

SOUND ANALYSIS

for

**SNOHOMISH COUNTY PUD
JENNINGS PARK SUBSTATION
MARYSVILLE, WASHINGTON**

Submitted to:

**Snohomish County PUD
P.O. Box 1107
Everett, Washington 98206**

Prepared by:

Ioana Park, P.E.

BRC Acoustics & Audiovisual Design

**1932 First Avenue, Suite 620
Seattle, WA 98101
p: 206.270.8910
f: 206.270.8690
www.brcacoustics.com**

July 23, 2022

CONTENTS

1. INTRODUCTION	1
2. PROJECT SITE AND NEARBY LAND USES	1
3. SOUND LEVEL DESCRIPTORS	3
4. EXISTING SOUND LEVELS	4
5. CITY OF MARYSVILLE NOISE LIMITS	5
6. CALCULATED SOUND LEVELS FROM THE PROPOSED SUBSTATION.....	6
7. SOUND MITIGATION MEASURES	9

1. INTRODUCTION

This report is a sound analysis of the proposed Snohomish County Public Utility District No. 1 (PUD) Jennings Park Substation to be located at 7808 47th Ave. NE in Marysville, Washington. The scope of this report is to present existing sound levels measured near the proposed project site, to evaluate sound levels from proposed sound sources for the site with respect to City of Marysville noise regulations, and to recommend noise-mitigation measures as necessary.

2. PROJECT SITE AND NEARBY LAND USES

Figure 2-1 shows a vicinity aerial photograph of the project site, surrounding properties, and sound measurement and calculation locations. The project site (Snohomish County Parcels 30052100412500 and 30052100414500, outlined in blue in Figure 2-1) is currently occupied by a wireless tower and a building, both to be removed. The site's northeast corner adjoins a lumber facility. Properties to the north, west, and south are commercial. Multi-family housing is located to the northeast and farther east. Single-family housing is located to the east, across 47th Ave. NE.

The substation site and parcels to the northwest, west, and south are zoned GC (General Commercial) by the City of Marysville. Properties to the northeast and east are zoned R 18 (Multi-Family Medium) and R-12 (Multi-Family Low), respectively.

The proposed site development relevant for the sound analysis is installation of one and then a second 28-MVA Waukesha transformer.



Projection: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet
 Planning and Development Services, Snohomish County



22.032

Figure 2-1

	Date	Name
Drafted	07-22-22	IP
Checked		

Snohomish County PUD Jennings Park Substation

Sound Measurement and Analysis Locations

BRC Acoustics & Audiovisual Design

3. SOUND LEVEL DESCRIPTORS

Sound is measured as sound level in units of decibels, dB. Environmental sound is often measured as A-weighted sound level in dBA. The A-weighting is a specific weighting filter in a sound level meter that corresponds to human hearing sensitivity at the various sound frequencies. People normally experience sound levels between about 30 and 90 dBA, depending on their activity. For example, a loud nearby vehicle, radio, or power tool may produce 80 to 90 dBA, normal conversation is about 50 to 60 dBA, and a bedroom or quiet office is about 30 to 40 dBA.

Each 10-dB increase in sound level corresponds to a tenfold increase of sound energy but is judged by a listener as only a doubling of loudness. The smallest changes in sound level considered clearly noticeable are about 3 to 5 dBA.

Sound levels from two or more sources are combined using logarithms, not by adding the levels. When two levels are combined, the louder level predominates, and the combined level is the louder level plus 0 to 3 dBA. Some examples: 50 dBA combined with 50 dBA is 53 dBA, and 50 dBA combined with 40 dBA results in 50.4 dBA.

Because sound levels fluctuate over time, several sound-level descriptors are used to characterize the sound. In this report, the following descriptors are used:

- | | |
|-----------------------|--|
| Leq | Equivalent sound level, Leq , is the most commonly used descriptor for measuring fluctuating sound. The Leq is the level of a constant sound that, over a given time period, contains the same amount of sound energy as the measured fluctuating sound. |
| Lmax | Maximum sound level, Lmax , is the highest instantaneous sound level for a given sound source, event, or time period. Because the Lmax in a neighborhood will, unlike Leq, typically have large fluctuations from hour to hour and day to day, Lmax is seldom used to measure noise impact, except in cases where brief high-level sound is causing an impact such as sleep disturbance. |
| Sound Spectrum | For a sound comprising energy over a range of frequencies, the distribution of sound energy by frequency. When considering sounds with a frequency spectrum such as the hum of a transformer, which is characterized by a large portion of the sound energy being concentrated in the 60-Hz and 120-Hz bands, the sound spectrum is also measured. The sound pressure levels are usually measured in frequency bands of one octave centered at frequencies of 31, 63, 125, 250, 500, 1000 (1k), 2000 (2k), 4000 (4k), and 8000 (8k) Hz. The most important of these octave bands |

in terms of potential annoyance is the 125 Hz octave band, because transformer hum occurs primarily at 120 Hz.

4. EXISTING SOUND LEVELS

Existing sound levels were measured at two locations near the project site, shown in Figure 2-1 as Locations M1 and H2. Two types of measurements were performed. Continuous measurements for 24 hours were conducted at Location M1. Short-term (fifteen-minute), attended measurements were made at Location H2. Both sets of measurements were conducted using a RION NL-32 Integrating Sound Level Meter. The instrument conforms to ANSI S1.4 requirements for Type I measurement systems. All measurements were conducted at the first-story elevation of five feet above the ground elevation. The locations and times of the measurements were as follows:

Location	Description
M1	At the west property line of Parcel 30052100412400, adjacent to the project site. This location was selected to be representative of existing baseline sound levels at the nearest residential property line to the northeast. A-weighted sound levels in 15-minute intervals were measured continuously for 24 hours beginning at 9:45 a.m. on Tuesday, June 21, 2022 using a RION NL-32 Integrating Sound Level Meter.
H2	At the south property line of Parcel 30052100407700, across 47 th Ave. NE to the east from the site. The measurement location is at a setback from 47 th Ave. NE that is typical of front-row residences. A 15-minute measurement of A-weighted sound pressure levels was made on Thursday, June 24, 2022 beginning at 9:30 a.m.

Two additional locations were considered in the analysis and are shown in Figure 2-1 and listed in Table 4-1.

Loc	Description
AL1	Southwest corner of Parcel 30052100411600 (Liberty Square Apartments)
AL2	West property line of single-family residence at 7809 47 th Ave. NE

The weather during the measurements included isolated showers, with daytime temperatures in the low 50s to mid-70s, nighttime temperatures in the low 50s to mid-60s degrees Fahrenheit,

and winds of variable directions at 0 to 12 mph. The weather was within the range allowed by Washington Administrative Code (WAC) 173-58 for the measurement of environmental sound.

A summary of the sound-measurement results is shown in Table 4-2.

TABLE 4-2 SUMMARY OF EXISTING MEASURED SOUND LEVELS (Leq, dBA)		
	MEASUREMENT LOCATION	
	M1	H2
Daytime	47-55 Overall 53	58
Nighttime	41-49 Overall 48	<i>Not measured</i>

The principal sources of sound at residential locations surrounding the Jennings Park site are traffic on 47th Ave. NE and daytime activities at the lumber facility northeast of the site.

5. CITY OF MARYSVILLE NOISE LIMITS

Marysville Municipal Code (MMC) Section 6.76, *Noise Regulation*, adopts by reference the noise limits contained in Chapter 173-60, *Maximum Environmental Noise Levels*, of the Washington Administrative Code (WAC). Noise limits under WAC 173-60 are based on the Environmental Designation for Noise Abatement (EDNA) of source and receiver properties. Where a local Zoning Code is in effect, the EDNA classification is made according to the zoning designation of source and receiver properties, with residential zones generally being Class A EDNA, commercial zones Class B, and industrial zones Class C.

The maximum permissible sound levels according to WAC Chapter 173-60 are listed in Table 5-1.

TABLE 5-1 STATE OF WASHINGTON PERMITTED SOUND LEVELS (dBA)			
EDNA of Sound Source	EDNA of Receiver		
	A	B	C
A	55	57	60
B	57	60	65
C	60	65	70

6. CALCULATED SOUND LEVELS FROM THE PROPOSED SUBSTATION

Snohomish County PUD proposes to install two 115-kV to 12.5-kV power transformers at the Jennings Park Substation. The locations of the transformers are shown on Figure 2-1. The first power transformer is anticipated to be installed in 2024, the second transformer at an undetermined future date.

6.1 Reference Sound Levels of Proposed Transformers

In order to quantify the sound emissions of the proposed 28-MVA Waukesha transformers, BRC Acoustics measured the sound spectrum of the existing 28-MVA, Waukesha transformer installed at the Tulalip Substation. The measurements took place on Tuesday, August 23, 2016, using a Bruel & Kjaer 2250 spectrum analyzer.

In order to quantify the noise emissions of the Waukesha transformer at Tulalip Substation, sound levels produced by the transformer were measured in octave bands at reference distances of 15 to 25 feet from the nearest surface of the transformer in four directions surrounding the unit. The load on the transformer was reported to be 279 to 301 amperes per phase during the measurements.

The sound emissions of the 28-MVA Waukesha transformer (PUD K-362), normalized to sound power levels, are presented in Table 6-1. The sound levels shown in the table include the noise of eight cooling fans operating. The four directions are defined with respect to the principal features of the transformer and also to the proposed orientation at the Jennings Park Substation site.

TABLE 6-1											
SOUND POWER LEVELS											
OF 28-MVA WAUKESHA TRANSFORMER PUD K-362											
DIRECTION		dBA	OCTAVE-BAND CENTER FREQUENCY, Hz								
			31.5	63	125	250	500	1k	2k	4k	8k
I	115 kV bushings (W)	78	73	78	83	79	76	73	66	61	61
II	(N)	79	87	78	87	82	75	73	66	61	61
III	12-kV bushings (E)	73	84	77	79	72	71	69	61	56	52
IV	(S)	77	71	74	80	73	75	73	64	55	50

6.2 Calculated Sound Levels at Surrounding Properties

The sound levels received at the nearest noise-sensitive surrounding properties from the proposed transformer banks were computed using the CadnaA program, which is based on International Standard ISO 9613 for the prediction of environmental noise. The model takes into account the sound power level, directivity, location, and height of the noise sources, distance, ground cover and topography between the noise source and receiver, atmospheric conditions, and location and height of the receiver.

The sound calculations were executed for the two analysis locations and two sound-measurement locations listed in Section 4 and shown in Figure 2-1. The calculated A-weighted sound levels at the surrounding locations from the proposed transformers without additional noise mitigation are shown in Table 6-2. The table also shows the City of Marysville noise limits as summarized in Section 5 and the existing measured Leq at the measurement locations.

The calculations indicate that, without added noise mitigation, A-weighted sound levels produced by the proposed transformers would be significantly below the City of Marysville daytime and nighttime noise limits at all Analysis Locations.

It should be noted that sound levels from the two transformers are also below the nighttime noise limit of 47 dBA that applies to commercial source and residential receiver properties. As stated previously, electrical substations are exempt from the nighttime reduction in the noise limits.

The calculated sound levels shown in Table 6-2 are also below the existing Leq sound levels measured during daytime and nighttime hours at all Analysis Locations.

TABLE 6-2					
CALCULATED SOUND LEVELS FROM THE PROPOSED FACILITY					
A-WEIGHTED DECIBELS (Leq, dBA)					
BRC Internal	Sound Sources	Analysis Location			
		M1	AL1	H2	AL2
01 One	Bank 1 Transformer	23	25	12	13
02 Two	Banks 1, 2 Transformers	26	28	15	16
	City of Marysville Daytime and Nighttime Noise Limit	57	57	57	57
	Existing daytime Leq	47-55 Overall 53	47-55* Overall 53	58	58*
	Existing nighttime Leq	41-49 Overall 48	41-49* Overall 48	--	--
<i>*Baseline Sound Levels at Locations AL1 and AL2 derived from measurements at M1 and H2, respectively</i>					

7. SOUND MITIGATION MEASURES

The calculated sound levels presented in Table 6-3 indicate that the transformer banks proposed for the Jennings Park Substation would comply with applicable noise limits and would be below existing measured sound levels at all Analysis Locations. Therefore, no additional noise mitigation measures are required.