Receptors

The proposed Project would be constructed entirely within the City of San Mateo. The Project area is located in a mix of low-, medium-, and high-density residential neighborhoods and office and commercial centers combined with parks and open spaces. Noise-sensitive receptors, such as schools, hospitals, and residences, are located in the Project vicinity. The nearest sensitive receptors are low-density residential structures located within approximately 35 feet of the diversion pipeline and force main proposed in Saratoga Drive. The proposed holding structure is approximately 100 feet from the nearest sensitive receptors (low-density residences) located northeast and adjacent to Saratoga Drive. The nearest school is the Nueva School, located approximately 1,000 feet southeast of the proposed diversion pipeline and structure in S. Delaware Street. The nearest medical facility is the Brookside Skilled Nursing Hospital, located over 0.25 mile southwest of the proposed diversion pipeline and structure in S. Delaware Street.

The Project site, primarily the diversion pipelines that are proposed on S. Delaware Street, is located within 250 feet of the Caltrain/Southern Pacific Railroad rail line.

The Noise Element in the *City of San Mateo General Plan – Vision 2030* (General Plan) (City of San Mateo, 2010) describes noise exposure in the City as follows:

> *"...[noise] is dominated by traffic on highways and major arterial roads and trains on the Southern Pacific (SPRR)/Caltrain rail line. Aircraft activity associated with San Francisco International Airport does not significantly affect noise levels in San Mateo, although some neighborhoods in the northeastern portion of the City are impacted by the airport approach path. Localized noise sources include the San Mateo County Fairgrounds, when events are being held. Generally, noise created by manufacturing uses does not have a major impact on the community, although occasional complaints are received from neighbors immediately adjacent to the manufacturing sites."*

The Project area is located outside of the San Francisco International Airport's community noise equivalent level (CNEL) 65 dBA noise contour (SFO, 2019).

Traffic noise levels at 50 feet (L_{dn}, or DNL) are provided in Table 4.6-1 of the City's *General Plan Update Draft Environmental Impact Report* (City of San Mateo, 2009). Major streets located in the Project area and their L_{dn} include:

- S. Delaware Street between approximately 19th Avenue and Saratoga Avenue – L_{dn} at 50 feet ranges from 64.3 to 65.3 dBA
- Hillsdale Boulevard between approximately El Camino Real and U.S. Route 101 (US 101) – L_{dn} at 50 feet ranges from 69.0 to 69.4 dBA
- US 101 through all of San Mateo (with 10-foot-tall sound walls) – L_{dn} at 50 feet of 84.9 dBA
- State Route 92 (SR 92) between approximately El Camino Real and US 101 – L_{dn} at 50 feet of 81.4 dBA

Analysis provided in the City's *General Plan Update Draft Environmental Impact Report* states that 92 commuter trains pass through San Mateo each weekday, and two freight trains operate six times per week between 7 p.m. and 10 p.m. from Sunday through Friday (City of San Mateo, 2009). Noise levels attributed to trains in the City were mainly due to the train's warning horn at grade crossings and stations (City of San Mateo, 2009).

Existing noise contours throughout the City are shown on Figure 4.6-2 of the *General Plan Update Draft Environmental Impact Report* (City of San Mateo, 2009). **Figure 12-1** shows the noise contours within the Project site. As shown, most of the Project area is located within the 60- to 64-dBA Ldn contour, though all the proposed diversion sewer pipelines would be located within the 65- to 69-dBA Ldn contour. Existing noise Ldn contours along the rail line corridor range from 70 dBA to greater than 75 dBA.

12.3 Regulatory Framework

The following sections describe the federal, state, and local noise regulations applicable to the proposed Project.

12.3.1 Federal Regulations

12.3.1.1 U.S. Environmental Protection Agency

EPA guidelines (1974) assist state and local governments in developing state and local laws, ordinances, regulations, and standards for noise. Because local regulations apply to the proposed Project, the EPA guidelines are not applicable.

12.3.1.2 Occupational Safety and Health Administration

Onsite and occupational noise levels are regulated through the OSHA. The noise exposure level of workers is regulated at 90 dBA over an 8-hour work shift to protect hearing (29 CFR 1910.95). Onsite operational noise levels will generally range from 70 to 85 dBA. Areas where noise levels exceed 85 dBA

will be posted as high-noise level areas, and hearing protection will be required when entering or working in those areas. The proposed Project will implement a hearing conservation program for applicable employees and maintain exposure levels below 90 dBA.

12.3.2 State Regulations

12.3.2.1 California Department of Industrial Relations, Division of Occupational Safety and Health

The California Department of Industrial Relations, Division of Occupational Safety and Health (also known as Cal/OSHA) enforces state noise regulations that are the same as the federal OSHA regulations described previously. Agency regulations are contained in the California Code of Regulations, Title 8, General Industrial Safety Orders, Article 105, Control of Noise Exposure, Sections 5095, et seq.

12.3.2.2 California Vehicle Code

Noise limits for highway vehicles are regulated under the California Vehicle Code, Sections 23130 and 23130.5. The limits are enforceable on the highways by the California Highway Patrol and county sheriff offices.

12.3.3 Local Regulations

12.3.3.1 General Plan

The City's Noise Element in the General Plan (City of San Mateo, 2010) establishes goals, objectives, and policies that address how potential noise associated with long-term land uses are evaluated within the City's jurisdiction. The City established land use compatibility guidelines for various land uses in Tables N-1 and N-2 of the General Plan; these are summarized in **Table 12-3**.

Table 12-3. City of San Mateo Noise Sensitive Land Use Compatibility Guidelines for Community Noise Environments
Underground Flow Equalization System Project, Environmental Impact Report

Land Use Category	Normally Acceptable Sound Level	Conditionally Acceptable Sound Level	Normally Unacceptable Sound Level
Single-Family Residential	50 to 59	60 to 70	Greater than 70
Multi-Family Residential	50 to 59	60 to 70	Greater than 70
Hotels, Motels, and Other Lodging Houses	50 to 59	60 to 70	Greater than 70
Long-Term Care Facilities	50 to 59	60 to 70	Greater than 70
Hospitals	50 to 59	60 to 70	Greater than 70
Schools	50 to 59	60 to 70	Greater than 70
Multi-Family Common Open Space Intended for the Use and Enjoyment of Residents	50 to 67	---	Greater than 67
Parks and Playgrounds	50 to 65	---	Greater than 65

Sound levels are shown in Ldn, A-weighted decibels, except for Parks and Playgrounds, which is shown in Leq, A-weighted decibels.

The following noise policies are excerpted from the General Plan Noise Element:

> *N 1.1: Interior Noise Level Standard. Require submittal of an acoustical analysis and interior noise insulation for all "noise sensitive" land uses listed in Table N-1 that have an exterior noise level of 60 dBA (L_{dn}) or above, as shown on Figure N-1. The maximum interior noise level shall not exceed 45 dBA (L_{dn}) in any habitable rooms.*

N 1.2: Exterior Noise Level Standard. …. Maximum exterior noise should not exceed 67 dBA (L_{dn}) for residential uses and should not exceed 65 dBA (L_{eq}) during the noisiest hour for public park uses.

N 2.1: Noise Ordinance. Continue implementation and enforcement of the City's existing noise control ordinance:

a) which prohibits noise that is annoying or injurious to neighbors of normal sensitivity, making such activity a public nuisance, and

b) restricts the hours of construction to minimize noise impact.

N 2.2: Minimize Noise Impact. Protect all "noise-sensitive" land uses listed in Tables N-1 and N-2 from adverse impacts caused by the noise generated on-site by new developments. Incorporate necessary mitigation measures into development design to minimize noise impacts. Prohibit long-term exposure increases of 3 dBA (L_{dn}) or greater at the common property line, or new uses which generate noise levels of 60 dBA (L_{dn}) or greater at the property line, excluding existing ambient noise levels.

N 2.3: Minimize Commercial Noise. Protect land uses other than those listed as "noise sensitive" in Table N-1 from adverse impacts caused by the on-site noise generated by new developments. Incorporate necessary mitigation measures into development design to minimize noise impacts. Prohibit new uses that generate noise levels of 65 dBA (L_{dn}) or above at the property line, excluding existing ambient noise levels.

12.3.3.2 San Mateo Municipal Code

Chapter 7.30 of the San Mateo City Charter and Municipal Code (Municipal Code) (City of San Mateo, 2017) establishes maximum permissible noise levels for various noise zones and land uses. The noise zones and the maximum permissible noise levels are shown in **Table 12-4**.

Table 12-4. San Mateo Municipal Code Maximum Permissible Noise Levels
Underground Flow Equalization System Project, Environmental Impact Report

Noise Zone	Description	Time Period	Noise Level (dBA)
1	All property in any single family residential zone (including adjacent parks and open space) as designated on the City's zoning map prepared pursuant to the provisions of Title 27, or any revisions thereto.	10 p.m. to 7 a.m. 7 a.m. to 10 p.m.	50 60
2	All property in any commercial/mixed residential, multi-family residential, specific plan district, or public utility district as designated.	10 p.m. to 7 a.m. 7 a.m. to 10 p.m.	55 60
3	All property in any commercial or central business district as designated on the City's zoning map prepared pursuant to the provisions of Title 27, or any revisions thereto.	10 p.m. to 7 a.m. 7 a.m. to 10 p.m.	60 65
4	All property in any manufacturing or industrial zone as designated on the City's zoning map prepared pursuant to the provisions of Title 27, or any revisions thereto.	Anytime	70

Source: City of San Mateo, 2017.

In addition, Chapter 7.30 of the Municipal Code states it is unlawful for any person to operate or cause to be operated any source of sound at any location within the City or allow the creation of any noise on property owned, leased, occupied, or otherwise controlled by such person, which causes the noise level when measured on any other property to exceed:

- The noise level standard for that property as specified in above for a cumulative period of more than 30 minutes in any hour
- The noise level standard plus 5 dBA for a cumulative period of more than 15 minutes in any hour
- The noise level standard plus 10 dBA for a cumulative period of more than 5 minutes in any hour
- The noise level standard plus 15 dBA for a cumulative period of more than 1 minute in any hour
- The noise level standard or the maximum measured ambient noise level, plus 20 dBA for any period of time

If the measured ambient noise level for any area is higher than the standard established above, then the ambient noise level shall be the base noise level standard. In such cases, the noise levels shall be increased in 5-dBA increments above the ambient noise level.

The Municipal Code states that utility and street repairs, street sweepers, garbage services, emergency response warning noises, emergency generators and fire alarm systems are exempt from this chapter. Section 7.30.060(e) of the Municipal Code also notes that construction, alteration, repair, or land development activities that are authorized by a valid City permit shall be allowed on weekdays between 7 a.m. and 7 p.m., on Saturdays between 9 a.m. and 5 p.m., and on Sundays and holidays between 12 noon and 4 p.m., or at such other hours as may be authorized or restricted by the permit, if they meet at least one of the following noise limitations:

- No individual piece of equipment shall produce a noise level exceeding 90 dBA at a distance of 25 feet. If the device is housed within a structure or trailer on the property, the measurement shall be made outside the structure at a distance as close to 25 feet from the equipment if possible.
- The noise level at any point outside of the property line boundary of the Project shall not exceed 90 dBA.

In addition, Section 7.30.070 of the Municipal Code allows exceptions if the applicant can show to the City Manager, or the manager's designee, that a diligent investigation of available noise abatement techniques indicates that immediate compliance with the requirements would be impractical or unreasonable. A permit to allow exception from the provisions may be issued, with appropriate conditions to minimize the public detriment caused by such exceptions. The duration of the permit will be as short as possible, but in no case for longer than 6 months. These permits are renewable upon showing good cause and shall be conditioned by a schedule for compliance and details of compliance methods in appropriate cases.

Chapter 23.06 (Administrative Code) of the Municipal Code identifies the conditions under which construction work outside of regularly allowed hours may occur (City of San Mateo, 2017). Specifically, Section 23.06.061 of the Municipal Code states:

> *As a condition of approval of a planning application issued pursuant to Title 26 and Title 27 of this code, a condition may be established which authorizes an exemption from the hours of work designated in Section 23.06.060 if the Building Official finds that:*
>
> *(a) The following criteria are met:*
>
> *(1) Permitting extended hours of construction will decrease the total time needed to complete the project, thus mitigating the total amount of noise associated with the project as a whole; or*
>
> *(2) An emergency situation exists where the construction is necessary to correct an unsafe or dangerous condition resulting in obvious and eminent peril to public health and safety. If such a condition exists, the City may waive any of the remaining requirements outlined below.*

(b) The exemption will not conflict with any other conditions of approval required by the City to mitigate significant impacts.

(c) The contractor or owner of the property will notify residential and commercial occupants of property adjacent to the construction site of the hours of construction activity which may impact the area. This notification must be provided three days prior to the start of the construction activity.

(d) The approved hours of construction activity will be posted at the construction site in a place and manner that can be easily viewed by an interested member of the public.

(e) The Building Official may revoke the exemption at any time if the contractor or owner of the property fails to abide by the conditions of the exemption or if it is determined that the peace, comfort and tranquility of the occupants of adjacent residential or commercial properties are impaired because of the location and nature of the construction.

A Waiver of Work Hours application can be submitted for staff approval for nighttime work. A letter of notification must be sent to the residents in the surrounding neighborhood (City of San Mateo, 2016).

12.4 Assessment Methods and Thresholds of Significance

12.4.1 Noise

The analysis of impacts was based on noise levels of typical construction equipment that is expected to be used to construct both the temporary holding structure and the diversion facilities. The expected equipment noise levels listed in the *FHWA Roadway Construction Noise Model User's Guide* (RCNM User Guide) (FHWA, 2006) were used for this evaluation. The RCNM User's Guide provides the most recent comprehensive assessment of noise levels from construction equipment. Given the linear nature of highway and pipeline construction, the method developed by FHWA can be reasonably applied to pipeline construction activities.

Equipment noise levels from Table 1 in the RCNM User Guide are shown in **Table 12-5**, which provides typical range and usage factors for general construction equipment and activities consistent with the FHWA Roadway Construction Noise Model. All listed noise levels are maximum A-weighted sound pressure levels at a reference distance of 50 feet. The acoustical usage factor is the fraction of time that the equipment generates noise at the maximum level. The model calculates the total noise level at the receptor by determining the noise from each piece of equipment, taking into account the reduction of noise with distance due to geometric divergence, and logarithmically adding the contribution of each piece of equipment to get the total noise anticipated from all the construction equipment. Geometric divergence is the primary mechanism of noise reduction close to a noise source. At farther distances, additional attenuation (e.g., ground effects and atmospheric attenuation) can be significant. This excess attenuation is not accounted for in the FHWA model; therefore, the model output presented in **Table 12-5** below should be considered conservatively high.

Table 12-5. Construction Equipment Noise Levels from the RCNM User Guide
Underground Flow Equalization System Project, Environmental Impact Report

Equipment Description	Acoustical Usage Factor (%)	Specified L_{max} at 50 feet (dBA)	Actual Measured L_{max} at 50 feet (dBA)	Number of Actual Data Samples
All Other Equipment Greater than 5 Horsepower	50	85	N/A	0
Auger Drill Rig	20	85	84	36

Table 12-5. Construction Equipment Noise Levels from the RCNM User Guide
Underground Flow Equalization System Project, Environmental Impact Report

Equipment Description	Acoustical Usage Factor (%)	Specified L_{max} at 50 feet (dBA)	Actual Measured L_{max} at 50 feet (dBA)	Number of Actual Data Samples
Backhoe	40	80	78	372
Bar Bender	20	80	N/A	0
Blasting	N/A	94	N/A	0
Boring Jack Power Unit	50	80	83	1
Chain Saw	20	85	84	46
Clam Shovel (dropping)	20	93	87	4
Compactor (ground)	20	80	83	57
Compressor (air)	40	80	78	18
Concrete Batch Plant	15	83	N/A	0
Concrete Mixer Truck	40	85	79	40
Concrete Pump Truck	20	82	81	30
Concrete Saw	20	90	90	55
Crane	16	85	81	405
Dozer	40	85	82	55
Drill Rig Truck	20	84	79	22
Drum Mixer	50	80	80	1
Dump Truck	40	84	76	31
Excavator	40	85	81	170
Flat Bed Truck	40	84	74	4
Front End Loader	40	80	79	96
Generator	50	82	81	19
Generator (less than 25 kilovolt-amperes, VMS signs)	50	70	73	74
Gradall	40	85	83	70
Grader	40	85	N/A	0
Grapple (on backhoe)	40	85	87	1
Horizontal Boring Hydraulic Jack	25	80	82	6
Hydra Break Ram	10	90	N/A	0
Impact Pile Driver	20	95	101	11
Jackhammer	20	85	89	133
Man Lift	20	85	75	23
Mounted Impact Hammer (hoe ram)	20	90	90	212

Table 12-5. Construction Equipment Noise Levels from the RCNM User Guide
Underground Flow Equalization System Project, Environmental Impact Report

Equipment Description	Acoustical Usage Factor (%)	Specified L_{max} at 50 feet (dBA)	Actual Measured L_{max} at 50 feet (dBA)	Number of Actual Data Samples
Pavement Scarifier	20	85	90	2
Paver	50	85	77	9
Pickup Truck	40	55	75	1
Pneumatic Tools	50	85	85	90
Pumps	50	77	81	17
Refrigerator Unit	100	82	73	3
Rivet Buster/Chipping Gun	20	85	79	19
Rock Drill	20	85	81	3
Roller	20	85	80	16
Sand Blasting (single nozzle)	20	85	96	9
Scraper	40	85	84	12
Shears (on backhoe)	40	85	96	5
Slurry Plant	100	78	78	1
Slurry Trenching Machine	50	82	80	75
Soil Mix Drill Rig	50	80	N/A	0
Tractor	40	84	N/A	0
Vacuum Excavator (Vac-truck)	40	85	85	149
Vacuum Street Sweeper	10	80	82	19
Ventilation Fan	100	85	79	13
Vibrating Hopper	50	85	87	1
Vibratory Concrete Mixer	20	80	80	1
Vibratory Pile Driver	20	95	101	44
Warning Horn	5	85	83	12
Welder/Torch	40	73	74	5

Source: FHWA, 2006.

N/A = not applicable

As described in the RCNM User Guide, the average noise level from each piece of equipment is determined by the following formula for geometric spreading:

Reference Noise Level – 20*log (distance to receptor/50) + 10*log (usage factor %/100)

The total noise level is determined in the model adding of the decibel contribution for each piece of equipment. Additional details are provided in the RCNM User Guide.

Review of the table of construction equipment noise levels indicates that the loudest equipment generally emits noise in the range of 80 to 90 dBA at 50 feet. Noise at any specific receptor is dominated by the closest and loudest equipment. The types, numbers, and duration of equipment anticipated to be used during construction of the proposed Project near any specific receptor location will vary over time.

The construction noise estimate was based on conservative assumptions of multiple pieces of loud equipment operating close to each other. This is believed to be a conservative, yet realistic, scenario for typical construction activities (unique activities such as pile driving are limited to daytime hours and considered separately). Assumptions include the following:

- One piece of equipment generating a reference noise level of 85 dBA (at 50 feet with a 40 percent usage factor located at the edge of the construction area
- Two pieces of equipment generating reference 85-dBA noise levels located 50 feet farther away from the edge of construction
- Two more pieces of equipment generating reference 85-dBA noise levels located 100 feet farther away the edge of construction

Expected average construction equipment noise levels at various distances, based on this scenario, are presented in **Table 12-6**. This extrapolation likely overstates noise impacts because it only considers geometric spreading and does not account for atmospheric absorption, ground effects, or other noise attenuation mechanisms.

Table 12-6. Average Construction Equipment Noise Levels Versus Distance
Underground Flow Equalization System Project, Environmental Impact Report

Distance from Construction Boundary (feet)	Anticipated Construction Activities L_{eq} Noise Level (dBA)
50	83
100	79
200	74
400	69
800	63
1,600	58

12.4.2 Vibration

Activities that result in excessive vibration may be annoying and in extreme cases, damage property. Operations will utilize equipment that is designed to produce low levels of vibration, and offsite vibration from equipment operations is not expected; therefore, operations are not discussed further in this section. To assess potential vibration impacts from construction activities, the Federal Transit Administration (FTA) guidance manual (FTA, 2006) methodology was used.

Vibration can be described in many ways using various metrics. Consistent with the FTA guidance, Peak Particle Velocity (PPV) was used to assess the potential for damage from vibration associated with the installation of shoring and pile driving activities. PPV is typically used to assess building damage and is measured in inches per second. PPV is "the maximum instantaneous positive or negative peak of the vibration signal" (FTA, p. 7-3). Vibration Velocity Level (Lv or VdB) is the root mean square (short-term average) velocity vibration expressed in decibel notation rather than inches per second. VdB is used by FTA to assess the potential for human annoyance for transit projects.

Table 12-7 provides the typical vibration levels from various construction equipment as established by FTA. As indicated, a typical impact pile driver could have a PPV of 0.644 in/sec or a VdB of 112 at a distance of 25 feet.

Table 12-7. Vibration Source Levels for Construction Equipment
Underground Flow Equalization System Project, Environmental Impact Report

Equipment		PPV at 25 ft (in/sec)	Approximate VdB at 25 ft
Pile Driver (impact)	upper range	1.518	112
	typical	0.644	104
Pile Driver (sonic)	upper range	0.734	105
	typical	0.170	93
Clam shovel drop (slurry wall)		0.202	94
Hydromill (slurry wall)	in soil	0.008	66
	in rock	0.017	75
Vibratory Roller		0.210	94
Hoe Ram		0.089	87
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Loaded trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58

Notes:
FTA = Federal Transit Administration
VdB = vibration velocity levels
PPV = peak particle velocity
Source: FTA Manual, Table 12-2, 2006.

Table 12-8 provides the criteria for damage from construction activities as established by FTA. As shown, the potential threshold for damage from vibration depends on the type of structure.

Table 12-8. Construction Vibration Damage Criteria
Underground Flow Equalization System Project, Environmental Impact Report

Building Category		PPV (inch/sec)	Approximate VdB
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:
FTA = Federal Transit Administration
VdB = vibration velocity levels
PPV = peak particle velocity
Source: FTA, 2006.

Table 12-9 shows that the typical sonic pile driver operated at a distance of 25 feet results in a PPV that does not exceed the 0.2 in/sec damage criteria for non-engineered timber or masonry structures. Using

the above upper range for an impact pile driver and typical values for a sonic pile driver, the following PPV and VdB at various distances has been tabulated.

Table 12-9. Predicted Vibrations from Pile Driving Equipment at Various Distances
Underground Flow Equalization System Project, Environmental Impact Report

Distance (ft.)	PPV (Upper Range, Impact)	PPV (Typical Sonic)	VdB (Upper Range, Impact)	VdB (Typical Sonic)
50	0.537	0.060	103	84
75	0.292	0.033	98	79
100	0.190	0.021	94	75
125	0.136	0.015	91	72
150	0.103	0.012	89	70
175	0.082	0.009	87	68
200	0.067	0.008	85	66
225	0.056	0.006	83	64

The FTA Manual uses VdB to discuss the human response to vibration from transit operations. Figure 12-2 shows typical levels of ground-borne vibration and the approximate human response on a scale from 50 VdB (typical background vibration) to 100 VdB. The threshold of human perception is around 65 VdB (FTA, p. 7-5). The manual notes that "there has been relatively little research into human response to vibration," and that "complaints have been associated with measured vibration that is lower than the perception threshold" (FTA p. 7-6). The FTA concludes that 75 VdB is the "approximate dividing line between barely perceptible and distinctly perceptible" and notes that "many people find transit vibration at this level annoying."

Caltrans has also published a *Transportation and Construction Vibration Guidance Manual* (Caltrans, 2013). Caltrans has not established a standard for vibration, but rather it presents a range of potential criteria. For continuous vibration from traffic, the CEC Staff's proposed criteria of a PPV of 0.2 in/sec is indicated in the Caltrans guidance to be "annoying" but not "unpleasant" and a level of 0.1 in/sec is indicated as "Begins to Annoy." It is also noted that "thresholds for perception and annoyance are higher for transient vibration than for continuous vibration." Pile driving is the activity that with the greatest likelihood to create perceptible offsite vibrations. Pile driving does not represent a continuous source of vibration and is also a short-term daytime construction activity; therefore, it is not unreasonable to expect people to be less sensitive to it and for a higher threshold be considered.

The proposed Project would cause a significant impact related to noise if it would result in the following:

- Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the Project in excess of standards established in the General Plan or noise ordinance, or applicable standards of other agencies
- A substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project
- Generation of excessive ground-borne vibration or ground-borne noise levels
- A substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project

- For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, the project would expose people residing or working in the Project area to excessive noise levels

The Project area is not located within an airport land use plan area or within 2 miles of a public airport or private airstrip; therefore, noise impacts related to airports are not discussed further.

12.5 Environmental Impacts

Impact 12-1. Would the proposed Project result* in generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the Project in excess of standards established in the General Plan or noise ordinance, or applicable standards of other agencies*?

As presented in Chapter 2, construction of the proposed Project would last up to 25 months in duration. The diversion pipelines and other temporary holding structure components would be constructed simultaneously. Construction of the diversion pipelines is expected to last approximately 13 months, with the location of construction activities progressing along the pipeline footprint. The typical construction duration for new portions of the pipeline would be approximately 3 to 5 days for a 500-foot segment, thus the period of greatest potential noise generation from pipeline construction near any one sensitive receptor would be limited in duration.

Construction activities specific to the temporary holding structure and associated facilities would have the greatest potential to generate substantial noise and would be anticipated to span approximately 18 months in duration. Pile driving activities could be required for the foundation of the holding structure and the installation of shoring is expected to support the excavation of the temporary holding structure and other underground structures. Shoring could consist of sheet piles, soldier pile shoring installed with pile drivers, or secant pile shoring installed with a crane and an auger. These activities would be localized within the construction disturbance area of the holding structure and associated components throughout the duration of construction. **Tables 12-5** and **12-6** present typical construction equipment sound levels.

As indicated in **Table 12-5**, pile drivers may result in a measured noise level of 101 dBA at 50 feet or 107 dBA at 25 feet. Pile driving sound levels would be expected to decrease at a rate of 6 dBA per doubling of distance.

Sound barriers are a common noise minimization measure that may be implemented to address construction noise concerns, such as pile driving. Noise walls interrupt noise propagation and create an “acoustic shadow zone.” The sound pressure level is lower in the shadow zone than in the respective unobstructed free field. Permanent noise barriers typically consist of earthen berms, freestanding walls (usually concrete), a combination of berms and walls, or pre-engineered panels. The effectiveness of these barriers depends on two primary design features:

1. The barrier must be high enough to break the line of sight between the observer and the noise source and long enough to prevent noise leaks around the ends.
2. Noise must not be transmitted through the barrier.

The effectiveness of a noise barrier is quantified by its field insertion loss, which is the difference in the noise levels at the same location before and after the barrier is constructed.

Plywood walls, mass-loaded vinyl (vinyl impregnated with metal), and hay bales have been used to create temporary walls around noisy equipment or site perimeters. The barrier should be tall enough to block the line of sight to the noise-generating portion of Project area. For most diesel-powered equipment, the wall would have to be tall enough to block the line of sight to the engine exhaust. A barrier wall constructed of ¾-inch plywood that minimizes open spaces (gaps) may achieve a 5- to 10-dBA reduction; a practical limit of barrier effectiveness is typically 20 dBA.

Section 7.30.060(e) of the Municipal Code allows permitted construction or land development activities on weekdays between 7 a.m. and 7 p.m., provided (1) individual construction equipment does not exceed 90 dB at a distance of 25 feet (equivalent to 84 dBA at 50 feet), or (2) Project-related construction noise outside the property line does not exceed 90 dB (equivalent to 84 dBA at 50 feet). The analysis summarized in **Table 12-6** predicts the average construction equipment noise level to be 83 dBA at 50 feet and noting the 90 dBA at 25 feet is equivalent to 84 dBA at the typical reference distance of 50 feet. A review of **Table 12-5** indicates that the noise level for many individual pieces of construction equipment would be below the 90-dBA threshold. However, individual construction equipment could generate noise that exceeds 90 dBA at 25 feet and may exceed 90 dBA at property line depending on where they operate, which is a potentially significant impact.

Noise related to construction activities will be short term, temporary, and limited to daytime hours in compliance with Section 7.30.060(e) of the Municipal Code. It is assumed that all work would typically be conducted Monday through Friday, within a normal shift between 7 a.m. and 7 p.m. Construction activities may occur during the weekends within the hours allowed per the City's municipal code. Any work outside of the allowed construction hours would not be done without prior approval by the City.

Compliance with the City's Municipal code and implementation of Final PEIR **Mitigation Measure 12-1a, Develop and implement construction noise minimization measures**, **Mitigation Measure 12-1b, Operate a construction noise hot line**, and **Mitigation Measure 12-1c, Resolve construction noise complaints** would help minimize noise impacts from construction of the Project. However, construction activities may still temporarily exceed 90 dBA at the property line, even with mitigation implemented.

Though temporary in nature, certain equipment or activities may cause significant and unavoidable noise impacts during Project construction.

Impact 12-2. Would the proposed Project result in a substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project?

The General Plan (City of San Mateo, 2010) defines a substantial or significant increase as an increase in the existing L_{dn} of at least 3 dBA at noise-sensitive receptors such as residences, hotels/motels/lodging, long-term care facilities, hospitals, schools, and multi-family common open-space areas. A project would also be considered to a have a significant impact if it generates noise levels above an L_{dn} of 60 dBA at noise-sensitive receivers and above L_{dn} 65 dBA in commercial areas. Operational and maintenance activities may result in minor short-term increases in noise levels due to workers and maintenance vehicles and equipment being used onsite. Noise associated with maintenance activities would not substantially exceed current noise levels from the existing uses on the property. Additionally, once maintenance activities are complete, workers and equipment would leave the site, and there would not be permanent change to existing noise levels.

The temporary holding structure would include new pumps to empty the holding structure after use; these pumps would be below ground, and noise would not be discernible at the property line surrounding the Project area; therefore, impacts would be less than significant.

Impact 12-3. Would the proposed Project generate excessive ground-borne vibration or ground-borne noise levels?

Construction of diversion sewer pipelines would be within 50 feet of residences, and construction activities for the temporary holding structure would be over 100 feet from the nearest residence. Construction will include the installation of shoring around the holding structure excavation site and piles to support the holding structure foundation which could generate localized ground-borne vibration. Shoring installation is expected to utilize vibratory methods, and foundation piles are expected to be installed via impact pile driving.

As indicated in **Tables 12-8** and **12-9** above, the potential for damage to structures from impact pile driving is limited to areas very close to the activity (within 100 feet), and given the nearest residence is more than 100 feet from impact pile driving, the damage criteria are not expected to be exceeded.

Additionally, the proposed Project would implement Final PEIR **Mitigation Measure 12-3**, **Incorporate vibration issues into Project construction** which would help reduce the effects of offsite vibration. Additionally, consistent with **Mitigation Measure 7-1** from the Final PEIR, the City has conducted site-specific geotechnical studies of the Project site and will use that information to incorporate measures to reduce the potential for damage to nearby structures as a result of vibrations or ground displacement during construction.

Mitigation Measure 12-3a, Assess and incorporate vibration monitoring and minimization measures as part of Project construction has been added to Final PEIR Mitigation Measure 12-3 as a site-specific minimization measure to further reduce impacts from construction activities. Even with vibration reduction measures incorporated, temporary construction activities may at times be perceptible and be potentially annoying to individuals offsite. However, given the distance from the construction activity to the nearest sensitive receptor and the short duration of construction activities resulting in vibration, impacts would be less than significant.

12.6 Mitigation Measures

12.6.1 Final PEIR Mitigation Measures

Implementation of the following mitigation measures from the Final PEIR, would reduce potential impacts on noise; however, impacts are expected to remain significant and unavoidable.

Mitigation Measure 12-1a. Develop and implement construction noise minimization measures. General noise minimization measures available to reduce sound levels from construction activities include but are not limited to the following:

- Specify general construction noise mitigation measures that require the contractor to use equipment that is in good working order, adequately muffled, and maintained in accordance with the manufacturers' recommendations.
- Use semi-permanent stationary equipment (e.g., generators and lights) with "quiet" packages (as available) and stationing it as far from sensitive areas as possible.
- During construction, erect temporary barriers using materials such as intermodal containers or frack tanks, plywood walls, mass-loaded vinyl (vinyl impregnated with metal), or hay bales. Barriers shall be erected as close as safely feasible to the noise source. Barriers shall be used when equipment is expected to exceed 90 dBA at the property plane, based on actual measured noise levels for the specific equipment, as cited in *Roadway Construction Noise Model User's Guide* (FHWA, 2006). The barrier shall be designed to provide sufficient attenuation to reduce noise to less than 90 dBA at the property plane, as feasible.

If a diligent investigation of available noise abatement techniques indicates that immediate compliance with the requirements would be impractical or unreasonable, the contractor shall obtain an exceptions permit per Section 7.30.070 of the Municipal Code. The permit shall be issued by the City Manager, or the manager's designee, with appropriate conditions to minimize the public detriment caused by such exceptions. The duration of the permit shall be as short as possible, but in no case for longer than 6 months.

Mitigation Measure 12-1b. Operate a construction noise hot line. The City shall establish a telephone number for use by the public to report any significant undesirable noise conditions associated with construction and demolition of the proposed Project. If the telephone is not staffed 24 hours per day,

the City shall include an automatic answering feature, with date and time stamp recording, to answer calls when the phone is unattended. This telephone number shall be posted at the Project site during construction and demolition so that it is visible to passersby. This telephone number shall be maintained during Project construction.

Mitigation Measure 12-1c. Resolve construction noise complaints. Throughout construction of the proposed Project, all legitimate Project-related noise complaints shall be documented, investigated, evaluated, and resolved as feasible. The City or its authorized agent shall be responsible for the following:

- Use the Noise Complaint Resolution Form typically suggested by the California Energy Commission, or a functionally equivalent procedure, to document and respond to each noise complaint.
- Attempt to contact the person(s) making the noise complaint within 24 hours.
- Conduct an investigation to attempt to determine the source of noise related to the complaint.
- If the noise complaint is legitimate, implement feasible measures to reduce the noise.

Mitigation Measure 12-3. Incorporate vibration issues into proposed Project construction. As part of the final design effort, the potential for construction activities to result in excess vibration shall be assessed and site-specific minimization measures for the proposed Project implemented as necessary.

12.6.2 Project-Specific Mitigation Measures

Implementation of the following Project-specific mitigation measure would ensure that potential impacts on noise would be less than significant.

Mitigation Measure 12-3a. Assess and incorporate vibration monitoring and minimization measures as part of Project construction. As part of the final design effort, the potential for pile-driving in the vicinity of sensitive vibration receivers to result in excess vibration shall be assessed based on factors including soils, hammer type (e.g., impact, vibratory), and location and type of nearby structures. Vibration monitoring will be conducted during pile driving activities, or in response to a complaint, to confirm that vibration levels are within acceptable guidelines. Site-specific minimization measures such as modifying the type of hammer or reducing hammer energy will be implemented as necessary to reduce the potential effects of offsite vibration. Monitoring may be reduced or eliminated when it has been established that these measures, if required, are effective for the site-specific conditions.

12.7 References

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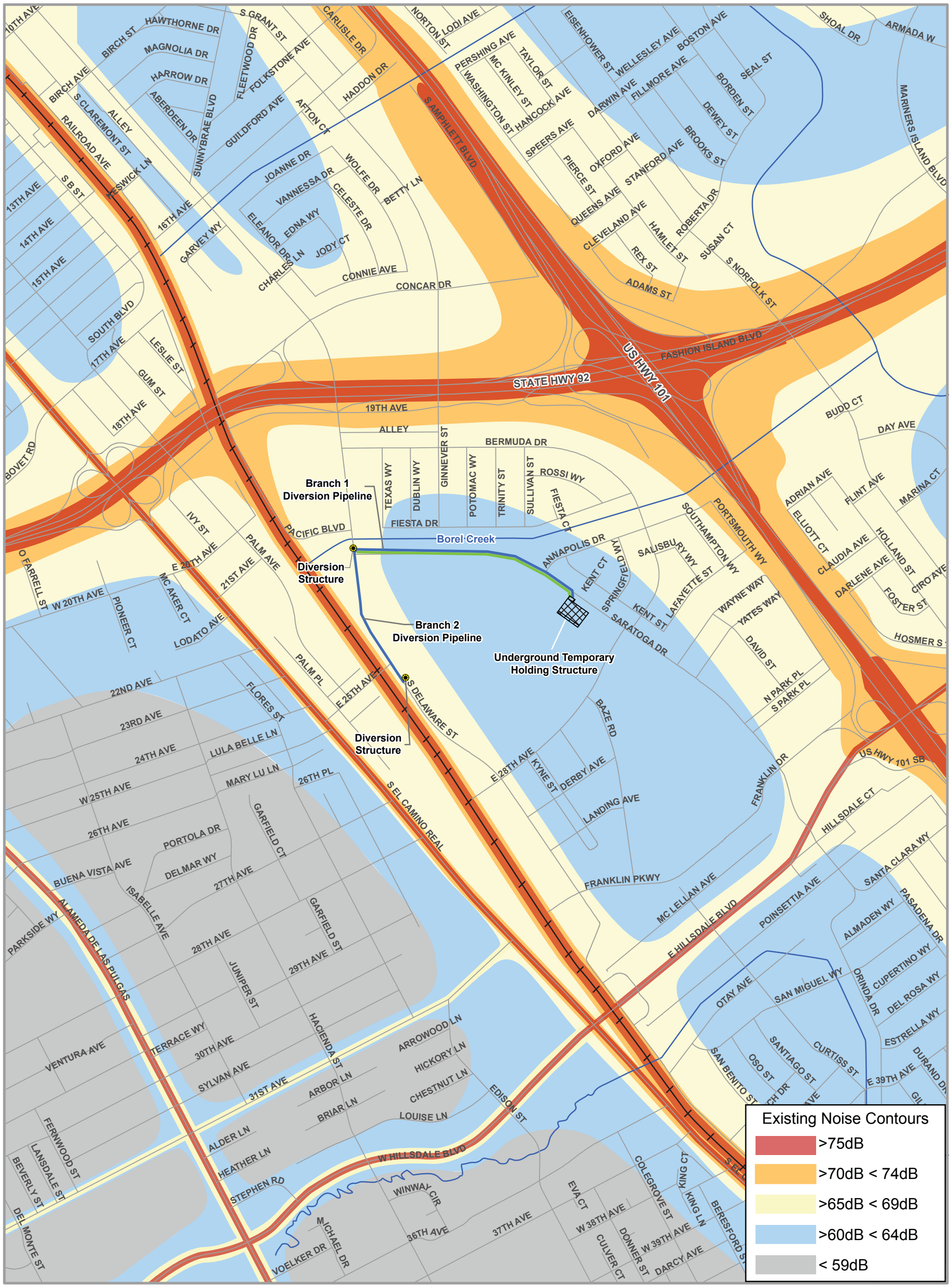
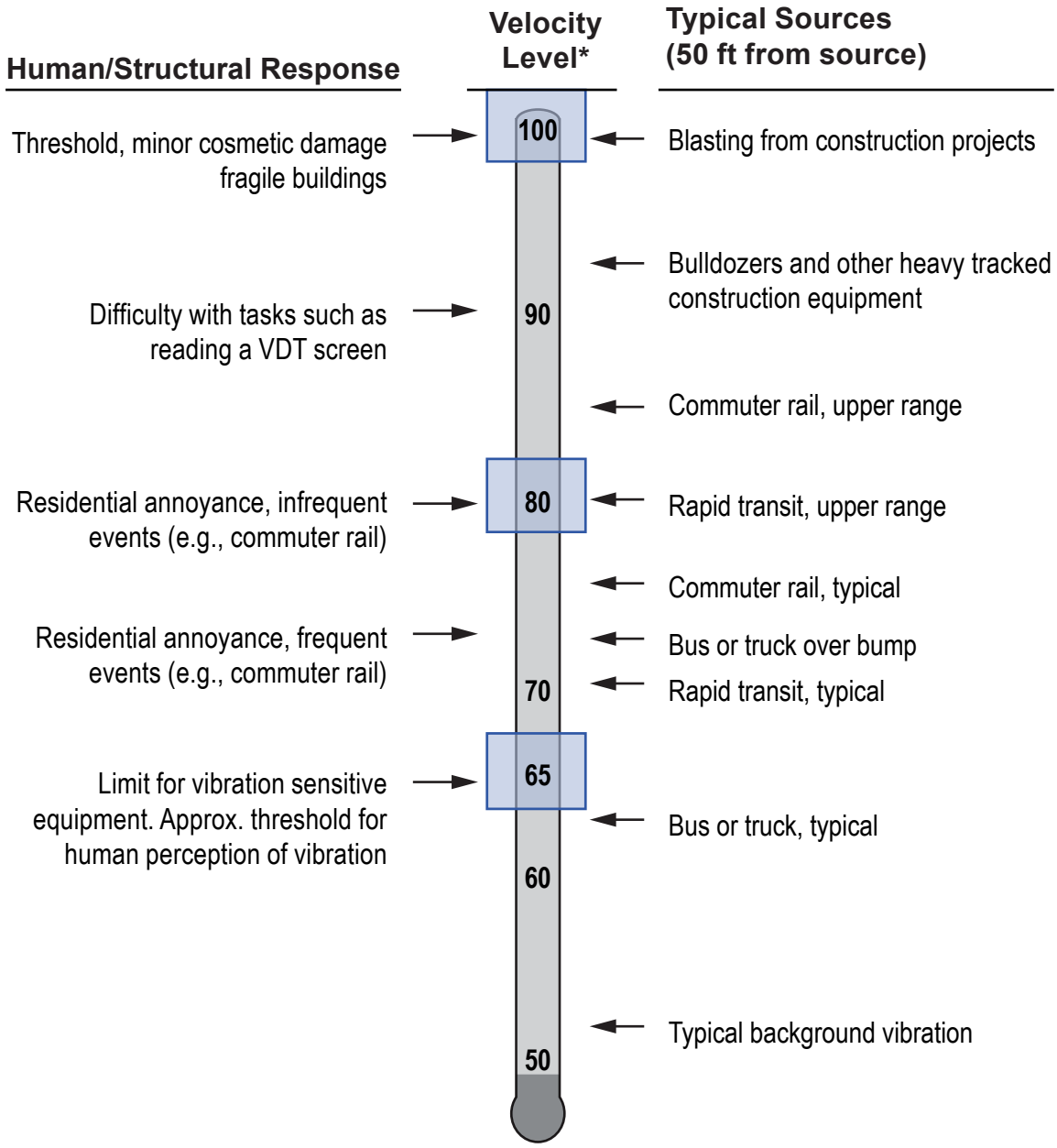


Source: City of San Mateo, 2009.

FIGURE 12-1
Project Area Noise Contours
Underground Flow Equalization System,
Environmental Impact Report
City of San Mateo Clean Water Program

CLEANWATERPROGRAM
PROTECTING THE BAY FOR A SUSTAINABLE FUTURE



** RMS Vibration Velocity Level in VdB relative to 10^{-6} inches/second*

Source: FTA 2006, Figure 7

Figure 12-2
Typical Levels of Ground-Borne Vibration
Underground Flow Equalization System,
Environmental Impact Report
City of San Mateo Clean Water Program