800 Carlisle Way Well & Water Tank Project Noise Assessment Report

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1. Introduction

1.1 Purpose and Study Objectives

The purpose of this study is to identify and analyze the potential noise and vibration impacts associated with the 800 Carlisle Way Well & Tank Project (Project). The following report provides a noise modeling assessment and vibration assessment of the water well drilling operations, demolition construction phase and the planned groundwater well pump station operations of the 800 Carlisle Way Well & Water Tank Project in Sunnyvale, California. Figure 1-1 identifies the site location.

The following is provided in this report:

- Information regarding the fundamentals of noise and vibration
- A description of local noise standards and development of noise and vibration thresholds of significance
- The existing ambient noise levels in the Project area
- An analysis of the potential noise impacts of the water well drilling, construction and pump station operations associated with the proposed Project and measures required to mitigate significant impacts.
- An analysis of the potential vibration impacts of the construction operations associated with the proposed Project and measures required to mitigate significant impacts.

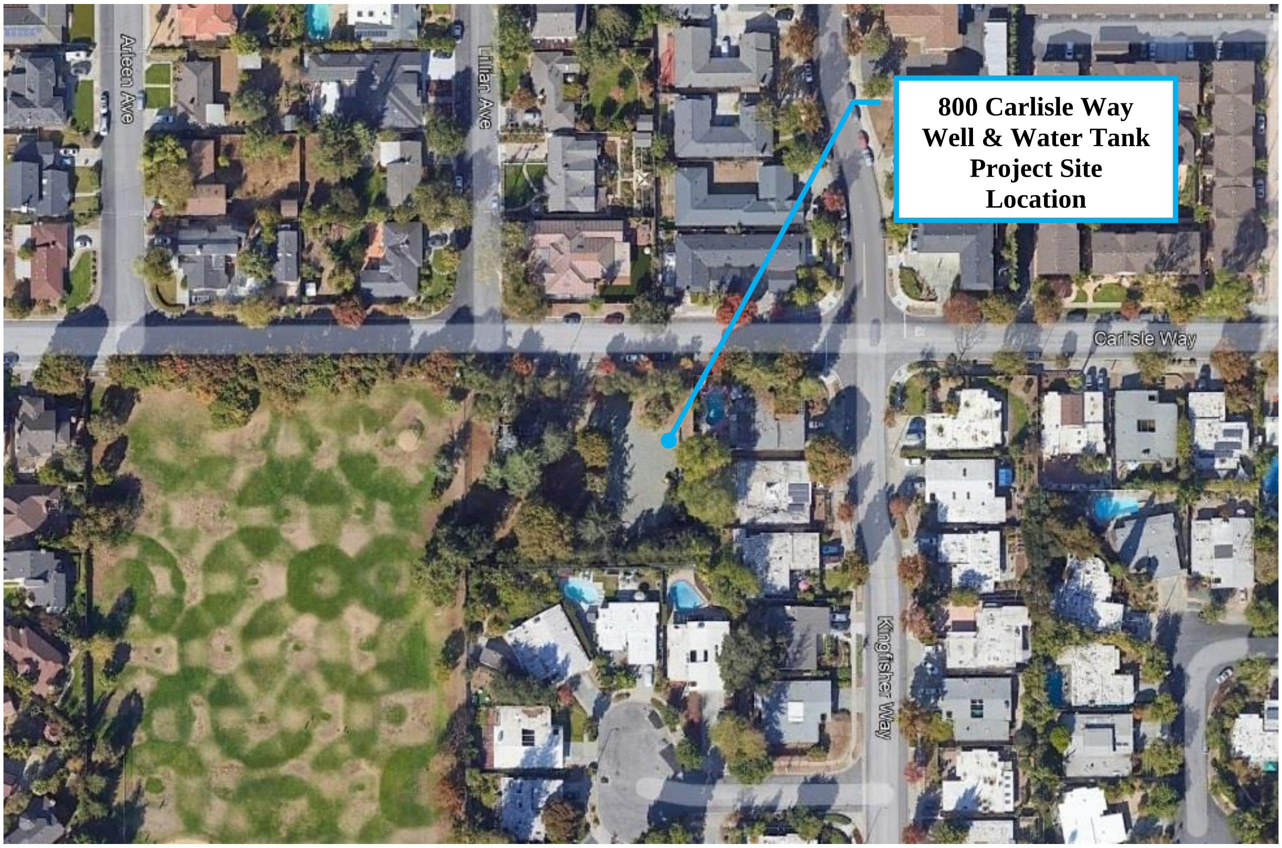


Figure 1-1 800 Carlisle Way Site and Surrounding Area

1.2 Project Description

The 800 Carlisle Way Well & Water Tank development project (Project) includes the water well drilling operation, the demolition of the existing chemical storage building, booster pump, electrical control panel, and connection to the existing water main on-site. After demolition, a replacement groundwater well will be installed and a new, approximately 56,000-gallon steel water storage tank, three chemical storage enclosures, and several utility and right-of-way improvements will be constructed. Drilling operations will occur for approximately 27 days during which 24 hours a day, seven days a week operations will be required. The Project will also include a diesel-powered emergency generator.

1.3 Project Location and Study Area

The Project Site is located at 800 Carlisle Way, Sunnyvale, Santa Clara County, California. The Project Site is located in a low to medium population density area in residential zoning.

Noise sensitive receptors (NSR's) were identified on the north, south, east and west sides of the Project Site, where adjacent residential and public facility properties are located. All identified NSR's were included in the noise level analysis. In locations where a cluster of residences exists, the residences with the highest potential for impact were selected for inclusion in the analysis and reporting of results. Figure 1-2 identifies the 9 NSR's in the vicinity of the Project Site that will be used as points of analysis throughout this study. A summary of the points is included in the Table 1-1.

Table 1-1 Noise Sensitive Receptor Location and Detailed Descriptions

Location	Description	Address	Approximate distance to Project Site (ft)
NSR 1	Residence located northwest of the Project Site	1394 Arleen Ave	164 ft
NSR 2	Residence located northwest of the Project Site	1393 Lillian Ave	80 ft
NSR 3	Residence located north of the Project Site	1394 Lillian Ave	50 ft
NSR 4	Residence located north of the Project Site	1371 Carlisle Way	65 ft
NSR 5	Residence located east of the Project Site (on property boundary)	1403 Kingfisher Way & 1409 Kingfisher Way	0 ft
NSR 6	Residence located southeast of the Project Site	1415 Kingfisher Way & 827 Coventry Ct	0 ft
NSR 7	Residence located south of the Project Site	823 Coventry Ct	0 ft
NSR 8	Residence located south of the Project Site	819 Coventry Ct	0 ft
NSR 9	Park located west of the Project Site (Public Facility)	Panama Park, 755 Dartshire Way	0 ft

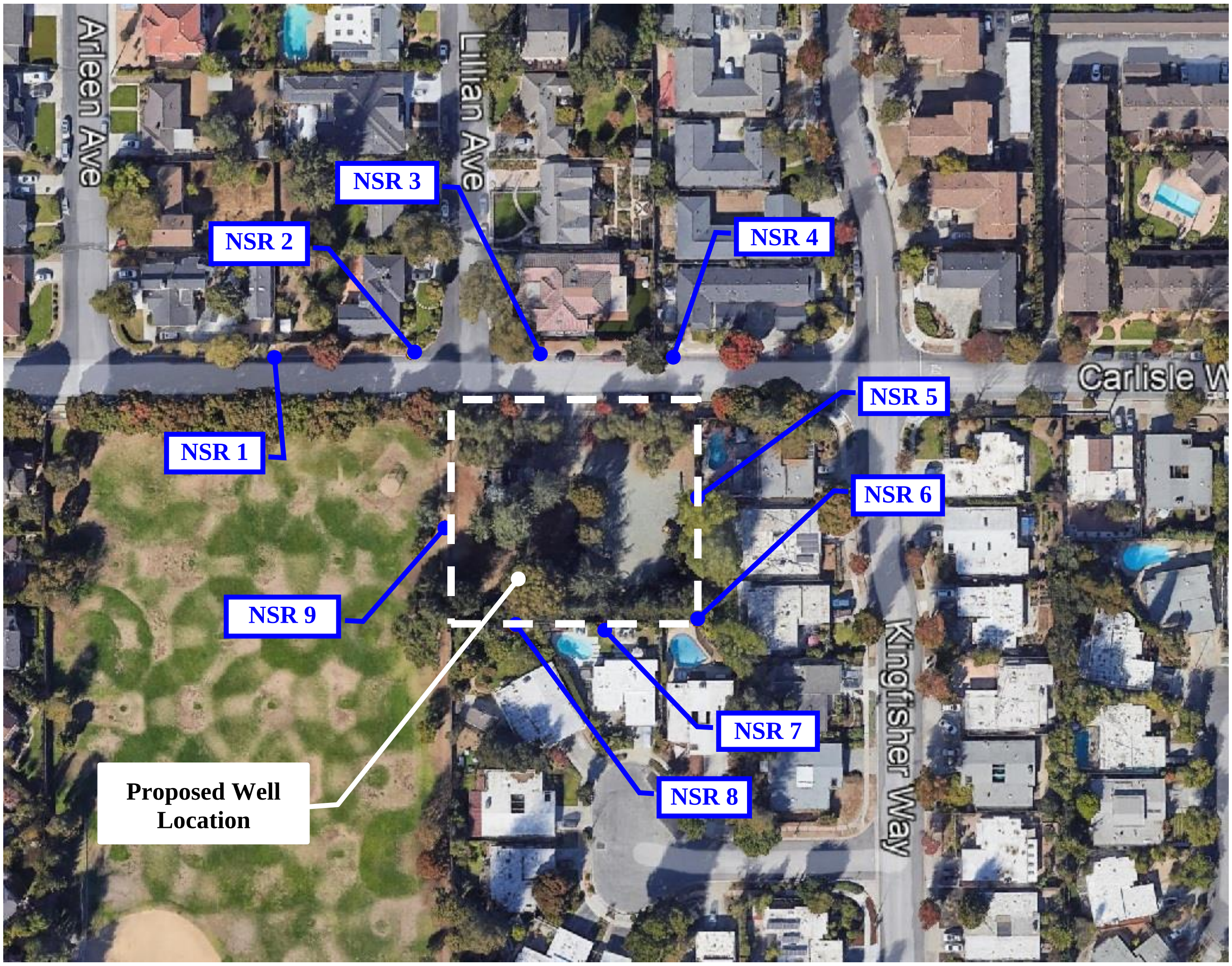


Figure 1-2 Noise Sensitive Receptors in Vicinity of Project Site

2. Noise Fundamentals

2.1 Environmental Noise

Sound is most commonly experienced by people as pressure waves passing through air. These rapid fluctuations in air pressure are processed by the human auditory system to produce the sensation of sound. The rate at which sound pressure changes occur is called the frequency. Frequency is usually measured as the number of oscillations per second or Hertz (Hz). Frequencies that can be heard by a healthy human ear range from approximately 20 Hz to 20,000 Hz. Toward the lower end of this range are low-pitched sounds, including those that might be described as a “rumble” or “boom”. At the higher end of the range are high-pitched sounds that might be described as a “screech” or “hiss”.

Environmental noise generally derives, in part, from a combination of distant noise sources. Such sources may include common experiences such as distant traffic, wind in trees, and distant industrial or farming activities. These distant sources create a low-level "background noise" in which no particular individual source is identifiable. Background noise is often relatively constant from moment to moment, but varies slowly from hour to hour as natural forces change or as human activity follows its daily cycle.

Superimposed on this low-level, slowly varying background noise is a succession of identifiable noisy events of relatively brief duration. These events may include the passing of single-vehicles, aircraft flyovers, screeching of brakes, and other short-term events. The presence of these short-term events causes the noise level to fluctuate. Typical indoor and outdoor A-weighted sound levels are shown in Figure 2-1. Detailed acoustical definitions have been provided in Appendix A – Glossary of Acoustical Terms.

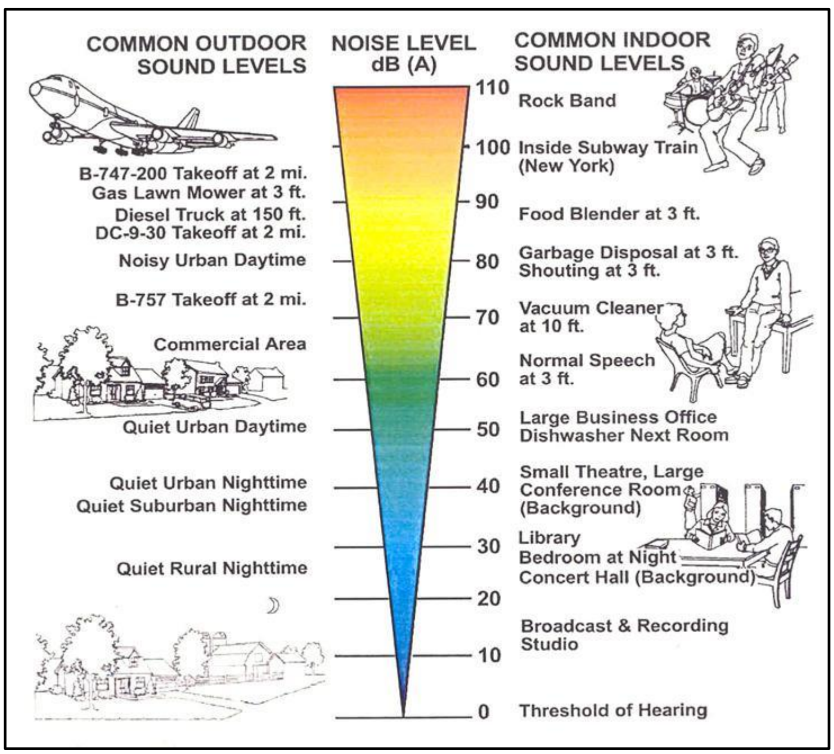


Figure 2-1 Typical Indoor and Outdoor A-Weighted Sound Levels

2.2 Relative Loudness of Environmental Noise

The relative loudness of environmental noise correlates a decibel change in sound levels with a perceived relative loudness as shown in Table 2-1. The sound level change is applicable in the field as opposed to a quiet laboratory loudness as shown in Table 2-1. The sound level change is applicable in the field as opposed to a quiet laboratory environment where smaller sound level differences could be perceived. A decrease in 10 dB is perceived as half as loud and similarly a decrease of 20 dB is perceived as ¼ as loud. Sound level increases are perceived similarly, with 10 dB increase perceived as a doubling of loudness and 20 dB increase perceived as 4 times as loud.

Table 2-1 FHWA Relativeness Loudness of Environmental Noise

Sound Level Change	Relative Loudness	Acoustic Energy Loss
0 dB(A)	Reference	0
-3 dB(A)	Barely Perceptible Change	50%
-5 dB(A)	Readily Perceptible Change	67%
-10 dB(A)	Half as Loud	90%
-20 dB(A)	1/4 as Loud	99%
-30 dB(A)	1/8 as Loud	99.9%

*Table adapted from FHWA Highway Traffic Noise: Analysis and Abatement Guidance, revised December 2010. Similar table in CALTRANS Technical Noise Supplement to the Traffic Noise Analysis Protocol.

2.3 Noise Descriptors

The following section identifies and describes the noise descriptors that will be used in this study.

Decibels

Human perception of loudness is logarithmic rather than linear. For this reason, sound level is usually measured on a logarithmic decibel (dB) scale, which is calculated from the ratio of the sound pressure to a reference pressure level. Specifically, the sound pressure level is calculated as follows:

$$SPL = 20\, log_{10} \frac{p}{p_{ref}}$$

Where:

SPL = sound pressure level in decibels
p = rms sound pressure
p_{ref} = reference sound pressure (20 microPascals)

The reference pressure for sound in the air is 20 microPascals (μPa), which is represented as zero on the decibel scale. This value is used because it approximates the lowest pressure level detectable by a healthy human ear.

A-Weighting

Humans are more sensitive to some sound frequencies than others. It is therefore common practice to apply an audio filter to measured sound levels to approximate the frequency sensitivity of the human ear. One such filter is called the A-weighted decibel scale, which emphasizes sounds between 500 and 5,000 Hz and attenuates the frequencies outside of that range. Measurements conducted utilizing the A-weighted decibel scale are denoted with an "(A)" or "A" after the decibel abbreviation (dB(A) or dBA). The A-weighted scale is nearly universally used when assessing noise impact on humans. Figure 2-1 shows typical dBA noise levels that can be found in both outdoor and indoor environments.

It is generally accepted that a change of 3 dB is perceptible to the average healthy human ear. A change of 5 dB is generally regarded as a readily perceptible increase/decrease in noise level.

Equivalent Sound Level (L_{eq})

Some sources, such as air-conditioning equipment, produce continuous noise with a steady level that does not change with time. Other sources may be transient in nature, such as a train or aircraft passing-by. Between these two extremes are constant sources that vary gradually with time, such as distant freeway traffic, and intermittent sources that vary rapidly with time, such as traffic on a surface street. A location may receive noise contributions from a number of sources that fall into some or all of these categories, resulting in a complex time-varying noise environment. For this reason, meaningful measurement and analysis of environmental noise usually requires time-dependent noise descriptors. The equivalent sound level, or L_{eq}, is a sound energy average, calculated over a stated time period. 1-hour, A-weighted L_{eq} values are used commonly in environmental noise assessments.

Maximum Noise Level (L_{max})

The maximum noise level is defined as the highest instantaneous noise level over a specified time interval. A one-hour L_{max} level would be the highest observed noise level over the one-hour period.

Minimum Noise Level (L_{min})

The minimum noise level is defined as the lowest instantaneous noise level over a specified time interval. A one-hour L_{min} level would be the lowest observed noise level over the one-hour period.

Community Noise Equivalent Level (CNEL)

The Community Noise Equivalent Level (CNEL) is an A-weighted average noise level calculated over 24 hours, with a 5 dBA weighting added to sound levels during evening hours (7 p.m. to 10 p.m.) and a 10 dBA weighting added to sound levels during nighttime hours (10 p.m. to 7 a.m.) to reflect the increased annoyance of noise at night.

3. Ground-Borne Vibration Fundamentals

Vibration is acoustic energy transmitted as waves through a solid medium, such as soil or concrete. Like noise, the rate at which pressure changes occur is called the frequency of the vibration, measured in Hz. Vibration may be the form of a single pulse of acoustical energy, a series of pulses, or a continuous oscillating motion.

Ground-borne vibration is the ground motion about some equilibrium position that can be described in terms of displacement, velocity, and acceleration. It can be generated by transportation systems, construction activities, and other large mechanical systems. Vibration motion moves in the X, Y and Z axes.

The way that vibration is transmitted through the ground depends on the soil type, the presence of rock formations or man-made features and the topography between the vibration source and the receptor location. As a general rule, vibration waves tend to dissipate and reduce in magnitude with distance from the source. Also, the high frequency vibrations are generally attenuated rapidly as they travel through the ground, so that the vibration received at locations distant from the source tends to be dominated by low-frequency vibration. The frequencies of ground-borne vibration most perceptible to humans are in the range from less than 1 Hz to 100 Hz.

When ground-borne vibration arrives at a building, a portion of the energy will be reflected or refracted away from the building, and a portion of the energy will typically continue to penetrate through the ground-building interface. However, once the vibration energy is in the building structure, it can be amplified by the resonance of the walls and floors. Occupants can perceive vibration as motion of the building elements (particularly floors) and also rattling of lightweight components, such as windows, shutters or items on shelves. At very high amplitudes (energy levels), low-frequency vibration can cause damage to buildings.

3.1 Vibration Descriptors

The following section describes the vibration descriptors that will be used in this study.

Peak Particle Velocity

The peak particle velocity (PPV) is defined as the maximum instantaneous velocity of a particle as it transmits a vibration wave. The accepted unit for measuring PPV is inches per second (ips). PPV is appropriate for evaluating the potential for building damage and for evaluating human response to ground-borne vibration. When reporting measured PPV values, a time interval is generally specified over which the PPV values were recorded during the measurement process.

Table 3-1 displays typical vibration exposure guidelines for various types of structures and Table 3-2 categorizes typical human responses to exposure of varying vibration levels. The vibration exposure guidelines were obtained from the Caltrans Transportation and Construction Vibration Guidance Manual dated April 2020, Chapter 6 Vibration Criteria Section 6.1 People and Section 6.2 Structures.

Table 3-1 Structural Guideline Vibration Criteria

Structure and Condition	Maximum PPV (ips) Transient Sources	Maximum PPV (ips) Continuous/Frequent Intermittent Sources
Extremely Fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structure	0.5	0.3
New residential structure	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5

Note: Transient sources create a single isolated vibration event. Continuous/frequent intermittent sources include impact pile drivers, vibratory pile drivers, and vibratory compaction equipment.
Source: Caltrans

Table 3-2 Human Guideline Vibration Criteria

Human Response	Maximum PPV (ips) Transient Sources	Maximum PPV (ips) Continuous/Frequent Intermittent Sources
Barely perceptible	0.035	0.012
Distinctly perceptible	0.24	0.035
Strongly perceptible	0.9	0.10
Severe	2.0	0.4

Note: Transient sources create a single isolated vibration event. Continuous/frequent intermittent sources include impact pile drivers, vibratory pile drivers, and vibratory compaction equipment.
Source: Caltrans

4. Existing Noise Environment

A sound level survey was conducted to measure and document the existing ambient noise levels in the vicinity of the Project Site. The measurement program consisted of a 24-hour ambient noise measurement and 15-minute short term (ST) ambient noise measurements at ten locations as shown in Figure 4-1.

Figure 4-1 Project Site Ambient Sound Monitoring Location

4.1 Ambient Sound Level Survey

One Type 1 sound level meter was deployed at the site to conduct the 24-hour ambient survey. The sound level meter conforms to Type 1 as per ANSI S1.4 *Specification for Sound Level Meters*. The microphone associated with the sound level meter was placed approximately 5 feet above the ground and at least 10 feet from any reflective surfaces. The sound level meter was calibrated before and after the measurement period. The instrumentation details are presented in Table 4-1.

Table 4-1 24-Hour Ambient Sound Level Survey Instrumentation Details

Location	Instrument	Manufacturer/Model	Serial Number
24-hour Meter Location	Sound Level Meter	SVANTEK SVAN 307 Sound Level Meter	106243
	Calibrator	Quest Technology	QIF060280

The sound level meter was deployed on Tuesday, July 19, 2022 and programmed to continuously monitor and record A-weighted sound levels. The meter was retrieved on Wednesday, July 20, 2022. Weather data including temperature, humidity, rainfall, wind speed and wind direction was acquired from www.wunderground.com.

The results of the 24-hour ambient measurements are shown in Table 4-2. The table presents daytime and nighttime average sound levels and the calculated CNEL level at Location 1. There were elevated short-duration sound level events that occurred during the 10:00 p.m. and 11:00 p.m. hour in which the sources could not be identified. These elevated sound levels affected the calculated CNEL making it louder than it would be if the sound events had not occurred. Detailed measurements from the 24-hour measurements can be found in Appendix B.

Table 4-2 24-Hour Average Ambient Sound Level Survey Results

Date	24-hour Average (dBA)	Daytime Leq (7 a.m. to 9 p.m.) (dBA)	Nighttime L_{eq} (9 p.m. to 7 a.m.) (dBA)	CNEL (dBA)
7/19/22 11 AM to 7/20/22 11 AM	46.3	46.9	45.1	52.1

4.2 Short Term Noise Measurements

A Type 1 sound level meter was utilized at the site to conduct a series of short term, 15-minute sound level measurements. The sound level meter conforms to Type 1 as per ANSI S1.4 *Specification for Sound Level Meters*. The microphone associated with the sound level meter was placed approximately 5 feet above the ground and at least 10 feet from any reflective surfaces. The sound level meter was calibrated before and after the measurement period. The instrumentation details are presented in Table 4-3.

Table 4-3 Short Term Sound Level Survey Instrumentation Details

Location	Instrument	Manufacturer/Model	Serial Number
1 - 10	Sound Level Meter	SVANTEK SVAN 971 Sound Level Meter	55474

Short term ambient sound level measurements were conducted at ten locations in the vicinity of the Project Site. The sound level survey was conducted on March 8, 2023 and recorded A-weighted sound levels.

The results of the 15-minute short term ambient measurements are shown in Table 4-4. The table presents 15-minute average Leq, and Lmax and Lmin sound levels.

Table 4-4 15-Minute Short Term Sound Level Survey Results

Measurement Location	Representative NSR's	Time	L_{eq} (dBA)	L_{max} (dBA)	L_{min} (dBA)
1	NSR 5 & NSR 6	1:49 PM – 2:04 PM	48.2	66.1	35.7
2	NSR 3	2:11 PM – 2:26 PM	54.0	72.4	37.0
3	NSR 1 & 2	2:27 PM - 2:42 PM	56.4	74.7	37.0
4	--	2:43 PM – 2:58 PM	49.2	66.2	36.7
5	NSR 4	3:00 PM – 3:15 PM	58.1	78.1	39.6
6	--	3:15 PM – 3:30 PM	56.8	72.9	40.2
7	NSR 7, 8 & 9	3:34 PM – 3:49 PM	48.4	62.6	41.6
8	--	3:51 PM – 4:06 PM	56.9	72.6	40.0
9	--	4:08 PM – 4:23 PM	43.8	59.3	34.5
10	--	4:24 PM – 4:39 PM	52.9	69.0	38.2

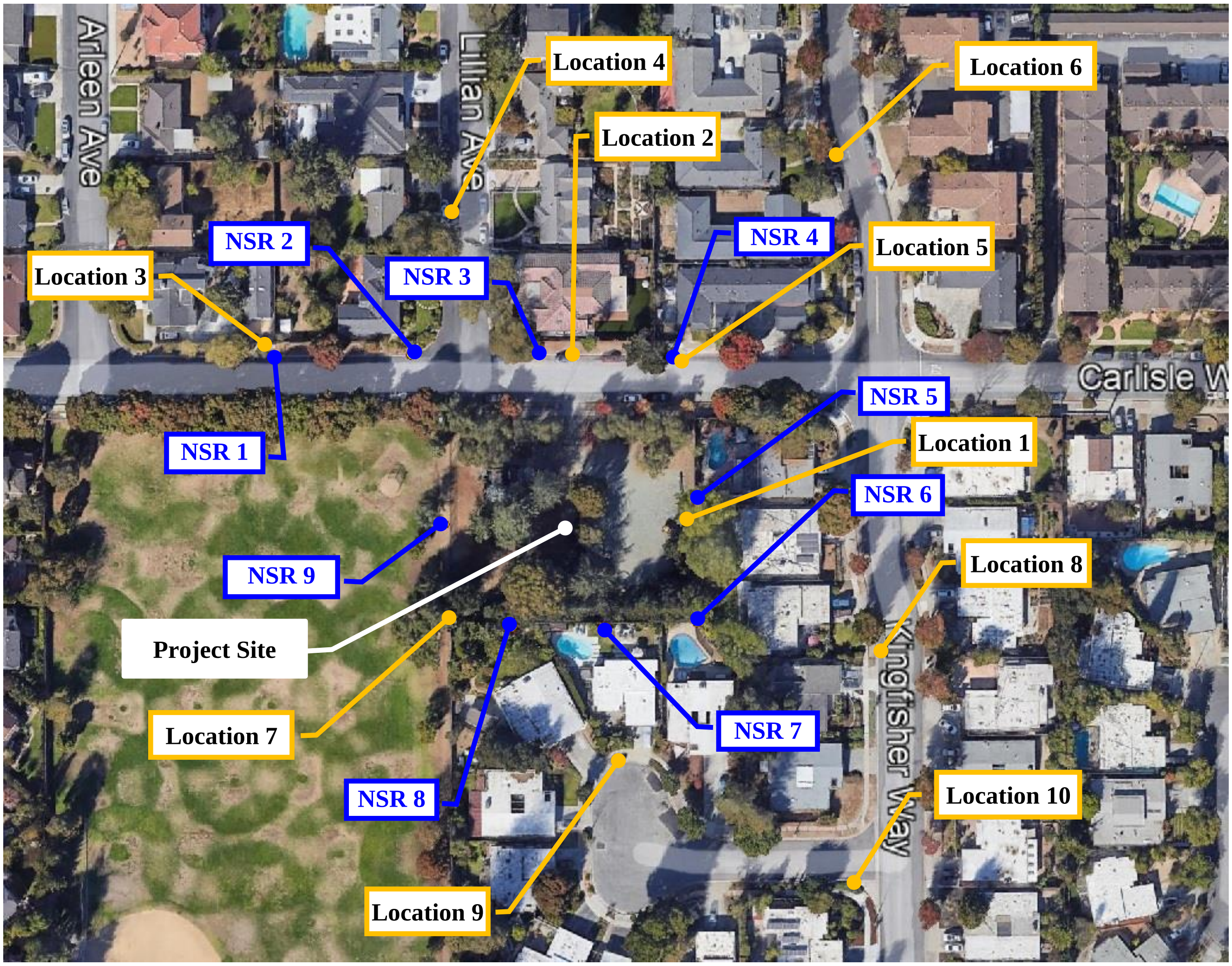


Figure 4-2 Short Term Noise Measurements and Noise Sensitive Receptors in Vicinity of Project Site

5. Noise and Vibration Standards and Thresholds of Significance

The Project Site is subject to City of Sunnyvale Municipal Code and City of Sunnyvale General Plan noise limits.

5.1 City of Sunnyvale Municipal Code Noise Standards

With regards to noise, Chapter 16.08 Administrative Code and Chapter 19.42 OPERATING STANDARDS of the Sunnyvale Municipal Code, state the following:

> Chapter 16.08.03 Hours of Construction – Time and noise limitations
>
> Construction activity shall be permitted between the hours of seven a.m. and six p.m. daily Monday through Friday. Saturday hours of operation shall be between eight a.m. and five p.m. There shall be no construction activity on Sunday or federal holidays when city offices are closed.
>
> (a) Construction activity is permitted for detached single-family residential properties when the work is being performed by the owner of the property, provided no construction activity is conducted prior to seven a.m. or after seven p.m. Monday through Friday, prior to eight a.m. or after seven p.m. on Saturday and prior to nine a.m. or after six p.m. on Sunday and national holidays when the city offices are closed. It is permissible for up to two persons to assist the owner of the property so long as they are not hired by the owner to perform work. For the purposes of this section, "detached single-family residential property" refers only to housing that stands completely alone with no adjoining roof, foundation or sides.
>
> (b) As determined by the chief building official:
>
> (1) No loud environmentally disruptive noises, such as air compressors without mufflers, continuously running motors or generators, loud playing musical instruments, radios etc., will be allowed where noise may be a nuisance to adjacent properties.
>
> (2) Where emergency conditions exist, construction activity may be permitted at any hour or day of the week. Such emergencies shall be completed as rapidly as possible to prevent any disruption to other properties.
>
> (3) Where additional construction activity will not be a nuisance to surrounding properties, based on location and type of construction, a waiver may be granted to allow hours of construction other than as stated in this section. (Ord. 3006-13§ 2).
>
> Chapter 19.42.030 Noise or Sound Level
>
> (a) Operational noise shall not exceed seventy-five dBA at any point on the property line of the premises upon which the noise or sound is generated or produced; provided, however, that the noise or sound level shall not exceed fifty dBA during the nighttime or sixty dBA during daytime hours at any point on adjacent residentially zoned property. If the noise occurs during the nighttime hours and the enforcing officer has determined that the noise involves a steady, audible tone such as a whine, screech or hum, or is a staccato or intermittent noise (e.g., hammering) or includes music or speech, the allowable noise or sound level shall not exceed forty-five dBA.

(b) Powered equipment used on a temporary, occasional or infrequent basis which produces a noise greater than the applicable operational noise limit set forth in subsection (a) shall be used only during daytime hours when used adjacent to a property with a residential zoning district. Powered equipment used on other than a temporary, occasional or infrequent basis shall comply with operational noise requirements. For the purpose of this section, powered equipment does not include leaf blowers. Construction activity regulated by Title 16 of this code shall not be governed by this section.

(c) It is unlawful for any person to make or allow to be made a nighttime delivery to a commercial or industrial establishment when the loading/unloading area of the establishment is adjacent to a property in a residential zoning district. Businesses legally operating at a specific location as of February 1, 1995, are exempt from this requirement.

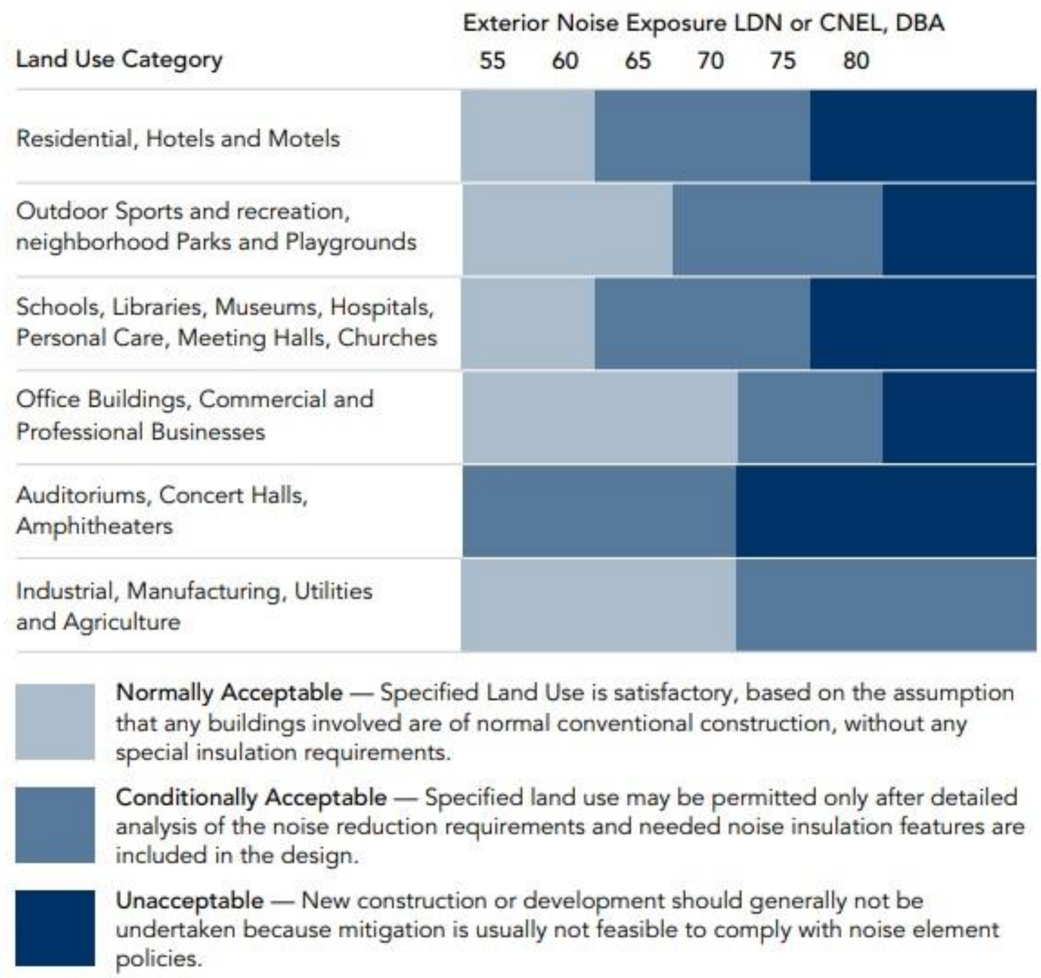
(d) A "leaf blower" is a small, combustion engine-powered device used for property or landscape maintenance that can be hand-held or carried on the operator's back and which operates by propelling air under pressure through a cylindrical tube. It is unlawful for 8:00 a.m. and 8:00 p.m. Effective January 1, 2000, all leaf blowers operated in or adjacent to a residential area shall operate at or below a noise level of sixty-five dBA at a distance of fifty feet, as determined by a test conducted by the American National Standards Institute or an equivalent. The dBA rating shall be prominently displayed on the leaf blower. (Ord. 2623-99 § 1; prior zoning code any person to operate a leaf blower on private property in or adjacent to a residential area except between the house of § 19.24.020(b)-(d)).

5.2 City of Sunnyvale General Plan Noise Standards

The City of Sunnyvale General Plan Chapter 6 Safety and Noise, Exterior Noise Standards section states:

"Generally, exterior noise exposures fall into three categories: normally acceptable, conditionally acceptable and unacceptable. Each land use has a particular dBA range within each exterior exposure category." The general plan presents guidelines "Land Use Compatibility for Community Noise Environment" in Figure 6-5 and is reproduced below:

Figure 6-5: State of California Noise Guidelines for Land Use Planning
Summary of Land Use Compatibility for Community Noise Environment



"The state Noise Guidelines indicate that all residential land uses with exterior noise levels 60-75 dBA Ldn are "conditionally acceptable." The City has applied this limit in plans and projects with "conditions acceptable." The City has applied this limit in plans and projects with conditions of approval that attempt to achieve a 60 dBA Ldn for backyards, large balconies and common recreation areas. These areas have a high use rate and deserve a fairly quiet setting.

Achieving an outdoor Ldn of 60 dBA if the noise is a railroad is generally more difficult. Train noise is usually made up relatively few loud events. Although the outdoor Ldn may be high, the noise level between events is typically acceptable for speech. An Ldn limit of 70 dBA is more appropriate for areas affected by train noise.

If the noise source is aircraft, the overhead noise is impractical to mitigate for outdoor residential areas. Preventing residential uses within areas of high Ldn from aircraft is a way of avoiding noise exposure of homes from aircraft. However, only industrial areas in the very northeast section of the City fall within a noise contour for the San Jose International Airport.

Historically, the City's demand for housing has been great. Due to the lack of alternative locations, most new residential projects are being developed near major roadways. These environments are noisy, but they must comply with Title 24 (State of California Noise Insulation Requirements) and are recommended to comply with state Noise Guidelines for Land Use Planning (see Figure 6-5).

In addition to reviewing proposed development for compliance with noise standards, all proposed development must be reviewed to see if it results in a "significant noise impact" on existing development. To determine if a proposed noise increase is considered "significant" under CEQA, the following standards should be used. The general plan presents guidelines "Significant Noise Impacts from New Development on Existing Land Use" in Figure 6-6 and is reproduced below:

Figure 6-6: Significant Noise Impacts from New Development on Existing Land Use

Ldn Category of Existing Development Per Figure 6-4	Noise Increase Considered "Significant" over Existing Noise Levels
Normally Acceptable	An increase of more than 3 dBA and the total Ldn exceeds the "normally acceptable" category
Normally Acceptable	An increase of more than 5 dBA
Conditionally Acceptable	An increase of more than 3 dBA
Unacceptable	An increase of more than 3 dBA

5.3 City of Sunnyvale Project Noise and Vibration Thresholds for Drilling and Construction Activities

The City of Sunnyvale on August 4, 2023 determined that for the Project scope, the following drilling and construction noise thresholds shall apply:

Noise Thresholds for Drilling and other Construction Activities:

- **Construction Noise**:
  - Within City Allowed Construction Hours (7am-6pm Mon-Fri and 8am-5pm Sat): Use Federal Transit Administration (FTA's) construction noise threshold,
    - Residential: 80 dBA and
    - Park Facility: 85 dBA.

The recommended construction noise thresholds listed by the City of Sunnyvale are from the FTA Manual's "Step 4 Assess Construction Noise Impact, Option B Table 7-3" as shown below:

Option B: Detailed Analysis – Compare the combined $L_{eq.equip(1hr)}$ and the combined $L_{dn.equip(30day)}$ for all equipment for each phase of construction determined in Section 7.1, Step 3 to the criteria below. Then, identify locations where the level exceeds the criteria.

Table 7-3 Detailed Analysis Construction Noise Criteria

Land Use	$L_{eq.equip(8hr)}$, dBA		$L_{dn.equip(30day)}$, dBA
	Day	Night	30-day Average
Residential	80	70	75
Commercial	85	85	80*
Industrial	90	90	85*

*Use a 24-hour $L_{eq(24hr)}$ instead of $L_{dn.equip(30day)}$.

- Outside Allowed Construction Hours: Use Sunnyvale's noise code standards separately for daytime hours (6pm-10pm Mon-Fri; 5pm-10pm Sat; and 7am-10pm Sun) and nighttime hours (10pm-7am Mon-Fri & Sun; 10pm-8am Sat),

  - Residential: 60 dBA during daytime hours and 50 dBA during nighttime hours and
  - Park Facility: 70 dBA during daytime and 60 dBA during nighttime hours.

○ **Operational Noise**: Use Sunnyvale Municipal Code Operational Noise Standards (60 dBA during daytime hours (7am-10pm) and 50 dBA during nighttime hours (10pm-7am))

- **Vibration Thresholds for Drilling and Other Construction Activities**:

  - Daytime: 0.25 in/sec PPV and
  - Nighttime: 0.04 in/sec PPV.

5.4 City of Sunnyvale Zoning

The City of Sunnyvale Zoning Map showing the site and adjacent surroundings is presented in Figure 5-1 and indicates the land uses and zoning of the site and neighboring properties. The site is located in a residential area and bordered by residentially zoned properties in three directions and a public facility zoned park to the west of the site.

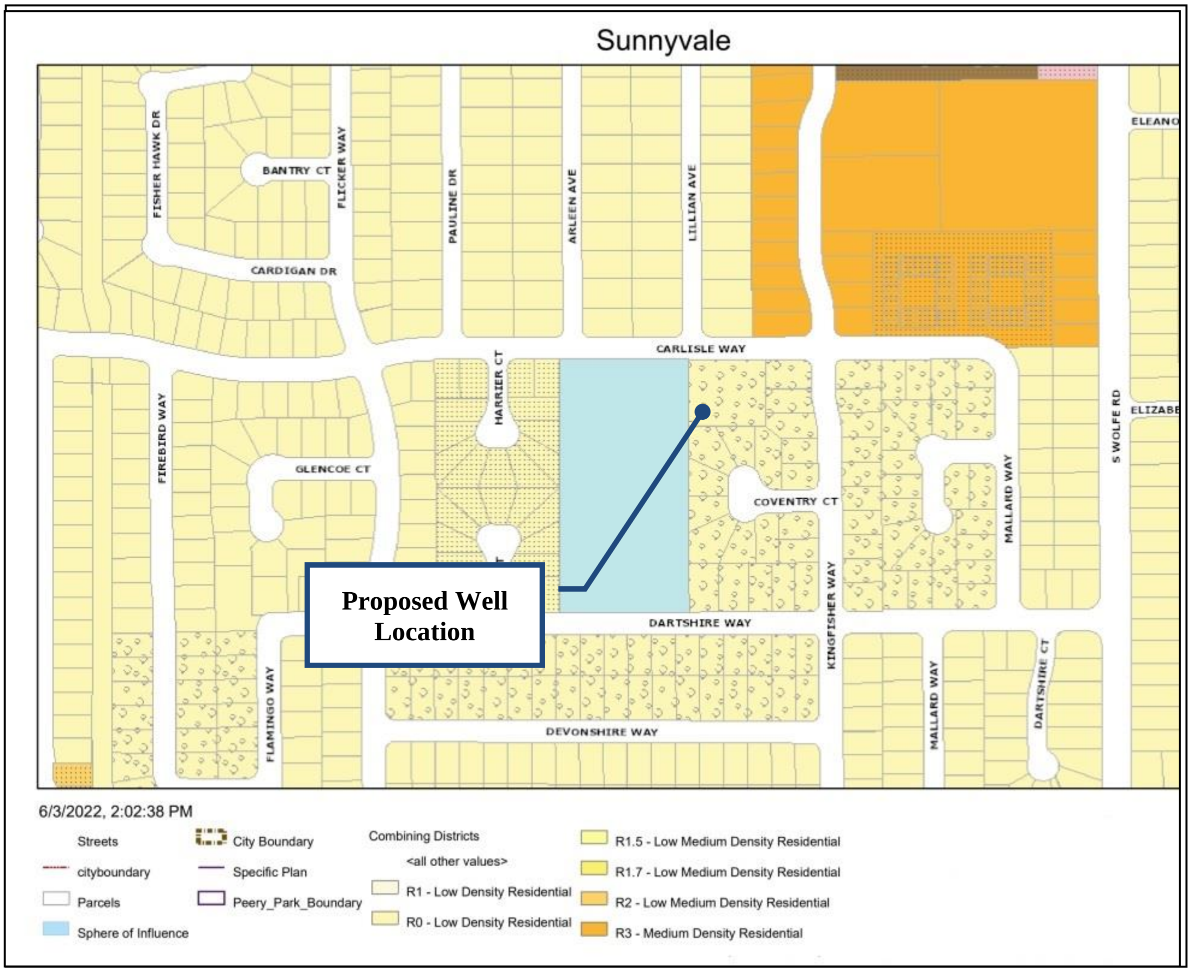


Figure 5-1 City of Sunnyvale Zoning Map

5.5 California Environmental Quality Act Guidelines

The California Environmental Quality Act of 1970 (CEQA) contains guidelines for establishing thresholds of significance for a proposed Project's noise and vibration impact potential. Specifically, the 2023 CEQA Statute & Guidelines in Appendix G, Section XIII present the following questions related to project noise and vibration impact potential relevant to the Project:

(a) 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 local general plan or noise ordinance, or applicable standards of other agencies?

(b) Generation of excessive groundborne vibration or groundborne noise levels?

(c) 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 two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?

5.6 Environmental Protection Agency Noise Guidelines for Environmental Impact Statements

The US EPA 1993 Noise Guidelines for Environmental Impact Statements states the following:

d. The information used to determine the impact of the predicted noise levels.

This includes, but is not limited to, the following criteria:

(1) What increase is considered tolerable?

(2) What levels are considered reasonable for various uses?

(3) Upon what basis is this information established (i.e., the Levels Document, sleep, speech and/or task interference)? The reference for the selected information should be cited.

(4) State and municipal standards or ordinance which apply should be cited.

Tabular summaries which present the numbers or residences and other noise sensitive areas which will realize changes in their present levels should be compiled. These should describe quantitively how many will be receiving levels in excess of L_{10} 70 dBA, and how many will experience increases over the present ambient of 0-5 dBA (slight impact), 5-10 dBA (significant impact) and over 10 dBA (very serious impact).

5.7 Project Thresholds of Significance

In establishing project thresholds, the CEQA guidelines, local standards, and industry standards were considered to determine the thresholds of significance for potential noise and vibration impacts they may be generated by the project.

During the water well drilling operations a significant impact would occur if:

1) The sound levels generated by the water well drilling operations exceed the City of Sunnyvale’s nighttime allowable noise limit of 50 dBA at the residential property boundaries and 60 dBA at the public facilities

properties. Per Cal Water, drilling operations will occur on their own with no overlap of other construction activities such as demolition, grading and excavation, trenching and foundation, and tank construction.

Ambient levels in the surrounding areas may be impacted by the drilling operations during this period, however the impacts are temporary and as such the City of Sunnyvale defined nighttime allowable noise limit of 50 dBA at the residential property boundaries and 60 dBA at the public facilities properties as detailed above. The duration of the drilling operations will be approximately 27 days during which 24 hours a day, seven days a week operations will be required. The 24 hour per day continuous construction activity would be split into two phases. The initial phase of continuous, 24 hour per day drilling activity would take approximately 12 days, after which the drilling would pause for approximately two weeks and be followed by continuous 24 hours per day per day work for approximately 15 additional days. All other construction for the remaining project components, including demolition, grading, trenching, and tank construction would take place during the City of Sunnyvale's standard construction hours.

During the daytime construction phases a significant impact would occur if:

1) The sound levels generated by the construction demolition activities exceed the City of Sunnyvale's daytime allowable of 80 dBA at the residential property and 85 dBA at the park facility property boundary.

During the pump station operations, a significant impact would occur if:

1) The sound levels generated by the pump station without operating emergency generator operations exceed the City of Sunnyvale's nighttime allowable noise limit of 50 dBA at the residential property boundaries and 60 dBA at the public facilities properties.

2) The sound levels generated by the pump station without operating emergency generator operations increase the existing ambient sound levels by 5 dBA or more, which is considered a readily perceptible change.

During the drilling phase, a significant vibration impact would occur if:

1) PPV ground-borne vibration levels caused by construction activities exceed the allowable vibration threshold of 0.25 ips at the nearest off-site structures as indicated in Table 3-1 Structural Guideline Vibration Criteria during daytime hours.

2) PPV ground-borne vibration levels caused by construction activities exceed the allowable vibration threshold of 0.04 ips at the nearest off-site structures as indicated in Table 3-2 Human Guideline Vibration Criteria during nighttime hours.

During the construction phase a significant impact vibration level would occur if:

1) PPV ground-borne vibration levels caused by construction activities exceed the allowable vibration threshold of 0.25 ips at the nearest off-site structures as indicated in Table 3-1 Structural Guideline Vibration Criteria during daytime hours.

2) PPV ground-borne vibration levels caused by construction activities exceed the allowable vibration threshold of 0.04 ips at the nearest off-site structures as indicated in Table 3-2 Human Guideline Vibration Criteria during nighttime hours.

6. Project Noise Impact Analysis

To evaluate the potential Project noise impact, the applicant has identified drilling operations, four phases of construction activities with the greatest noise-generating potential and well pump operations activities as the Project Site activities to assess. The Project drilling and construction schedule and equipment lists were provided by the applicant.

6.1 Noise Modeling Methodology

To evaluate the noise impact of the proposed water well drilling operation, various construction phase activities and the permanent well pump operation of the areas adjacent to the Project Site, noise impact models were created to represent the water well drilling activities, the four loudest construction activity phases at the site and the permanent well pump site operations.

The noise modeling was completed with use of three-dimensional computer noise modeling software. All models in this report were developed with SoundPLAN 8.2 software using the ISO 9613-2 calculation standard. Noise levels are predicted based on the locations, noise levels and frequency spectra of the noise sources, and the geometry and reflective properties of the local terrain, buildings and barriers. To ensure a conservative assessment and compliance with ISO 9613-2 standards, light to moderate winds are assumed to be blowing from the source to receptor.

The sound level data utilized to model the water well drilling operations, four construction phases and well pump operations were based on data provided by California Water Service in combination with archived data for similar proposed equipment operating on site. The Project construction schedule and equipment lists have been provided by the applicant. Field sound level measurements may vary from the modeling results due to the varying loudness of the construction and well pump operations equipment that may be implemented at the site.

The drilling, demolition, and other modeled construction phases are anticipated to be the loudest phases during Project construction. It is expected that other phases will generate far less noise due to use less/smaller construction equipment.

6.2 Noise Receptors

The NSR's have been chosen to assess the noise impact of the water well drilling operations, various construction phase activities and well pump operations. Receptor locations were chosen at the closest adjacent property boundaries as detailed in Table 1-1 and shown in Figure 1-2.

7. Water Well Drilling Operation Modeling

An evaluation of the Project Site water well drilling operation potential noise impact was generated to predict the impact at the nearby properties. The drilling operations will occur for approximately 27 days, during which 24 hours a day, seven days a week operations be required. The water well drilling equipment associated with this operation included in the noise modeling is shown in Table 7-1. The water well drilling operations equipment layout is shown in Figure 7-1.

Table 7-1 Water Well Drilling Equipment Modeled

Equipment	Quantity in Model	Individual Sound Power Level (dBA)	Sound Level Data Reference
Rig Engine	1	104.1	*BAENC File Data for similar equipment
Rig Engine Exhaust	1	87.6	*BAENC File Data for similar equipment
Cooling Fan	1	99.7	*BAENC File Data for similar equipment
Drawworks	1	95.6	*BAENC File Data for similar equipment
Rotary Table	1	98.5	*BAENC File Data for similar equipment
Mud Pump Shaker	1	99.2	*BAENC File Data for similar equipment
Mud Pump Motor	1	97.2	*BAENC File Data for similar equipment
Mud Pump Engine & Fan	1	102.4	*BAENC File Data for similar equipment
Air Compressor	1	103.3	*BAENC File Data for similar equipment
Genset	1	93.6	*BAENC File Data for similar equipment

*Behrens and Associates Environmental Noise Control (BAENC)

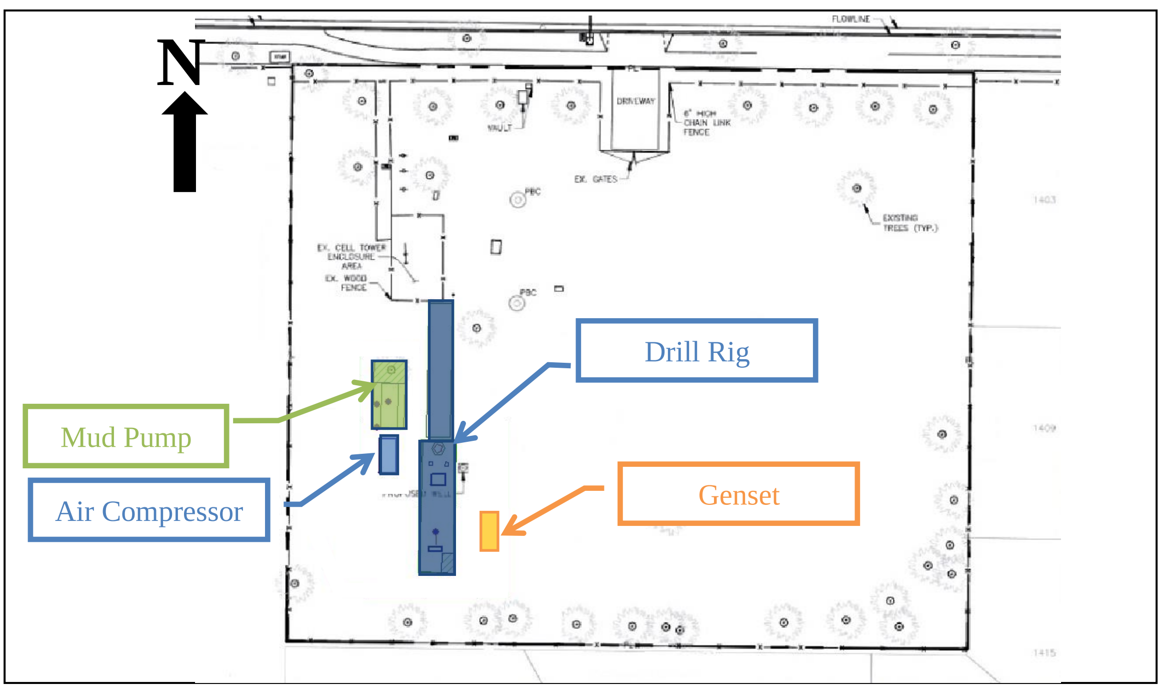


Figure 7-1 Water Well Drilling Operations Rig Layout

7.1 Water Well Drilling Operations Noise Modeling Results

The results of the water well drilling operations noise modeling are shown in Table 7-2. The calculated noise levels represent only the contribution of the water well drilling operations and do not include ambient noise or noise from other sources not listed in Table 7-1. Actual field sound level measurements may vary from the modeled noise levels due to other noise sources such as traffic, other human activity, or environmental factors.

Table 7-2 Water Well Drilling Activities Noise Modeling Results (dBA)

Receptor	Unmitigated Drilling Activities Noise Level	Allowable Noise Limit
NSR 1	62.8	50
NSR 2	65.7	50
NSR 3	65.8	50
NSR 4	62.8	50
NSR 5	65.9	50
NSR 6	65.6	50
NSR 7	68.7	50
NSR 8	74.1	50
NSR 9	79.8	60

The water well drilling operations noise modeling results indicate that the predicted noise levels at all assessed receptors will exceed the allowable nighttime noise limit of 50 dBA and 60 dBA at all residential and public facility receptors, respectively. The noise modeling results are also shown as a noise contour map in Figure 7-2. The noise contours are provided in 5 dB increments with the color scale indicating the sound level of each contour.

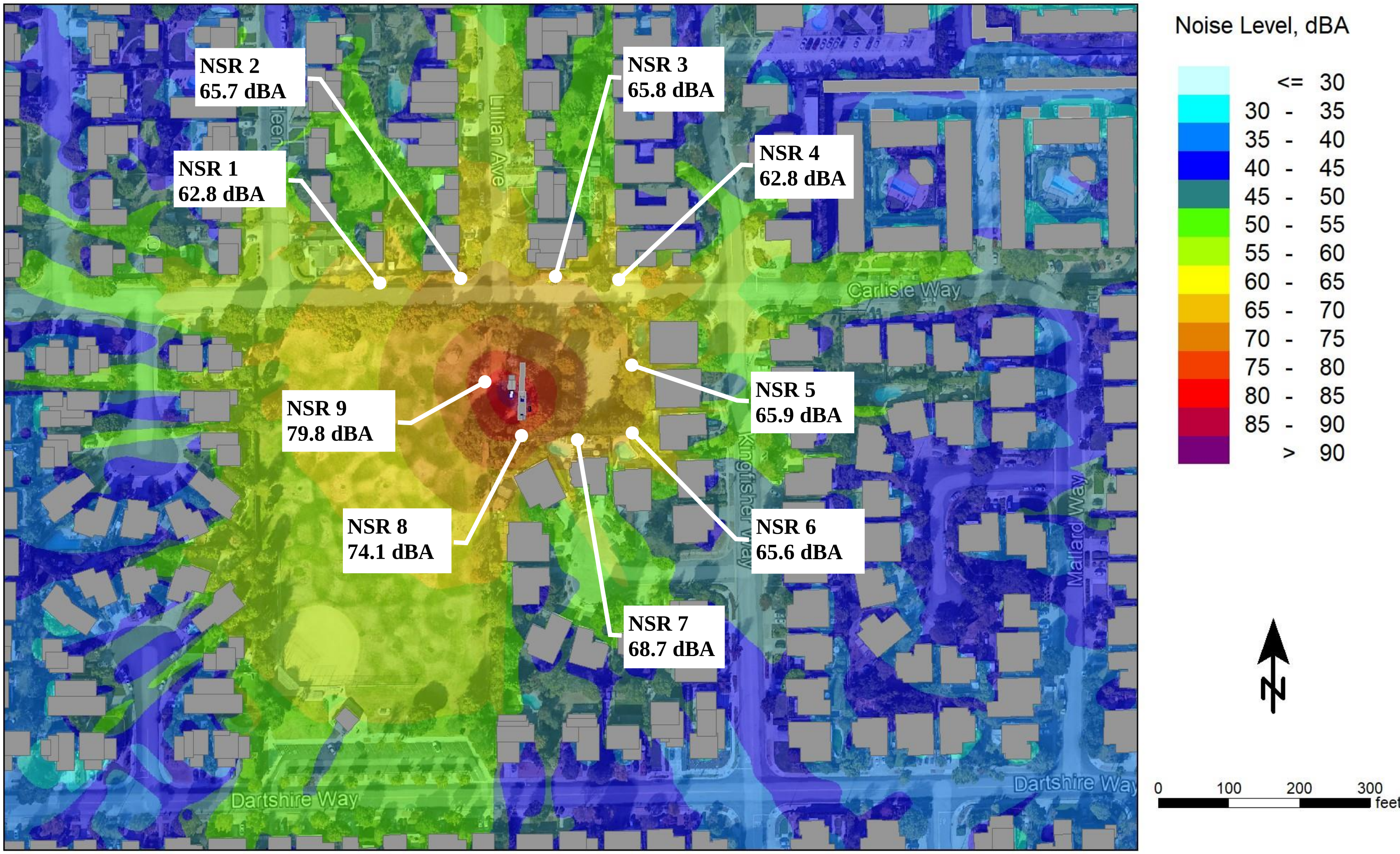


Figure 7-2 Proposed Water Well Drilling Operational Noise Contour Map (dBA)

7.2 Water Well Drilling Operations Mitigation Recommendations

The water well drilling operations noise modeling results indicate that the predicted noise levels at all assessed receptors will exceed the allowable nighttime noise limit of 50 dBA and 60 dBA at all residential and public facility receptors, respectively. The recommended noise impact mitigation measures were included to reduce noise levels to achieve compliance. The proposed sound barriers have been positioned to prevent damage to existing trees that are planned to remain on site as shown in layout drawing provided in Figure 7-3. The sound barrier layout included in the modeling is as follows:

- A total of 600 linear feet of 32-foot-high, Sound Transmission Class (STC) rated 32 acoustic barrier wall installed on the well site property perimeter. The acoustic barrier wall should be installed with no openings or gaps. An acoustical gate should be installed along the wall as shown in Figure 7-3 for site access and remain closed during drilling operations.
- A total of 190 linear feet of 20-foot-high, Sound Transmission Class (STC) rated 32 dual K-rail mounted sound barriers installed on the east, west, south and north sides of drilling equipment.
- A total of 72 linear feet of 12-foot-high, Sound Transmission Class (STC) rated 25 acoustic barrier walls installed on the north, west and south sides of mud pump and air compressor.
- A total of 96 linear feet of 8-foot-high, Sound Transmission Class (STC) rated 25 acoustical blankets installed on the rig floor.

The 32-foot-high sound wall will be removed after well construction, well testing and well development.

The layout of the proposed sound barrier layout is shown in Figure 7-3.

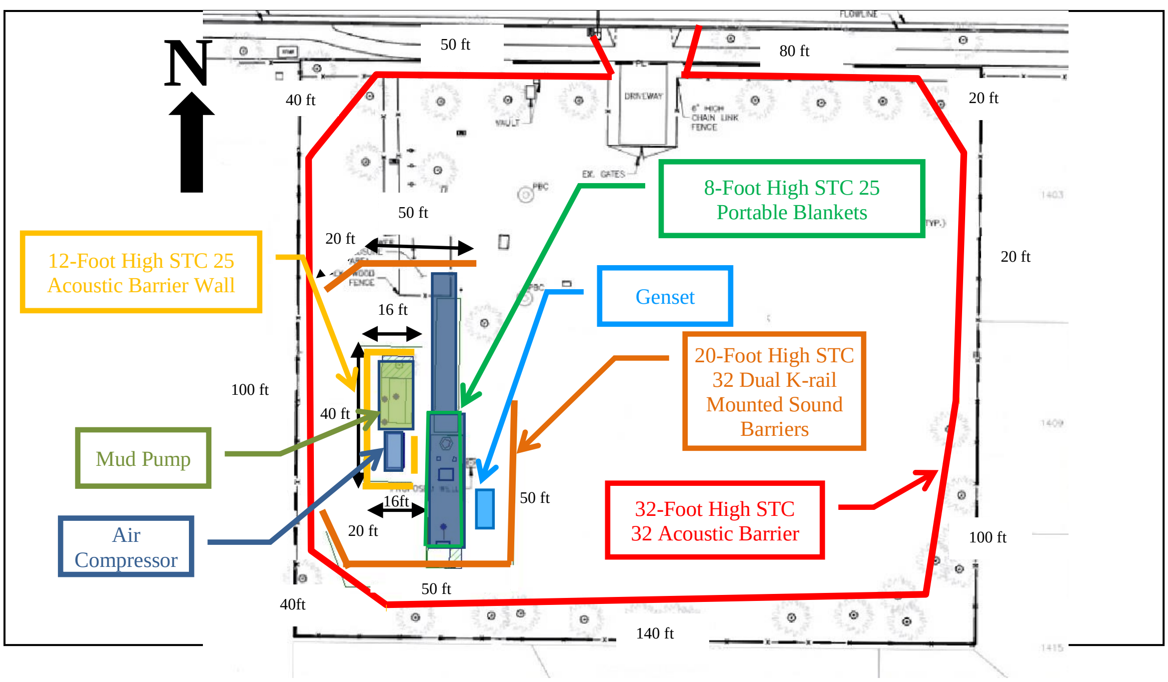


Figure 7-3 Modeled Noise Mitigation Sound Barrier Layout at Proposed Well Site

7.3 Mitigated Water Well Drilling Operations Noise Modeling Results

The results of the water well drilling operations noise modeling with the implementation of mitigation measures described in the report are presented in Table 7-3. The calculated noise levels represent only the contribution of the drilling rig in operation and do not include ambient noise. Actual field sound level measurements may vary from the modeled noise levels due to other noise sources such as traffic, other human activity, or environmental factors.

Table 7-3 Mitigated Water Well Drilling Noise Modeling Results (dBA)

Receptor	Unmitigated Water Well Operations	Mitigated Water Well Operations	Reduction	Noise Limits
NSR 1	62.8	46.7	16.1	50
NSR 2	65.7	49.2	16.5	50
NSR 3	65.8	49.8	16.0	50
NSR 4	62.8	48.7	14.1	50
NSR 5	65.9	47.3	18.5	50
NSR 6	65.6	48.5	17.1	50
NSR 7	68.7	52.2	16.5	50
NSR 8	74.1	57.7	16.4	50
NSR 9	79.8	57.5	22.3	60

The noise modeling results indicate that the predicted noise levels along the northern, western and eastern properties will comply with the nighttime noise limits at all receptors except at Receptor 7 and 8 which are located closest to the drilling operations equipment. With the implementation of the mitigation measures detailed, noise reductions of up to 22.3 dBA can be achieved.

The results of the noise modeling are also shown as noise contour map in Figure 7-4. The noise contours are provided in 5 dB the sound level of each contour.

The installation of temporary sound walls will occur during daytime hours for a very brief period and are not anticipated to generate sound levels above the allowable 80 dBA daytime construction noise limit at the residential properties. Additionally, the installation of temporary sound walls do not require deep embedding into the ground for installation, therefore installation is not expected to generate ground-borne vibration at nearby residences above the daytime threshold of 0.25 ips.

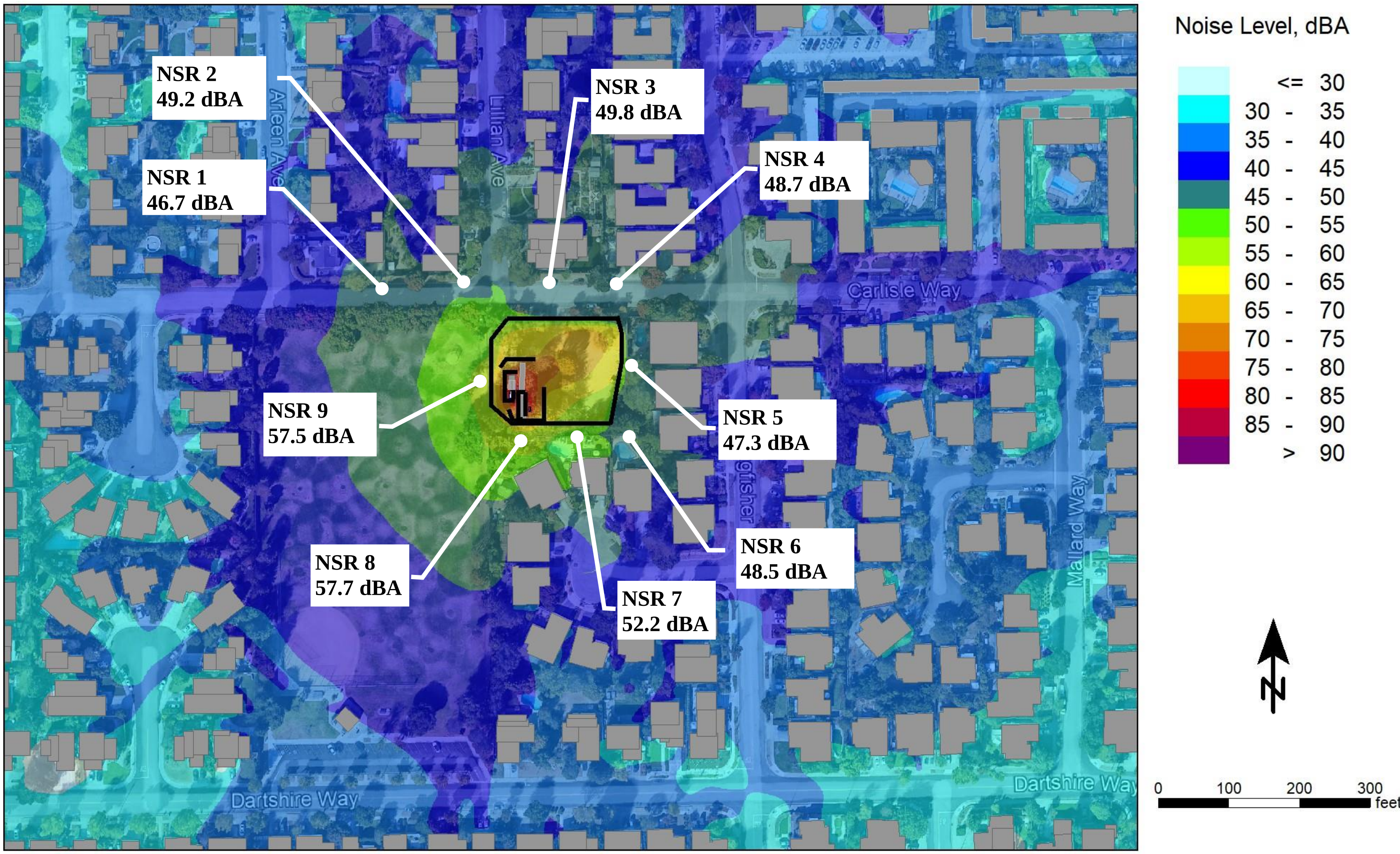


Figure 7-4 Proposed Water Well Drilling with implemented Best Management Practices Operational Noise Contour Map (dBA)

8. Construction Activities Noise Impact Analysis

An evaluation of the Project Site construction activities potential noise impact was generated to predict the impact at the nearby properties. Four construction phases have been modeled to demonstrate the various potential noise impact levels at the adjacent properties. The construction phases modeled include demolition, grading & excavation, trenching & foundation, and tank construction. The construction equipment associated with each construction phase included in the construction noise modeling for all four construction phases are shown in Table 8-1 through Table 8-4. The construction activities work areas for each construction phase is shown in Figure 8-1 through Figure 8-4.

Table 8-1 Demolition Construction Phase Equipment Modeled

Equipment	Quantity in Model	Individual Equipment Item Sound Level at 50 ft (dBA)	Acoustical usage Factor (%)	Sound Level Data Reference
Concrete Saw	1	90	20	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory
Rubber-Tired Dozers	1	85	40	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory
JD 444 Loader	1	80	40	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory
Backhoe	1	80	40	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory

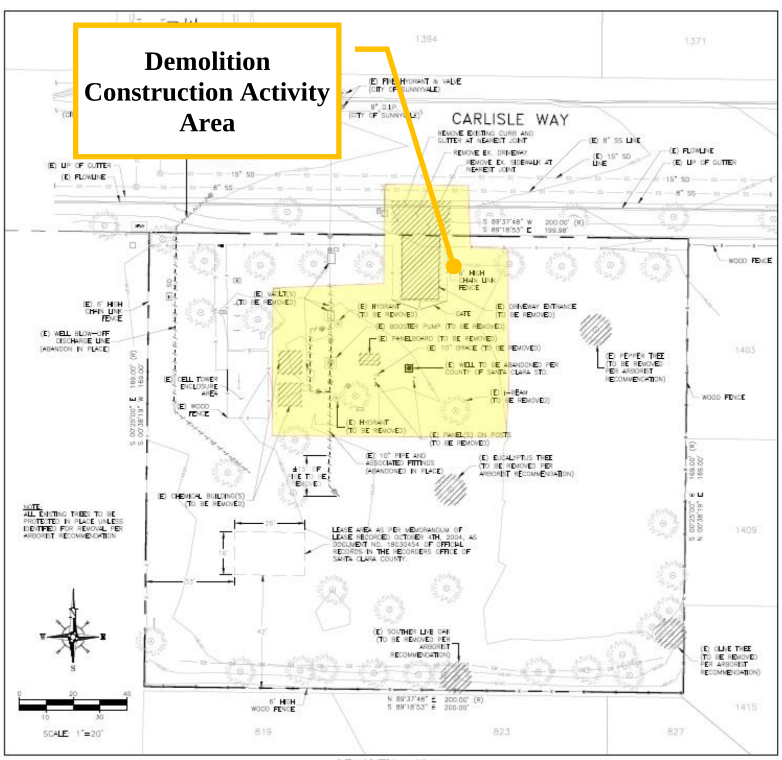


Figure 8-1 Construction Demolition Phase Activities Area

Table 8-2 Grading and Excavation Construction Phase Equipment Modeled

Equipment	Quantity in Model	Individual Equipment Item Sound Level at 50 ft (dBA)	Acoustical usage Factor (%)	Sound Level Data Reference
Concrete Saw	1	90	20	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory
Rubber-Tired Dozers	1	85	40	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory
JD 444 Loader	1	80	40	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory
Backhoe	1	80	40	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory

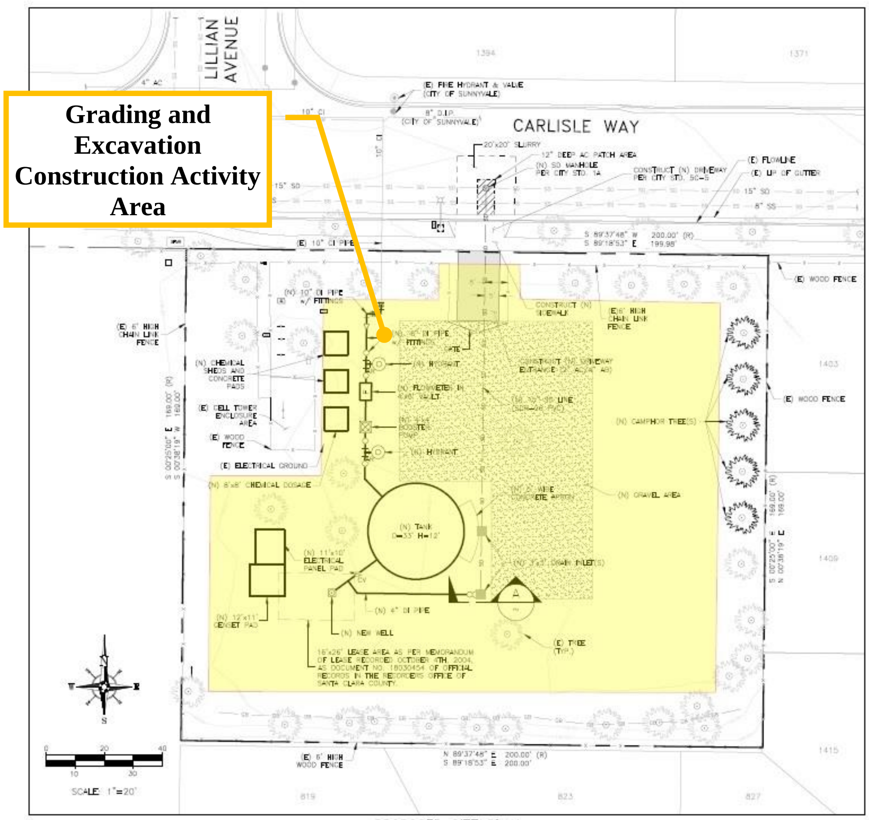


Figure 8-2 Construction Grading and Excavation Phase Activities Area

Table 8-3 Trenching and Foundation Construction Phase Equipment Modeled

Equipment	Quantity in Model	Individual Equipment Item Sound Level at 50 ft (dBA)	Acoustical usage Factor (%)	Sound Level Data Reference
Backhoe	1	80	40	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory

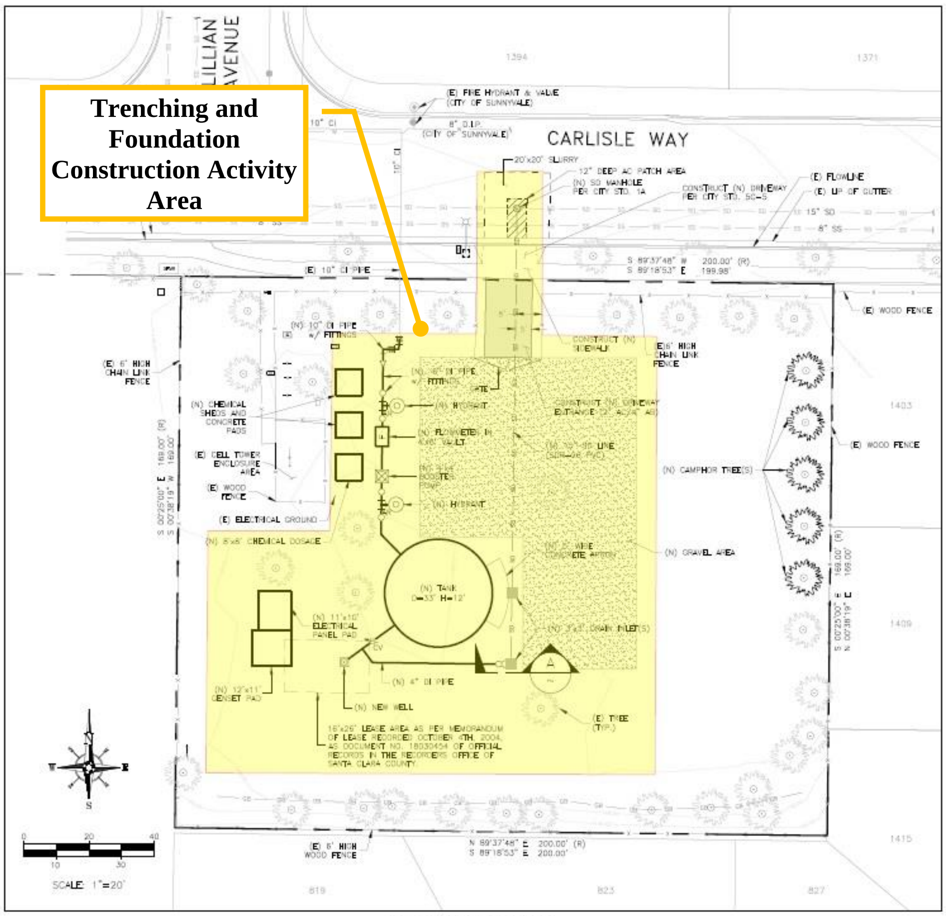


Figure 8-3 Construction Trenching and Foundation Phase Activities Area

Table 8-4 Tank Construction Phase Equipment Modeled

Equipment	Quantity in Model	Individual Equipment Item Sound Level at 50 ft (dBA)	Acoustical usage Factor (%)	Sound Level Data Reference
Crane	1	81	16	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory
Forklifts	2	80	40	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory
JD 444 Loader	1	80	40	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory
Backhoe	1	80	40	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory
Welder	1	74	40	FHWA Construction Noise Handbook 9.4.1 RCNM Inventory

Table 8-5 Tank Construction Phase Equipment Modeled

Equipment	Quantity in Model	Individual Equipment Item Sound Level at 23 ft (dBA)	Acoustical usage Factor (%)	Sound Level Data Reference
Generator Set*	1	68	50	Manufacturer Data for similarly sized generator

*Appendix C Figure C-1 has manufacturer data for similar Generator Set

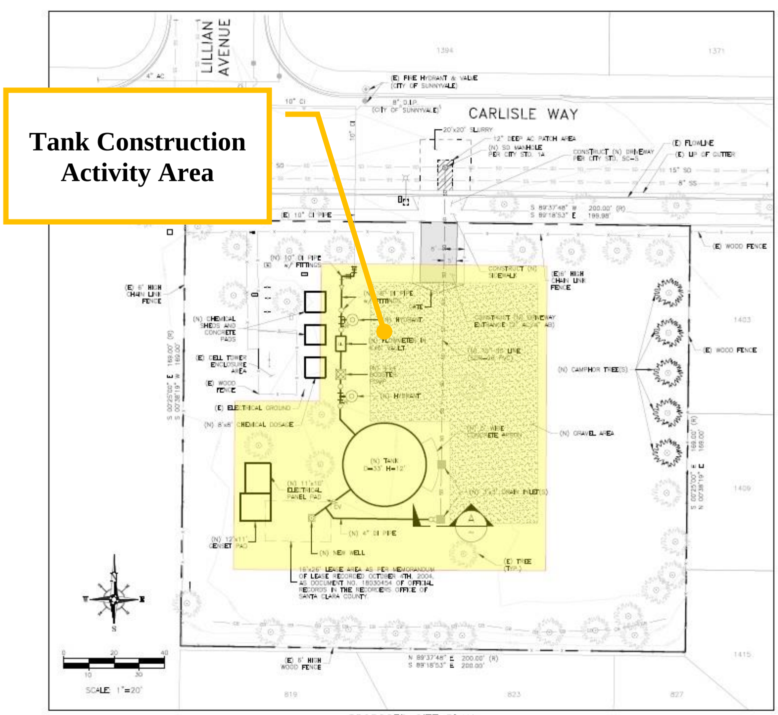


Figure 8-4 Construction Tank Construction Phase Activities Area

8.1 Construction Activities Noise Modeling Results

The results of the construction demolition, grading and excavation, trenching and foundation, and tank construction activities noise modeling are shown in Table 8-6 through Table 8-8. The noise modeling results are also shown as a noise contour map in Figure 8-5 through Figure 8-8. The noise contours are provided in 5 dB increments with the color scale indicating the sound level of each contour. The calculated noise levels represent only the contribution of the construction activities and do not include ambient noise or noise from other equipment. Actual field sound level measurements may vary from the modeled noise levels due to other noise sources such as traffic, other human activity, or environmental factors.

Table 8-6 Demolition Construction Phase Activities Noise Modeling Results (dBA)

Receptor	Land Use	Unmitigated Construction Activities Noise Level
NSR 1	Residential	70.8
NSR 2	Residential	75.4
NSR 3	Residential	82.0
NSR 4	Residential	77.2
NSR 5	Residential	79.3
NSR 6	Residential	76.2
NSR 7	Residential	78.4
NSR 8	Residential	77.7
NSR 9	Park Property	80.2
Noise Limits for Construction Activities	**80 dBA for Residential Land Use / 85 dBA for Commercial/Recreational Land Use**	

Table 8-7 Grading and Excavation Construction Phase Activities Noise Modeling Results (dBA)

Receptor	Land Use	Unmitigated Construction Activities Noise Level
NSR 1	Residential	69.6
NSR 2	Residential	73.8
NSR 3	Residential	78.9
NSR 4	Residential	76.4
NSR 5	Residential	81.6
NSR 6	Residential	78.9
NSR 7	Residential	81.9
NSR 8	Residential	80.8
NSR 9	Park Property	81.3
Noise Limits for Construction Activities	**80 dBA for Residential Land Use / 85 dBA for Commercial/Recreational Land Use**	

Table 8-8 Trenching and Foundation Construction Phase Activities Noise Modeling Results (dBA)

Receptor	Land Use	Unmitigated Construction Activities Noise Level
NSR 1	Residential	59.9
NSR 2	Residential	64.0
NSR 3	Residential	69.6
NSR 4	Residential	65.3
NSR 5	Residential	68.9
NSR 6	Residential	67.7
NSR 7	Residential	72.3
NSR 8	Residential	72.8
NSR 9	Park Property	73.7
Noise Limits for Construction Activities	**80 dBA for Residential Land Use / 85 dBA for Commercial/Recreational Land Use**	

Table 8-9 Tank Construction Phase Activities Noise Modeling Results (dBA)

Receptor	Land Use	Unmitigated Construction Activities Noise Level
NSR 1	Residential	66.3
NSR 2	Residential	70.3
NSR 3	Residential	74.6
NSR 4	Residential	72.4
NSR 5	Residential	78.8
NSR 6	Residential	76.0
NSR 7	Residential	78.9
NSR 8	Residential	78.6
NSR 9	Park Property	79.6
Noise Limits for Construction Activities	**80 dBA for Residential Land Use / 85 dBA for Commercial/Recreational Land Use**	

The demolition construction activities noise modeling results indicate that the predicted noise levels at all assessed receptors will meet the allowable daytime noise limit of 80 dBA at all receptors except at NSR 3, where the predicted noise level exceeds the daytime limit by 2 dBA.

The grading and excavation construction activities noise modeling results indicate that the predicted noise levels at all assessed receptors will meet the allowable daytime noise limit of 80 dBA at all receptors except at NSR 5, NSR 7 and NSR 8, where predicted noise levels exceed the daytime limit by 1.6 dBA, 1.9 dBA and 0.8 dBA, respectively.

The trenching and foundation, and tank construction activities noise modeling results indicate that the predicted noise levels at all assessed receptors will meet the allowable daytime noise limit of 80 dBA at all receptors.

It should be noted that the modeled scenarios represent a worst-case scenario in which all anticipated equipment is operating concurrently. It is highly possible that not all equipment listed for each scenario will be operating concurrently, since construction equipment utilization varies and is used intermittently during the workday. The construction operations are temporary and are anticipated to occur during daytime hours only.

To mitigate potential noise concerns by the nearby residents, California Water Service intends to speak to neighbors preemptively to address their noise concerns in the case that construction activity noise becomes a nuisance.

Additionally, to further mitigate, portable sound barriers can be implemented to reduce sound levels to meet the 80 dBA allowable limit. The portable sound barriers can reduce sound levels by up to 6 dB once there is a line of site break between noise source and receptor. With strategic positioning of the sound barriers greater noise reduction may be achieved. These sound barriers can be mobile and can be erected around various construction equipment in order to reduce the noise levels at the nearby residences of concern. The sound barriers can be utilized when noise levels exceed 80 dBA at property line. Ongoing noise monitoring can be implemented during construction.

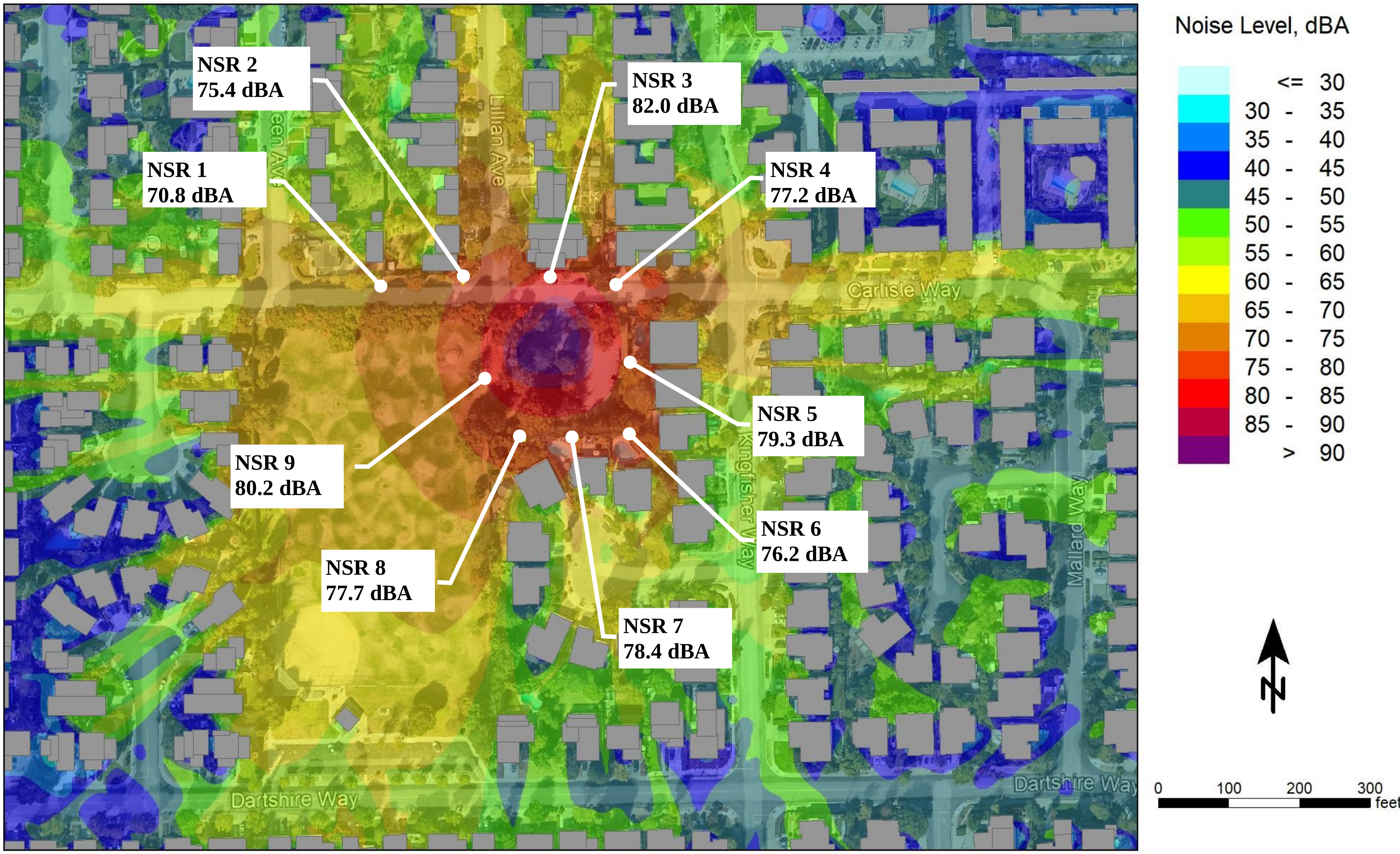


Figure 8-5 Unmitigated Construction Demolition Operations Noise Contour Map (dBA)

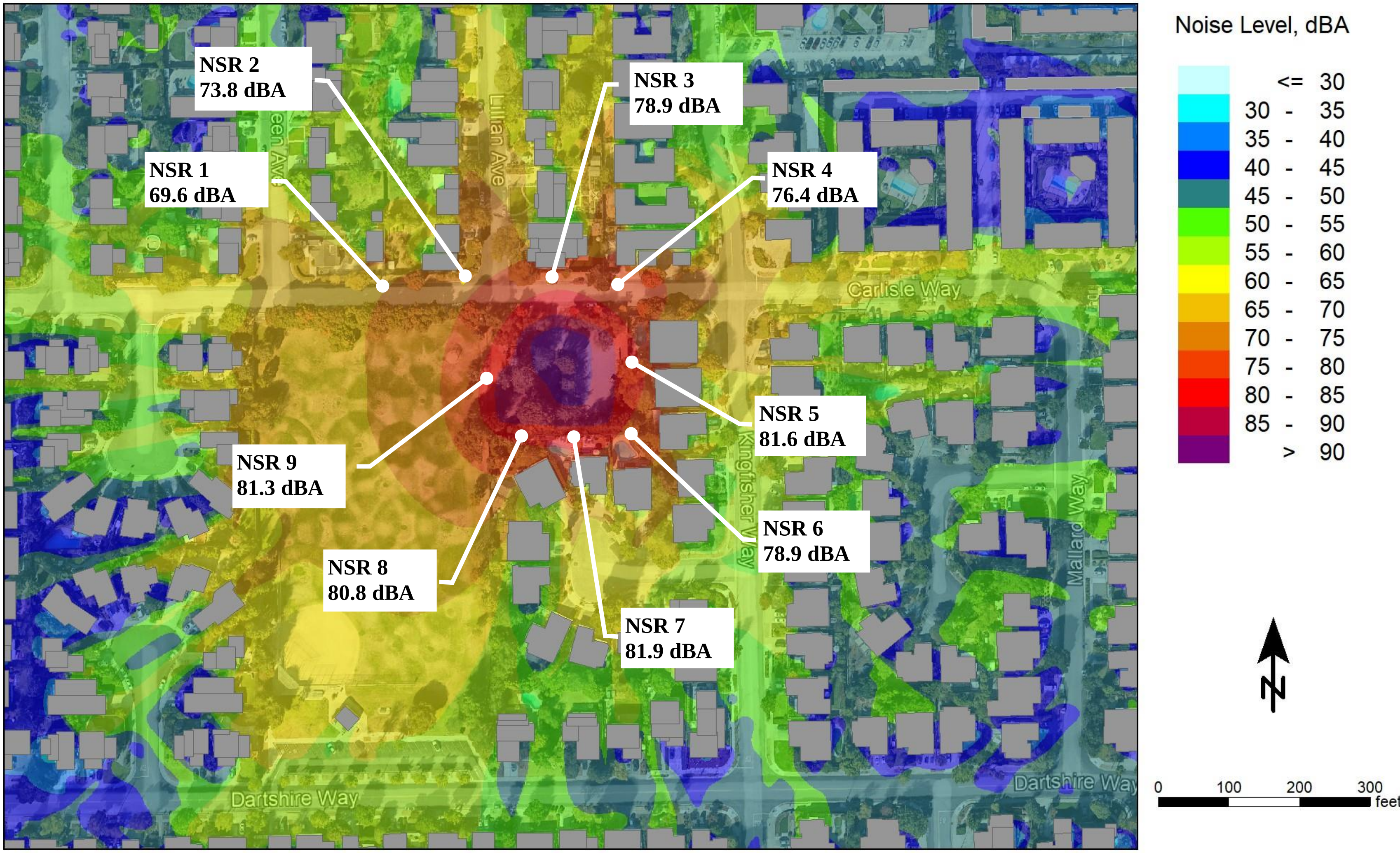


Figure 8-6 Unmitigated Construction Grading and Excavation Operations Noise Contour Map (dBA)

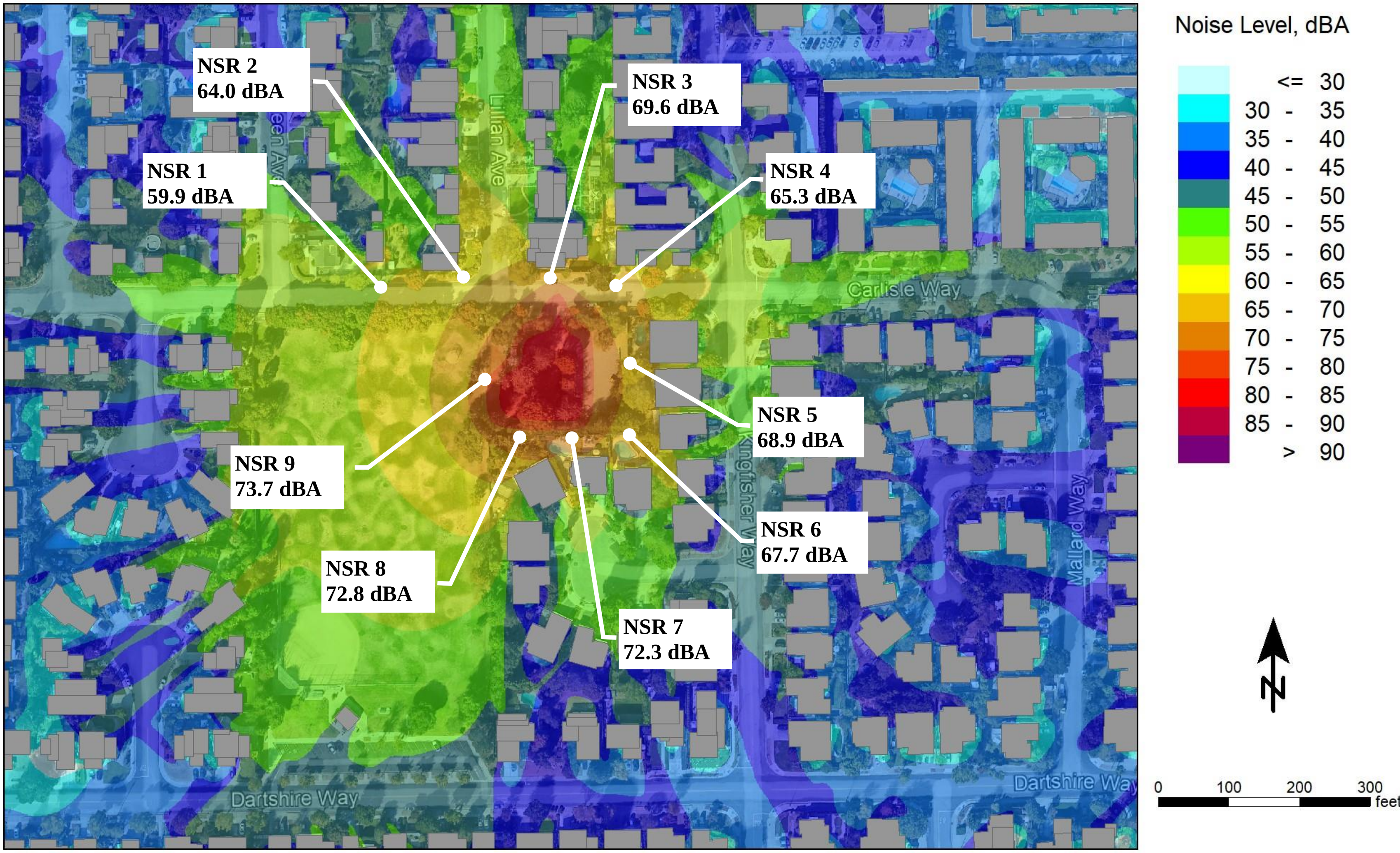


Figure 8-7 Unmitigated Construction Trenching and Foundation Operations Noise Contour Map (dBA)

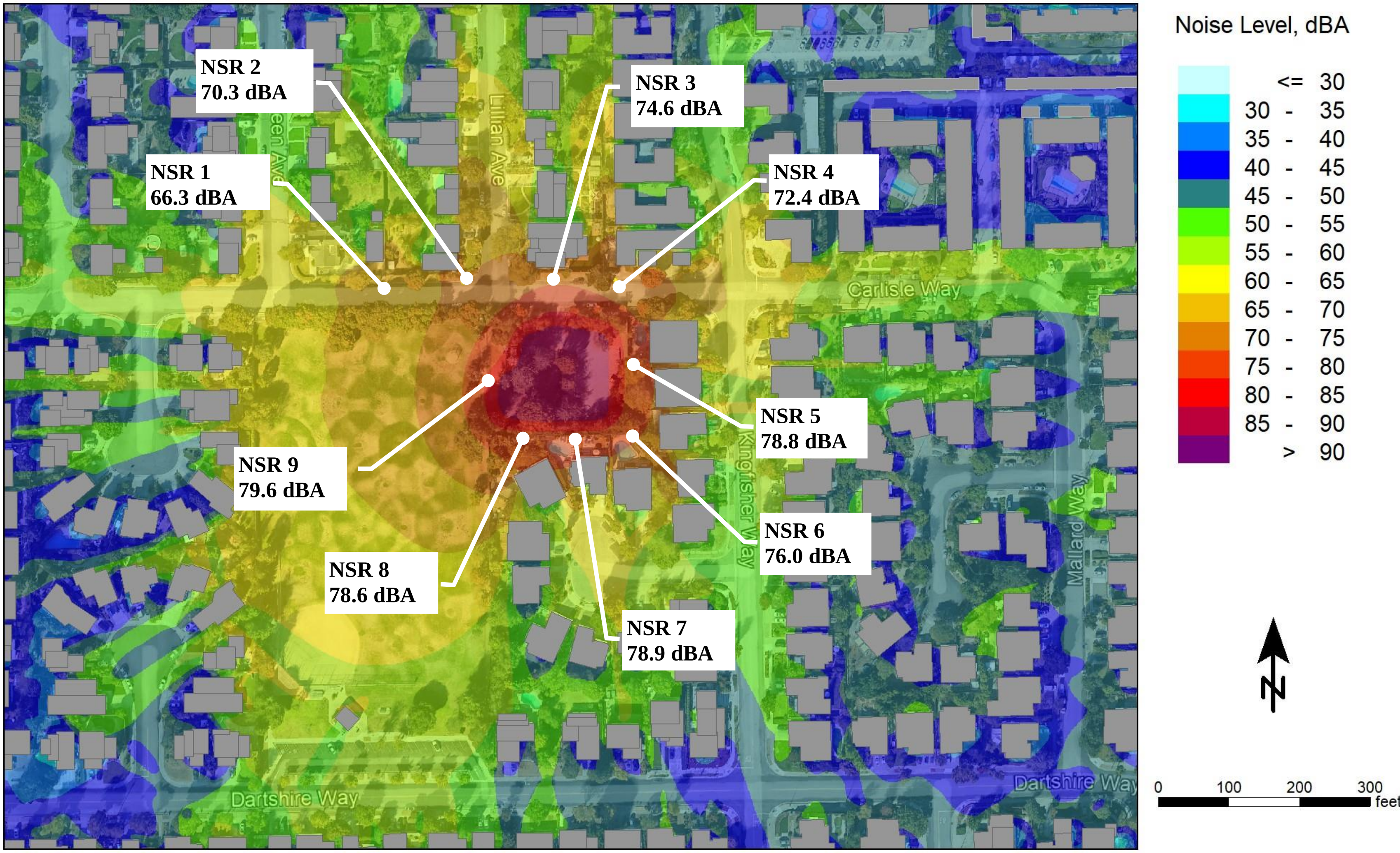


Figure 8-8 Unmitigated Construction Tank Construction Activities Operations Noise Contour Map (dBA)

9. Well Pump Operations Noise Impact Analysis

An evaluation of the groundwater well pump operations potential noise impact was generated to predict the impact at the nearby properties. The evaluation also includes a noise impact assessment against the existing ambient sound levels to determine if a significant impact will occur during the well pump operations. The operational equipment associated with the groundwater pump station operational activity and included in the modeling is shown in Table 9-1. The well pump operations site layout is shown in Figure 9-1. It should be noted that the Backup Generator listed in the table below will only operate during power outages or during monthly maintenance testing. Two models were generated to represent the pump station operation with and without the backup generator.

Table 9-1 Groundwater Pump Station Equipment Modeled

Equipment	Quantity in Model	Sound Power Level (dBA)	Sound Level Data Reference*
Cummins 230DSHAD Backup Generator	1	117.8	Manufacturer Data
Booster Pump	1	81.0	Manufacturer Data
Nidec Well Pump Motor	1	76.0	Manufacturer Data

*Appendix C Figures C-2 through C-4 has manufacturer data provided by California Water Service Company

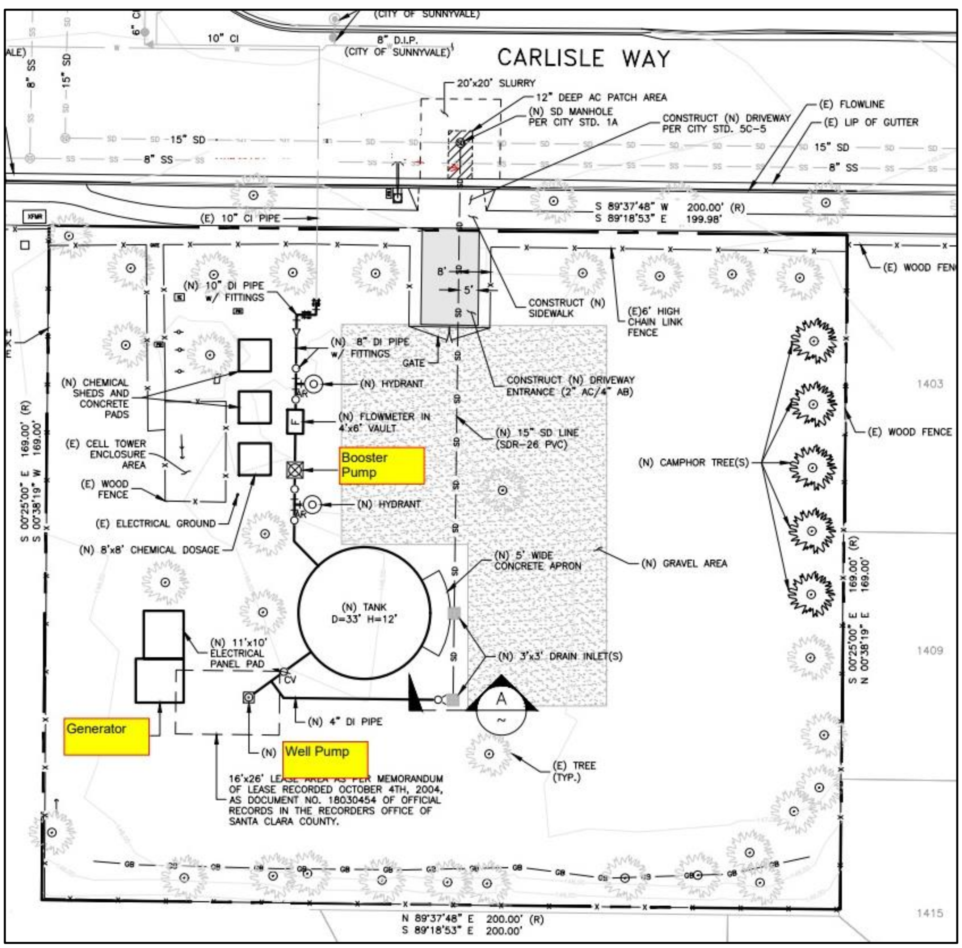


Figure 9-1 Groundwater Pump Station Operations Equipment Layout

9.1 Groundwater Pump Station Operations with Backup Generator Noise Modeling Results

The results of the noise modeling are shown in Table 9-2. The calculated noise levels represent only the contribution of the groundwater pump station operations do not include ambient noise or noise from other equipment not listed in Table 9-1. Actual field sound level measurements may vary from the modeled noise levels due to other noise sources such as traffic, other human activity, or environmental factors.

Table 9-2 Groundwater Pump Station with Backup Generator Activities Noise Modeling Results

Receptor	Unmitigated Groundwater Pump Station Operations with Noise Level (dBA)	City of Sunnyvale Municipal Code Allowable Noise Limit (dBA)
NSR 1	74.1	50
NSR 2	77.6	50
NSR 3	78.9	50
NSR 4	74.7	50
NSR 5	67.7	50
NSR 6	79.6	50
NSR 7	81.8	50
NSR 8	88.1	50
NSR 9	92.4	50

The groundwater pump station operations with the backup generator noise modeling results indicate that the predicted noise levels at all assessed receptors will exceed the allowable City of Sunnyvale Municipal Code nighttime noise limit. It should be noted that the backup generator is only intended to operate during power outages and monthly maintenance testing, which are infrequent occurrences.

However, noise mitigation was modeled to demonstrate compliance with the City of Sunnyvale Municipal Code nighttime noise limit as requested by California Water Service Company for the rare occasion the emergency generator is in operation. The noise modeling results are also shown as a noise contour map in Figure 9-2. The noise contours are provided in 5 dB increments with the color scale indicating the sound level of each contour.

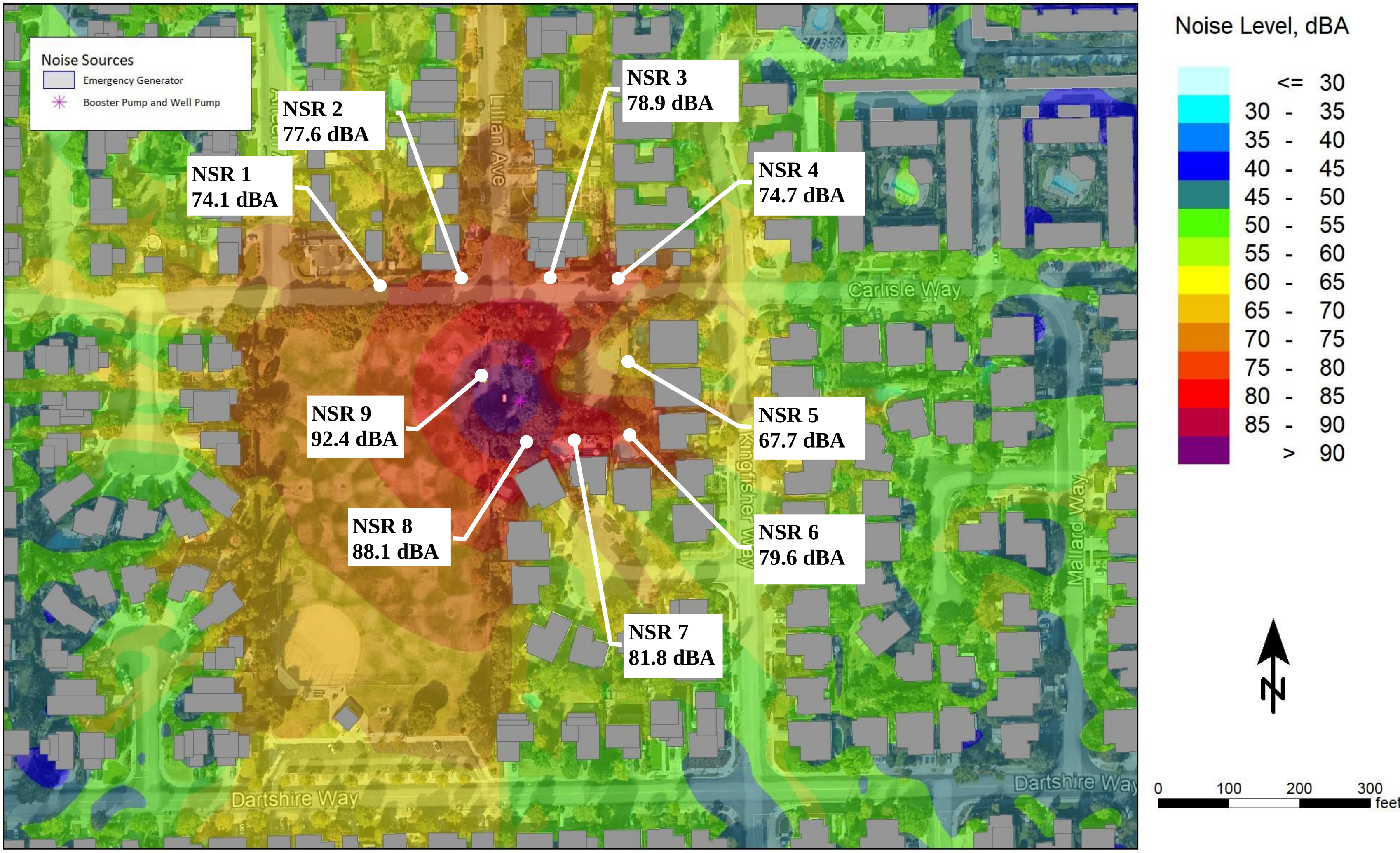


Figure 9-2 Unmitigated Groundwater Pump Station Operations Noise Contour Map (dBA)

9.2 Mitigations Recommendations for Groundwater Pump Station Operations with Backup Generator

Noise mitigation has been included in the pump station operations with backup generator operating model to reduce the noise level impact at the assessed receptors to achieve the allowable noise of the City of Sunnyvale Municipal Code and City of Sunnyvale General Plan guidelines. The mitigation recommended is described below:

- The proposed backup Cummins DSHAD 230 kW generator inside a weather enclosure generates sound levels of 96 dBA at 7 meters from the generator. The enclosure needs to be enhanced with an acoustically rated enclosure that will measure 57 dBA at 7 meters from generator to be compliant with noise level limit requirements described in the City of Sunnyvale Municipal Code and City of Sunnyvale General Plan guidelines. The pump station operations backup generator is shown in Figure 9-3.

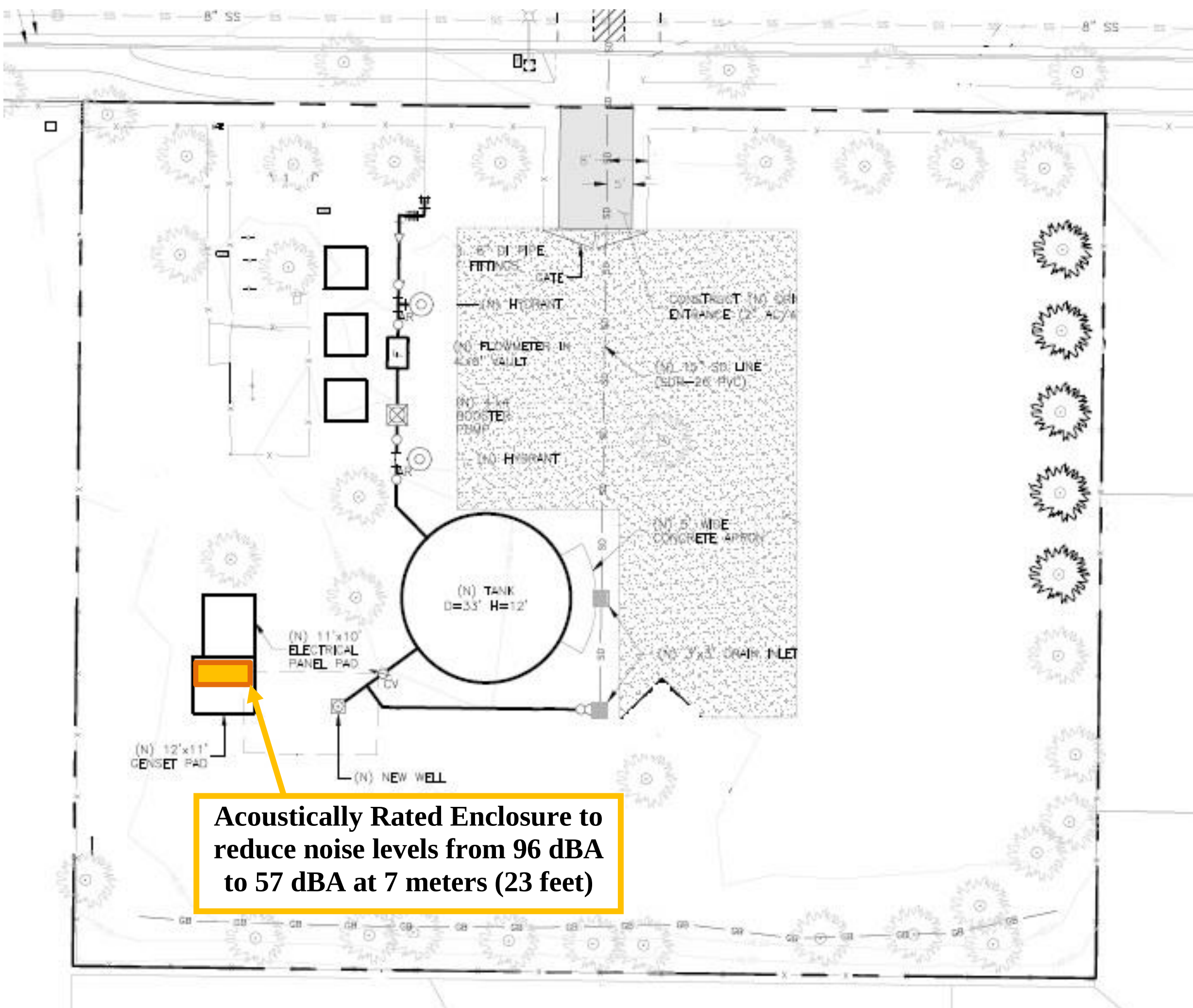


Figure 9-3 Pump Station Operations Backup Generator Acoustically Rated Enclosure

9.3 Groundwater Pump Station Operations with Mitigated Backup Generator Noise Modeling Results

The results of the mitigated noise modeling are presented in Table 9-3 and Table 9-4. The calculated noise levels in Table 9-3 represent only the contribution of the mitigated groundwater pump station operations with the backup generator do not include ambient noise or noise from other equipment. The calculated noise levels in Table 9-4 represent the contribution of the mitigated groundwater pump station operations with the backup generator plus the measured ambient sound level to show the sound level impact to existing ambient sound levels. Actual field sound level measurements may vary from the modeled noise levels due to other noise sources such as traffic, other human activity, or environmental factors.

Table 9-3 Mitigated Groundwater Pump Station w/Backup Generator Activities Noise Modeling Results

Receptor	Mitigated Groundwater Pump Station Operations with Noise Level (dBA)	City of Sunnyvale Municipal Code Allowable Noise Limit (dBA)
NSR 1	37.6	**50**
NSR 2	41.7	**50**
NSR 3	44.0	**50**
NSR 4	38.8	**50**
NSR 5	38.1	**50**
NSR 6	42.8	**50**
NSR 7	43.7	**50**
NSR 8	50.0	**50**
NSR 9	54.6	**60**

Table 9-4 Mitigated Pump Station w/Backup Generator plus Ambient Noise Level Modeling Results (dBA)

Receptor	Mitigated Groundwater Pump Station Operations with Noise Level (dBA)	Short Term (ST) Ambient Noise Level (dBA)	Mitigated Groundwater Pump Station Operations plus Ambient Noise Level (dBA)	Sound Level contribution above Ambient (dBA)	Relative Loudness
NSR 1	37.6	56.4	56.5	0.1	Generally Not Perceptible
NSR 2	41.7	56.4	56.5	0.1	Generally Not Perceptible
NSR 3	44.0	54.0	54.4	0.4	Generally Not Perceptible
NSR 4	38.8	58.1	58.2	0.1	Generally Not Perceptible
NSR 5	38.1	48.2	48.6	0.4	Generally Not Perceptible
NSR 6	42.8	48.2	49.3	1.1	Generally Not Perceptible
NSR 7	43.7	48.4	49.7	1.3	Generally Not Perceptible
NSR 8	50.0	48.4	52.3	3.9	Generally Not Perceptible
NSR 9	54.6	48.4	55.5	7.1	Readily Perceptible

The mitigated groundwater pump station operations with the backup generator inside an enhanced acoustically rated enclosure noise modeling results indicate that the predicted noise levels at all assessed receptors will meet the allowable City of Sunnyvale Municipal Code nighttime noise limit at all locations.

The mitigated groundwater pump station operations with the backup generator inside an enhanced acoustically rated enclosure ambient noise impact results indicate that the predicted noise levels at all assessed receptors fall into the "generally not perceptible" category receptors except at NSR 9, where it would be readily perceptible due to the proximity of the receptor and emergency generator position.

However, it should be noted that the backup generator is only intended to operate during power outages and monthly maintenance testing which are infrequent occurrences. The noise modeling results are also shown as a noise contour map in Figure 9-4. The noise contours are provided in 5 dB increments with the color scale indicating the sound level of each contour.

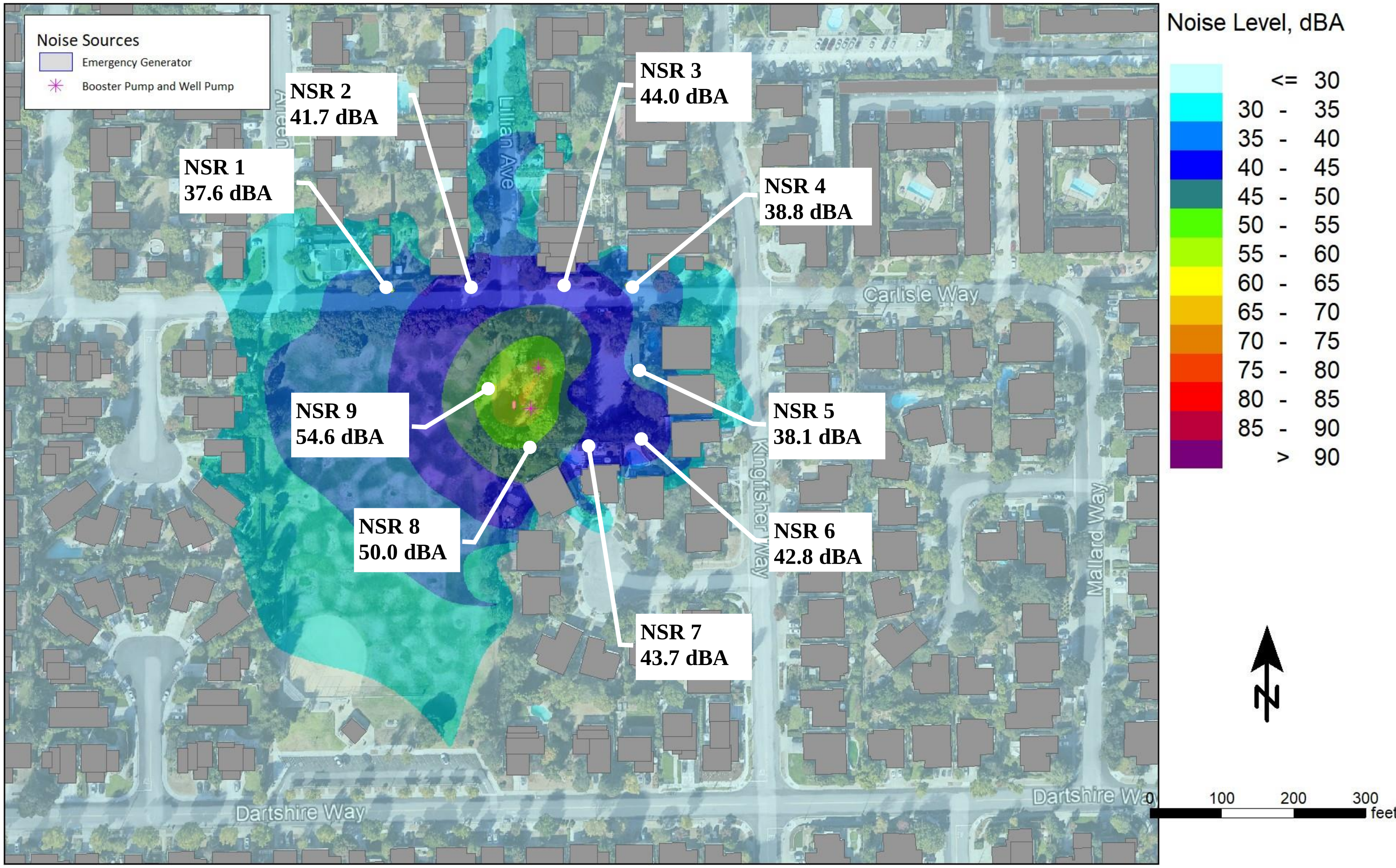


Figure 9-4 Mitigated Groundwater Pump Station Operations Noise Contour Map (dBA)

9.4 Groundwater Pump Station Operations without Backup Generator Noise Modeling Results

The results of the noise modeling are shown in Table 9-5 and Table 9-6. The calculated noise levels in Table 9-5 represent only the contribution of the groundwater pump station operations without the backup generator do not include ambient noise or noise from other equipment. The calculated noise levels in Table 9-6 represent the contribution of the groundwater pump station operations without the backup generator plus the measured ambient sound level to show the sound level impact to existing ambient sound levels. Actual field sound level measurements may vary from the modeled noise levels due to other noise sources such as traffic, other human activity, or environmental factors.

Table 9-5 Groundwater Pump Station without Backup Generator Activities Noise Modeling Results

Receptor	Unmitigated Groundwater Pump Station Operations with Noise Level (dBA)	City of Sunnyvale Municipal Code Allowable Noise Limit (dBA)
NSR 1	33.9	**50**
NSR 2	39.0	**50**
NSR 3	42.0	**50**
NSR 4	35.8	**50**
NSR 5	37.6	**50**
NSR 6	38.9	**50**
NSR 7	37.1	**50**
NSR 8	44.3	**50**
NSR 9	46.7	**60**

Table 9-6 Pump Station without Backup Generator plus Ambient Noise Level Modeling Results (dBA)

Receptor	Unmitigated Groundwater Pump Station Operations with Noise Level (dBA)	Short Term (ST) Ambient Noise Level (dBA)	Unmitigated Groundwater Pump Station Operations plus Ambient Noise Level (dBA)	Sound Level contribution above Ambient (dBA)	Relative Loudness
NSR 1	33.9	56.4	56.4	0	Generally Not Perceptible
NSR 2	39.0	56.4	56.5	0.1	Generally Not Perceptible
NSR 3	42.0	54.0	54.3	0.3	Generally Not Perceptible
NSR 4	35.8	58.1	58.1	0	Generally Not Perceptible
NSR 5	37.6	48.2	48.6	0.4	Generally Not Perceptible
NSR 6	38.9	48.2	48.7	0.5	Generally Not Perceptible
NSR 7	37.1	48.4	48.7	0.3	Generally Not Perceptible
NSR 8	44.3	48.4	49.8	1.4	Generally Not Perceptible
NSR 9	46.7	48.4	50.6	2.2	Generally Not Perceptible

The groundwater pump station operations without the backup generator noise modeling results indicate that the predicted noise levels at all assessed receptors will not exceed the allowable City of Sunnyvale Municipal Code nighttime noise limit and City of Sunnyvale General Plan noise limits at all locations. Therefore, noise mitigation is not required while the backup generator is not operational. The noise modeling results are also shown as a noise contour map in Figure 9-5. The noise contours are provided in 5 dB increments with the color scale indicating the sound level of each contour.

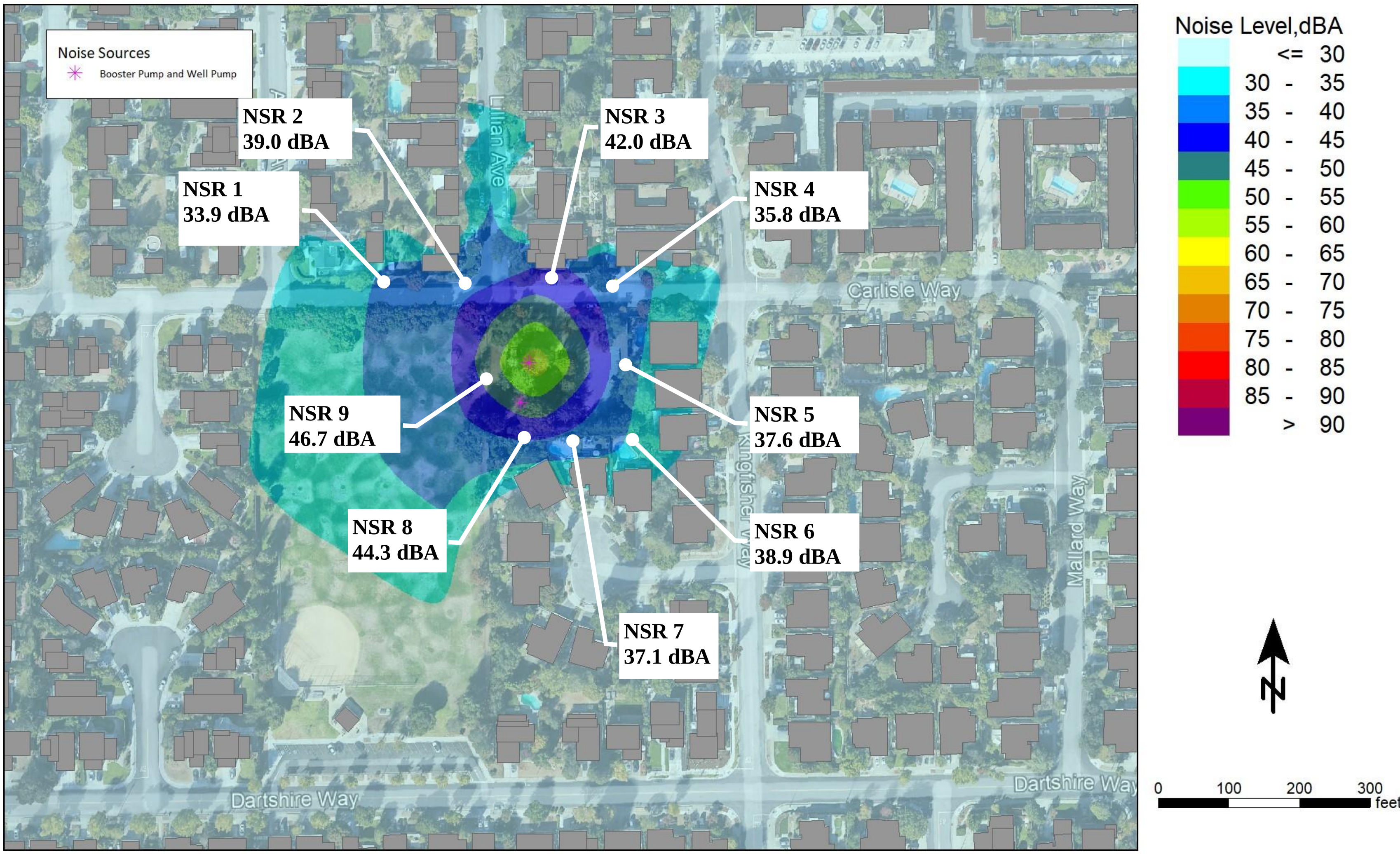


Figure 9-5 Unmitigated Groundwater Pump Station Operations without Backup Generator Noise Contour Map (dBA)

10. Vibration Impact Analysis

10.1 Water Well Drilling Vibration Assessment

The use of equipment during water well drilling activities with the potential to cause vibration outside the immediate area of activities has been assessed. Accordingly, the following analysis evaluates the potential human and structural response to the projected vibration levels at the nearest structures to the drilling activities.

The condition of the nearest structures to the Project Site is unknown. A vibration limit of 0.25 ips which Table 3-1 shows as the maximum continuous vibration level for Historic and some old buildings, was established as a threshold in Section 5.4 to minimize the potential for damage to the structures. Furthermore, a limit of 0.04 ips was established at the nearest occupied structures to minimize the potential for human annoyance.

Typical vibration levels produced by the analyzed water well drilling equipment is provided in Table 10-2 at a reference distance of 100 feet. The reference vibration levels are derived from collected vibration levels of a similarly sized water well drilling equipment obtained from a field vibration measurement survey conducted by Behrens and Associated Environmental Noise Control (BAENC).

Table 10-2 also shows the results of the vibration analysis. The ‘Distance to Exposure Limit of “Historic and some old buildings” level’ column shows the approximate closest distance at which the water well drilling equipment can operate without generating vibration levels above 0.25 ips at the structures. The ‘Distance to “Distinctly Perceptible” Level’ shows the approximate closest distance at which the water well drilling equipment can operate without generating vibration levels above 0.04 ips as specified in the human guideline criteria.

The approximate distance to the closest occupied residential structure for the water well drilling operations is shown in Table 10-2. A comparison of the distances to the nearest structures and the calculated distances at which the equipment would generate 0.25 ips and 0.04 ips reveals the structures are located beyond that area of potential damage and the area for potential human annoyance.

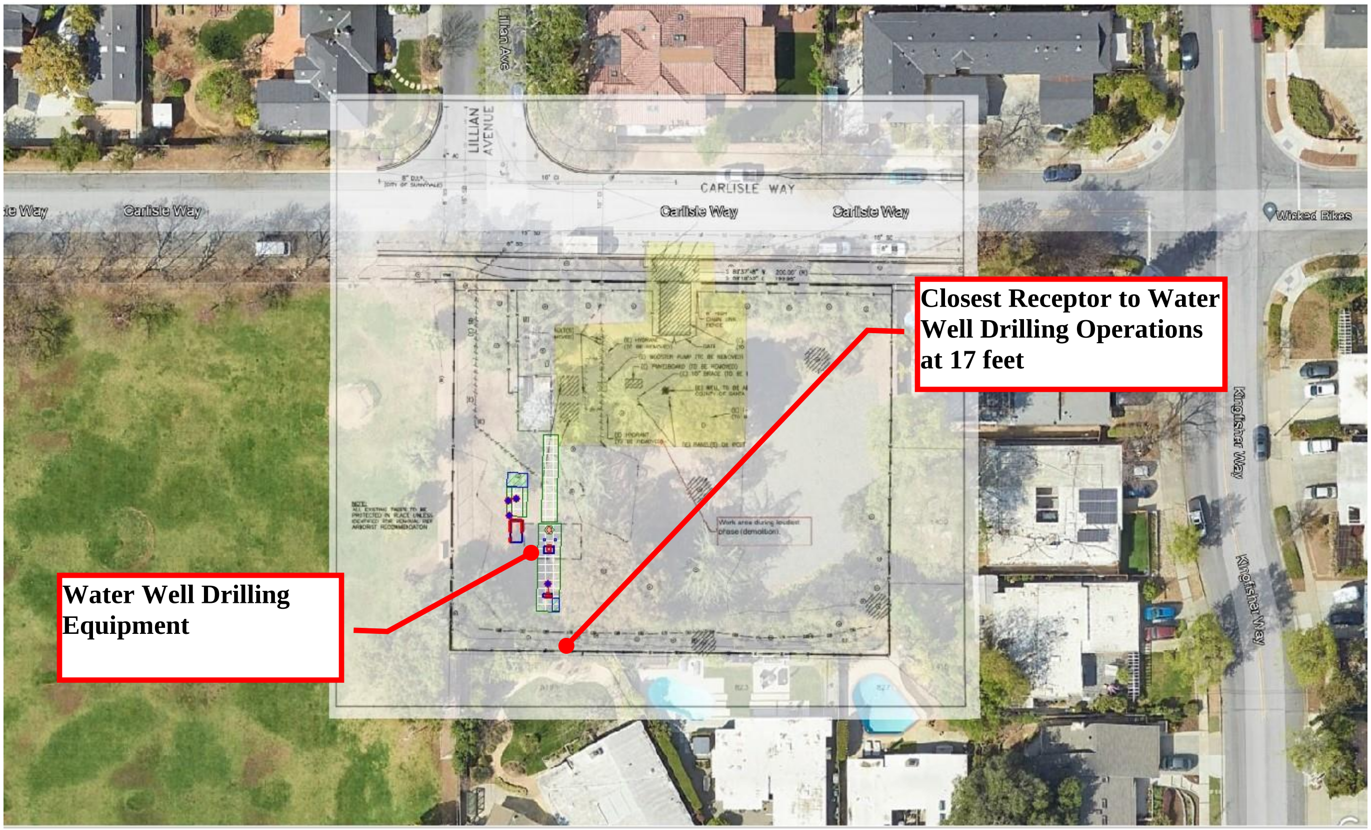


Table 10-1 Water Well Drilling Vibration Analysis Results

Activity	Typical PPV at 100 ft (ips)	Distance to Nearest Structure (ft)	Distance to Vibration Limit for "Historic and Some Old Buildings" (ft)	Distance to "Distinctly Perceptible" for Fragile Buildings (ft)	Approximate Vibration Level at 17 feet from source (ips)
Water Well Drilling Equipment	0.0021	17	5	14	0.03
Vibration Limit for "Historic and Some Old Buildings" (ips)			**0.25**		
"Distinctly Perceptible Level" (ips)			**0.04**		

Based on the vibration thresholds of significance defined in Section 5.4 of this report, vibration produced by the projects will be less than 0.25 ips for the "Vibration Limit for Historic and some old building" and below the 0.04 ips "Distinctly Perceptible" level during the water well drilling activities. Since the results indicate that the approximate vibration levels are below the "Historic and some old building" vibration limit and the "distinctly perceptible" limit during the water well drilling phase, no vibration mitigation measures are recommended.

10.2 Construction Demolition Phase Vibration Assessment

The use of equipment and machinery during the construction demolition activities with the potential to cause vibration outside the immediate area of activities has been assessed. Accordingly, the following analysis evaluates the potential human and structural response to the projected vibration levels at the nearest structures to the construction and drilling activities.

The condition of the nearest structures to the Project Site is unknown. A vibration limit of 0.25 ips which Table 3-1 shows as the maximum continuous vibration level for Historic and some old buildings, was established as a threshold in Section 5.4 to minimize the potential for damage to the structures. Furthermore, a limit of 0.04 ips was established at the nearest occupied structures to minimize the potential for human annoyance.

Typical vibration levels produced by the analyzed construction equipment are provided in Table 10-2 as a reference distance of 25 feet. The reference vibration levels are derived from a combination of field vibration measurements and data made available by Federal Transportation Authority (1995). Equipment utilized in the construction and drilling activities not capable of producing substantial vibration levels have been omitted from the analysis.

Table 10-2 also shows the results of the vibration analysis. The ‘Distance to Exposure Limit of “Historic and some old buildings” level’ column shows the approximate closest distance at which each piece of equipment can operate without generating vibration levels above 0.25 ips at the structures. The ‘Distance to “Distinctly Perceptible” Level’ shows the approximate closest distance at which each equipment item can operate without generating vibration levels above 0.04 ips as specified in the human guideline criteria.

The approximate distance to the closest occupied residential structure for each construction phase is provided in Table 10-2. A comparison of the distances to the nearest structures and the calculated distances at which the equipment would generate 0.25 ips and 0.04 ips reveals the structures are located far beyond that area of potential damage and the area for potential human annoyance.


Closest Receptor to Construction Demolition Activities at 55 feet
Demolition Construction Phase Equipment
Arleen Ave
Lillian Ave
Kingfisher Way
Carlisle Way
Coventry Ct

Table 10-2 Construction Demolition Vibration Analysis Results

Activity	Typical PPV at 25 ft (ips)	Distance to Nearest Structure (ft)	Distance to Vibration Limit for "Historic and Some Old Buildings" (ft)	Distance to "Distinctly Perceptible" for Fragile Buildings (ft)	Approximate Vibration Level at 55 feet from source (ips)
Excavator	0.058	55	10	30	0.02
Hoe Ram	0.089	55	13	40	0.03
Jack Hammer	0.035	55	7	23	0.01
Dozer	0.089	55	13	40	0.03
Vibration Limit for "Historic and Some Old Buildings" (ips)			**0.25**		
"Distinctly Perceptible Level" (ips)			**0.04**		

Based on the vibration thresholds of significance defined in Section 5.4 of this report, vibration produced by the projects will be less than 0.25 ips for the "Vibration Limit for Historic and some old building" and below the 0.04 ips "Distinctly Perceptible" level during the demolition construction activities. Since the results indicate that the approximate vibration levels are below the "Historic and some old building" vibration limit and the "distinctly perceptible" limit during the demolition construction phase, no vibration mitigation measures are recommended.

Appendix A - Glossary of Acoustical Terms

Ambient Noise
The all-encompassing noise associated with a given environment at a specified time, usually a composite of sound from many sources both near and far.

Average Sound Level
See Equivalent-Continuous Sound Level

A-Weighted Sound Level, dB(A)
The sound level obtained by use of A-weighting. Weighting systems were developed to measure sound ina way that more closely mimics the ear's natural sensitivity relative to frequency so that the instrument is less sensitive to noise at frequencies where the human ear is less sensitive and more sensitive at frequencies where the human ear is more sensitive.

C-Weighted Sound Level, dBC
The sound level obtained by use of C-weighting. Follows the frequency sensitivity of the human ear at very high noise levels. The C-weighting scale is quite flat and therefore includes much more of the low-frequency range of sounds than the A and B scales. In some jurisdictions, C-weighted sound limits are used to limit the low-frequency content of noise sources.

Community Noise Equivalent Level (CNEL)
A 24-hour A-weighted average sound level which takes into account the fact that a given level of noise may be more or less tolerable depending on when it occurs. The CNEL measure of noise exposure weights average hourly noise levels by 5 dB for the evening hours (between 7:00 pm and 10:00 pm), and 10 dB between 10:00 pm and 7:00 am, then combines the results with the daytime levels to produce the final CNEL value. It is measured in decibels, dB.

Day-Night Average Sound Level (Ldn)
A measure of noise exposure level that is similar to CNEL except that there is no weighting applied to the evening hours of 7:00 pm to 10:00 pm. It is measured in decibels, dB.

Daytime Average Sound Level
The time-averaged A-weighted sound level measured between the hours of 7:00 am to 7:00 pm. It is measured in decibels, dB.

Decibel (dB)
The basic unit of measurement for sound level.

Direct Sound
Sound that reaches a given location in a direct line from the source without any reflections.

Divergence
The spreading of sound waves from a source in a free field, resulting in a reduction in sound pressure level with increasing distance from the source.

Energy Basis
This refers to the procedure of summing or averaging sound pressure levels on the basis of their squared pressures. This method involves the conversion of decibels to pressures, then performing the necessary arithmetic calculations, and finally changing the pressure back to decibels.

Equivalent-Continuous Sound Level (Leq)
The average sound level measured over a specified time period. It is a single-number measure of time-varying noise over a specified time period. It is the level of a steady sound that, in a stated time period and at a stated location, has the same A-Weighted sound energy as the time-varying sound. For example, a person who experiences an Leq of 60 dB(A) for a period of 10 minutes standing next to a busy street is exposed to the same amount of sound energy as if he had experienced a constant noise level of 60 dB(A) for 10 minutes rather than the time-varying traffic noise level.

Fast Response
A setting on the sound level meter that determines how sound levels are averaged over time. A fast sound level is always more strongly influenced by recent sounds, and less influenced by sounds occurring in the distant past, than the corresponding slow sound level. For the same non-steady sound, the maximum fast sound level is generally greater than the corresponding maximum slow sound level. Fast response is typically used to measure impact sound levels.

Field Impact Insulation Class (FIIC)
A single number rating similar to the impact insulation class except that the impact sound pressure levels are measured in the field.

Field Sound Transmission Class (FSTC)
A single number rating similar to sound transmission class except that the transmission loss values used to derive this class are measured in the field.

Flanking Sound Transmission
The transmission of sound from a room in which a source is located to an adjacent receiving room by paths other than through the common partition. Also, the diffraction of noise around the ends of a barrier.

Frequency
The number of oscillations per second of a sound wave

Hourly Average Sound Level (HNL)
The equivalent-continuous sound level, Leq, over a 1-hour time period.

Impact Insulation Class (IIC)
A single number rating used to compare the effectiveness of floor/ceiling assemblies in providing reduction of impact-generated sound such as the sound of a person's walking across the upstairs floor.

Impact Noise
The noise that results when two objects collide.

Impulse Noise
Noise of a transient nature due to the sudden impulse of pressure like that created by a gunshot or balloon bursting.

Insertion Loss
The decrease in sound power level measured at the location of the receiver when an element (e.g., a noise barrier) is inserted in the transmission path between the sound source and the receiver.

Inverse Square Law
A rule by which the sound intensity varies inversely with the square of the distance from the source. This results in a 6dB decrease in sound pressure level for each doubling of distance from the source.

L_n Sound Level
Time-varying noise environments may be expressed in terms of the noise level that is exceeded for a certain percentage of the total measurement time. These statistical noise levels are denoted L_n, where n is the percent of time. For example, the L_{50} is the noise level exceeded for 50% of the time. For a 1-hour measurement period, the L_{50} would be the noise level exceeded for a cumulative period of 30 minutes in that hour.

Masking
The process by which the threshold of hearing for one sound is raised by the presence of another sound.

Maximum Sound Level (Lmax)
The greatest sound level measured on a sound level meter during a designated time interval or event.

NC Curves (Noise Criterion Curves)
A system for rating the noisiness of an occupied indoor space. An actual octave-band spectrum is compared with a set of standard NC curves to determine the NC level of the space.

Noise Reduction
The difference in sound pressure level between any two points.

Noise Reduction Coefficient (NRC)
A single number rating of the sound absorption properties of a material. It is the average of the sound absorption coefficients at 250, 500, 1000, and 2000 Hz, rounded to the nearest multiple of 0.05.

Octave
The frequency interval between two sounds whose frequency ratio is 2. For example, the frequency interval between 500 Hz and 1,000 Hz is one octave.

Octave-Band Sound Level
For an octave frequency band, the sound pressure level of the sound contained within that band.

One-Third Octave
The frequency interval between two sounds whose frequency ratio is 2^(1/3). For example, the frequency interval between 200 Hz and 250 Hz is one-third octave.

One-Third-Octave-Band Sound Level
For a one-third-octave frequency band, the sound pressure level of the sound contained within that band.

Outdoor-Indoor Transmission Class (OITC)
A single number rating used to compare the sound insulation properties of building façade elements. This rating is designed to correlate with subjective impressions of the ability of façade elements to reduce the overall loudness of ground and air transportation noise.

Peak Sound Level (Lpk)
The maximum instantaneous sound level during a stated time period or event.

Pink Noise
Noise that has approximately equal intensities at each octave or one-third-octave band.

Point Source
A source that radiates sound as if from a single point.

RC Curves (Room Criterion Curves)
A system for rating the noisiness of an occupied indoor space. An actual octave-band spectrum is compared with a set of standard RC curves to determine the RC level of the space.

Real-Time Analyzer (RTA)
An instrument for the determination of a sound spectrum.

Receiver
A person (or persons) or equipment which is affected by noise.

Reflected Sound
Sound that persists in an enclosed space as a result of repeated reflections or scattering. It does not include sound that travels directly from the source without reflections.

Reverberation
The persistence of a sound in an enclosed or partially enclosed space after the source of the sound has stopped, due to the repeated reflection of the sound waves.

Room Absorption
The total absorption within a room due to all objects, surfaces and air absorption within the room. It is measured in Sabins or metric Sabins.

Slow Response
A setting on the sound level meter that determines how measured sound levels are averaged over time. A slow sound level is more influenced by sounds occurring in the distant past that the corresponding fast sound level.

Sound
A physical disturbance in a medium (e.g., air) that is capable of being detected by the human ear.

Sound Absorption Coefficient
A measure of the sound-absorptive property of a material.

Sound Insulation
The capacity of a structure or element to prevent sound from reaching a receiver room either by absorption or reflection.

Sound Level Meter (SLM)
An instrument used for the measurement of sound level, with a standard frequency-weighting and standard exponentially weighted time averaging.

Sound Power Level
A physical measure of the amount of power a sound source radiates into the surrounding air. It is measured in decibels.

Sound Pressure Level
A physical measure of the magnitude of a sound. It is related to the sound's energy. The terms sound pressure level and sound level are often used interchangeably.

Sound Transmission Class (STC)
A single number rating used to compare the sound insulation properties of walls, floors, ceilings, windows, or doors. This rating is designed to correlate with subjective impressions of the ability of building elements to reduce the overall loudness of speech, radio, television, and similar noise sources in offices and buildings.

Source Room
A room that contains a noise source or sources

Spectrum
The spectrum of a sound wave is a description of its resolution into components, each of different frequency and usually different amplitude.

Tapping Machine
A device used in rating different floor constructions against impacts. It produces a series of impacts on the floor under test, 10 times per second.

Tone
A sound with a distinct pitch

Transmission Loss (TL)
A property of a material or structure describing its ability to reduce the transmission of sound at a particular frequency from one space to another. The higher the TL value the more effective the material or structure is in reducing sound between two spaces. It is measured in decibels.

White Noise
Noise that has approximately equal intensities at all frequencies.

Windscreen
A porous covering for a microphone, designed to reduce the noise generated by the passage of wind over the microphone.

Appendix B - Tables of Measured Sound Pressure Levels

Table B-1 24-Hour, Hourly Sound Level Averages (dBA)

Start date & time	1-hr Leq dBA	1-hr L_{10} dBA	1-hr L_{50} dBA	1-hr L_{90} dBA
07/19/2022 11:00:00 AM	46.1	47.2	42.5	40.3
07/19/2022 12:00:00 PM	44.8	47.3	42.0	39.9
07/19/2022 01:00:00 PM	46.4	48.9	43.9	41.2
07/19/2022 02:00:00 PM	47.5	47.4	43.6	41.3
07/19/2022 03:00:00 PM	49.8	50.1	44.7	42.3
07/19/2022 04:00:00 PM	48.4	49.4	45.1	42.9
07/19/2022 05:00:00 PM	46.6	49.3	44.8	43.0
07/19/2022 06:00:00 PM	48.1	47.5	44.1	42.1
07/19/2022 07:00:00 PM	47.6	47.5	43.9	42.3
07/19/2022 08:00:00 PM	44.4	46.5	42.9	41.3
07/19/2022 09:00:00 PM	42.6	44.5	41.0	39.3
07/19/2022 10:00:00 PM	51.1	43.2	39.9	38.5
07/19/2022 11:00:00 PM	50.7	41.5	38.0	36.1
07/20/2022 12:00:00 AM	37.9	38.7	35.6	34.1
07/20/2022 01:00:00 AM	34.7	36.3	33.8	32.1
07/20/2022 02:00:00 AM	37.0	36.8	34.0	31.7
07/20/2022 03:00:00 AM	31.1	32.3	30.4	29.0
07/20/2022 04:00:00 AM	31.3	32.0	30.4	29.0
07/20/2022 05:00:00 AM	36.9	36.8	34.6	31.5
07/20/2022 06:00:00 AM	43.4	43.7	37.5	35.7
07/20/2022 07:00:00 AM	42.1	43.2	40.1	38.3
07/20/2022 08:00:00 AM	49.7	54.1	44.3	42.2
07/20/2022 09:00:00 AM	46.7	46.4	42.9	41.5
07/20/2022 10:00:00 AM	44.4	46.2	42.2	40.7

Table B-2 20 Hz through 315 Hz, 1/3 Octave Hourly Sound Level Averages (dB)

Time	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 HZ	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz
11:00:00 AM	47.4	49.0	48.7	48.5	50.7	49.7	48.5	49.1	46.6	44.8	42.7	40.4	38.8
12:00:00 PM	46.9	48.2	48.2	48.8	49.1	48.7	49.0	46.9	45.4	43.0	39.9	39.2	36.5
01:00:00 PM	47.2	48.9	47.5	47.5	47.6	46.8	50.3	45.6	44.0	43.8	39.7	38.6	36.5
02:00:00 PM	45.9	47.3	47.6	46.7	46.6	46.7	49.0	47.7	47.1	45.4	42.6	42.0	40.5
03:00:00 PM	47.6	49.3	49.2	48.7	48.0	49.0	48.5	50.0	50.1	45.6	44.1	42.8	42.1
04:00:00 PM	47.3	50.8	49.9	48.3	49.4	49.2	47.7	47.7	46.3	44.5	43.0	41.8	41.8
05:00:00 PM	47.6	49.5	49.2	49.5	49.2	50.2	48.3	46.6	46.3	44.1	41.6	40.9	39.3
06:00:00 PM	47.4	50.3	50.1	49.8	49.1	49.0	49.4	50.7	47.3	44.0	45.2	41.7	42.4
07:00:00 PM	47.7	49.5	49.6	49.4	49.9	50.4	53.3	50.3	47.4	46.6	43.1	41.2	40.0
08:00:00 PM	46.9	49.5	48.6	48.6	48.4	49.1	51.8	48.3	46.6	44.6	42.9	41.3	39.2
09:00:00 PM	46.0	49.1	48.4	47.8	48.1	48.3	47.6	47.0	45.9	44.0	41.6	39.4	37.6
10:00:00 PM	44.3	46.1	49.7	46.1	48.5	49.5	54.2	50.9	53.7	56.4	53.9	49.4	47.7
11:00:00 PM	56.4	47.2	49.6	54.5	47.3	53.0	51.5	52.2	49.4	47.9	47.6	46.2	46.0
12:00:00 AM	42.4	43.2	45.6	43.6	44.2	46.0	45.2	42.0	40.7	41.4	36.8	34.5	33.1
01:00:00 AM	42.1	42.0	43.8	42.1	42.6	44.2	41.5	39.2	38.6	37.4	34.8	31.7	30.1
02:00:00 AM	43.1	43.4	44.1	42.6	42.6	43.8	43.9	40.2	43.8	42.0	34.6	32.1	30.7
03:00:00 AM	42.0	41.1	43.0	41.2	41.4	42.2	39.5	37.3	36.2	33.6	30.3	27.3	25.4
04:00:00 AM	42.0	41.9	43.5	42.1	42.4	43.4	40.9	39.2	37.4	35.0	30.4	27.8	25.8
05:00:00 AM	43.9	44.2	47.0	44.8	45.0	45.6	44.3	43.3	41.1	38.7	34.8	31.9	30.1
06:00:00 AM	45.7	46.8	47.9	47.0	48.2	48.2	47.0	46.3	44.3	41.8	38.7	35.9	34.2
07:00:00 AM	48.8	47.4	50.7	49.3	49.6	50.6	49.8	50.1	46.7	43.5	40.5	39.9	36.9
08:00:00 AM	49.6	51.6	52.3	51.5	52.9	53.0	53.7	57.2	51.0	48.5	46.6	44.8	43.1
09:00:00 AM	49.2	52.0	52.0	51.6	52.3	53.0	51.6	50.2	48.0	46.2	43.5	43.0	41.7
10:00:00 AM	49.0	50.0	50.7	50.7	51.3	51.2	50.0	48.9	46.0	43.4	40.7	39.0	37.3

Table B-3 400 Hz through 6300 Hz, 1/3 Octave Hourly Sound Level Averages (dB)

Time	400 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 HZ	2500 Hz	3150 Hz	4000 Hz	5000 Hz	6300 Hz
11:00:00 AM	37.1	37.7	38.2	37.7	35.0	33.7	33.0	31.2	30.1	32.0	32.5	32.6	27.2
12:00:00 PM	34.7	34.0	33.1	33.9	33.1	32.9	32.7	30.5	27.9	31.8	33.6	33.7	32.5
01:00:00 PM	35.3	35.8	34.8	35.0	33.8	31.9	30.5	29.6	29.0	33.1	35.4	33.7	39.4
02:00:00 PM	39.0	39.7	38.7	39.8	38.3	36.1	34.8	33.9	31.9	31.6	31.6	29.6	29.1
03:00:00 PM	42.2	42.8	42.2	42.6	40.2	37.6	36.8	36.2	34.9	33.5	34.9	32.5	31.0
04:00:00 PM	41.3	41.2	40.4	40.2	38.0	35.0	34.0	33.9	33.4	34.4	35.9	33.6	31.9
05:00:00 PM	38.2	38.3	36.7	37.7	36.8	34.5	33.2	31.6	29.3	32.0	36.4	33.6	29.4
06:00:00 PM	43.7	42.1	40.8	41.0	37.4	34.6	33.0	31.9	29.5	30.3	31.7	29.6	28.6
07:00:00 PM	41.8	42.2	39.4	39.0	37.4	34.4	34.8	33.0	30.0	31.4	33.3	29.4	25.1
08:00:00 PM	38.2	37.9	35.7	36.0	34.7	31.8	29.7	27.6	23.6	22.2	23.1	22.2	21.5
09:00:00 PM	35.8	34.7	32.8	33.0	32.7	32.1	30.3	27.4	21.0	18.5	17.7	16.9	16.8
10:00:00 PM	43.5	42.4	41.0	40.0	37.2	34.4	35.1	35.4	34.5	34.3	32.7	27.8	25.0
11:00:00 PM	45.5	46.0	45.5	44.0	38.9	35.1	34.3	33.7	30.5	26.9	22.6	18.8	16.4
12:00:00 AM	32.0	31.1	28.1	27.3	26.0	23.4	23.2	22.9	21.3	19.7	19.1	17.3	16.4
01:00:00 AM	28.8	27.9	25.1	24.6	23.4	20.3	18.7	17.3	15.3	15.6	16.4	15.6	15.9
02:00:00 AM	30.1	29.0	27.0	25.8	25.5	23.4	21.9	21.4	19.9	19.6	18.8	18.2	17.5
03:00:00 AM	24.6	24.2	20.5	20.2	20.9	17.4	14.8	14.4	11.6	11.7	12.5	12.8	13.8
04:00:00 AM	24.4	23.5	19.2	19.9	18.9	16.4	15.0	13.6	12.3	12.4	12.8	12.9	13.8
05:00:00 AM	27.6	26.4	23.3	23.9	22.4	19.6	18.1	15.9	16.4	25.4	29.3	25.4	18.4
06:00:00 AM	31.5	29.7	27.1	27.2	25.6	24.9	24.3	23.0	23.0	34.4	38.3	33.1	27.1
07:00:00 AM	34.2	32.2	30.1	30.8	29.4	28.4	26.9	25.1	22.9	28.3	29.3	25.0	23.0
08:00:00 AM	42.0	42.8	40.7	39.5	37.2	34.3	34.7	33.4	30.5	35.6	39.6	37.2	27.3
09:00:00 AM	40.3	40.3	40.0	38.2	34.9	31.4	30.0	29.8	28.2	28.7	30.4	33.8	26.8
10:00:00 AM	35.3	35.5	34.3	33.9	32.6	30.6	29.5	28.1	29.5	33.4	33.8	30.6	27.1

Table B-3 8000 Hz through 20000 Hz, 1/3 Octave Hourly Sound Level Averages (dB)

Time	8000 Hz	10000 Hz	12500 Hz	16000 Hz	20000 Hz	Total dBA
11:00:00 AM	37.1	37.7	38.2	37.7	35.0	33.7
12:00:00 PM	34.7	34.0	33.1	33.9	33.1	32.9
01:00:00 PM	35.3	35.8	34.8	35.0	33.8	31.9
02:00:00 PM	39.0	39.7	38.7	39.8	38.3	36.1
03:00:00 PM	42.2	42.8	42.2	42.6	40.2	37.6
04:00:00 PM	41.3	41.2	40.4	40.2	38.0	35.0
05:00:00 PM	38.2	38.3	36.7	37.7	36.8	34.5
06:00:00 PM	43.7	42.1	40.8	41.0	37.4	34.6
07:00:00 PM	41.8	42.2	39.4	39.0	37.4	34.4
08:00:00 PM	38.2	37.9	35.7	36.0	34.7	31.8
09:00:00 PM	35.8	34.7	32.8	33.0	32.7	32.1
10:00:00 PM	43.5	42.4	41.0	40.0	37.2	34.4
11:00:00 PM	45.5	46.0	45.5	44.0	38.9	35.1
12:00:00 AM	32.0	31.1	28.1	27.3	26.0	23.4
01:00:00 AM	28.8	27.9	25.1	24.6	23.4	20.3
02:00:00 AM	30.1	29.0	27.0	25.8	25.5	23.4
03:00:00 AM	24.6	24.2	20.5	20.2	20.9	17.4
04:00:00 AM	24.4	23.5	19.2	19.9	18.9	16.4
05:00:00 AM	27.6	26.4	23.3	23.9	22.4	19.6
06:00:00 AM	31.5	29.7	27.1	27.2	25.6	24.9
07:00:00 AM	34.2	32.2	30.1	30.8	29.4	28.4
08:00:00 AM	42.0	42.8	40.7	39.5	37.2	34.3
09:00:00 AM	40.3	40.3	40.0	38.2	34.9	31.4
10:00:00 AM	35.3	35.5	34.3	33.9	32.6	30.6

Appendix C - Referenced Manufacturer Sound Data

Enclosures

CAT

SA Aluminum Enclosure		Cooling Air Flow Rate		SPL @7m (23ft)
Model	Standby eKW	m^3/s	cfm	dBA
D40-6	40	1.7	3602	68

Figure C-1 Input Data Utilized for Tank Construction Phase Generator Set

Sound data

230DSHAD 60 Hz

Sound pressure level @ 7 meters, dB(A)

Configuration		Position (note 1)								8 Position Average
		1	2	3	4	5	6	7	8	
Standard – unhoused (note 3)	Infinite exhaust	88.2	92.2	89.6	90.5	86.2	93.0	91.6	92.5	90.9
F182 – weather w/ exhaust silencer	Mounted muffler	91.8	96.4	94.9	95.7	92.8	97.9	97.0	97.3	95.9
F172 – quiet site II first stage	Mounted muffler	92.1	92.8	83.4	82.9	77.9	82.1	83.7	92.8	89.0
F173 – quiet site II second stage	Mounted muffler	76.7	79.3	77.5	80.5	76.8	77.7	77.9	78.3	78.2

Note:
1. Position 1 faces the engine front at 23 feet (7 m) from surface of the generator set. The positions proceed around the generator set in a counter-clockwise direction in 45° increments.
2. Data based on full rated load with standard radiator fan package.
3. Sound data for generator set with infinite exhaust do not include exhaust noise.
4. Sound pressure levels per ANSI S1.13-1971 as applicable.
5. Reference sound pressure is 20 μPa.
6. Sound pressure levels are subject to instrumentation, measurement, installation and generator set variability.
7. Sound data with remote-cooled set are based on rated loads without fan noise.

Sound power level, dB(A)

Configuration		Octave band center frequency (Hz)								Sound power level
		63	125	250	500	1000	2000	4000	8000	
Standard – unhoused (note 3)	Infinite exhaust	79.0	93.8	107.8	111.5	114.0	111.9	106.5	103.8	117.8
F182 – weather w/ exhaust silencer	Mounted muffler	103.1	109.4	117.1	119.2	117.3	113.9	113.0	109.1	122.7
F172 – quiet site II first stage	Mounted muffler	87.3	94.9	103.8	108.9	111.2	110.1	103.8	96.6	115.1
F173 – quiet site II second stage	Mounted muffler	85.5	92.8	99.0	97.4	98.1	96.7	95.9	91.0	105.1

Figure C-2 Cummins 230DSHAD Backup Generator Manufacturer Sound Data

MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
HF50	HO100V2SLG	3	RUSI	404TP
ORDER NO.	26927	LINE NO.		

MPI:	141574
HP:	100
POLES:	4
VOLTS:	460
HZ:	60
SERVICE FACTOR:	1.15
EFFICIENCY (%):	
S.F.	94.8
FULL	95
3/4	95.5
1/2	95.1
1/4	92.4
POWER FACTOR (%):	
S.F.	86.4
FULL	86.3
3/4	84.5
1/2	78.5
1/4	59.7
NO LOAD	5.1
LOCKED ROTOR	32.9
AMPS:	
S.F.	131
FULL	114
3/4	87
1/2	63
1/4	42
NO LOAD	32.8
LOCKED ROTOR	737.5
NEMA CODE LETTER	G
NEMA DESIGN LETTER	B
FULL LOAD RPM	1785
NEMA NOMINAL / EFFICIENCY (%)	95.4
GUARANTEED EFFICIENCY (%)	94.5
MAX KVAR	22.2
AMBIENT (°C)	40
ALTITUDE (FASL)	3300
SAFE STALL TIME-HOT (SEC)	[illegible]5
SOUND PRESSURE (DBA @ 1M)	70
TORQUES:	
BREAKDOWN{% F.L.}	230
LOCKED ROTOR{% F.L.}	186
FULL LOAD{LB-FT}	294.3

Figure C-3 Booster Pump Manufacturer Sound Data

MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
DT96	HO75V2SLG	3	RUSI	365TP

ORDER NO.	22254	LINE NO.	

MPI:		192030
HP:		75
POLES:		4
VOLTS:		460
HZ:		60
SERVICE FACTOR:		1.15
EFFICIENCY (%):		
	S.F.	94.2
	FULL	94.5
	3/4	95.3
	1/2	95
	1/4	92.6
POWER FACTOR (%):		
	S.F.	85.7
	FULL	85.4
	3/4	83
	1/2	75.8
	1/4	55.6
	NO LOAD	4.3
	LOCKED ROTOR	38.8
AMPS:		
	S.F.	100
	FULL	87
	3/4	67
	1/2	49
	1/4	34
	NO LOAD	27.6
	LOCKED ROTOR	539
NEMA CODE LETTER		G
NEMA DESIGN LETTER		B
FULL LOAD RPM		1780
NEMA NOMINAL EFFICIENCY (%)		95
GUARANTEED EFFICIENCY (%)		94.1
MAX KVAR		18.7
AMBIENT (°C)		40
ALTITUDE (FASL)		3300
SAFE STALL TIME-HOT (SEC)		19
SOUND PRESSURE (DBA @ 1M)		65
TORQUES:		
	BREAKDOWN{% F.L.}	245
	LOCKED ROTOR{% F.L.}	203
	FULL LOAD{LB-FT}	221.1

Figure C-3 Well Pump Motor Manufacturer Sound Data

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Date: July 17, 2024

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From: **Paul R. Donavan, ScD**
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RE: 800 Carlisle Way Well & Tank Project

SUBJECT: Review of the Updated 800 Carlisle Way Well & Water Tank Project Noise Report

Illingworth & Rodkin, Inc. (I&R) reviewed the response to comments from our peer review of the 800 Carlisle Way Well & Water Tank Project Noise Report prepared by Behrens and Associates, Inc. All of the comments from the I&R peer review were adequately addressed in the revised Noise Report dated July 10, 2024. In regard to the I&R comment on the Ambient Sound Level Survey, this author especially appreciated the additional reporting on these measures. Review of these data lead to the conclusion that the noise levels for the hours of 10:00 pm and 11:00 pm were due to some unknown transient noises due to the high level of the hourly L_{eq} values and absence of corresponding higher levels of the L_{10} and other L_n values as noted in the revised report. The differences in the spectra for these hours also suggest that the events were not related.

Submitted by

Paul R. Donavan, Sc.D.
Principal
Illingworth & Rodkin, Inc.