CHAPTER 9. NOISE

9.1 WHAT IS NOISE AND HOW IS IT EVALUATED?

Noise is defined as unwanted sound. Sound is created when a source (such as a machine) creates mechanical energy that travels as pressure waves through the air. Several parameters are used to measure noise, including the rate of oscillation of sound waves (frequency), the speed of wave propagation, and the pressure level or energy content (*amplitude*).

Noise Key Findings

Alternatives 1 and 3, and the distributed generation, energy storage, and peak generation plant components of Alternative 2, would result in minor construction noise impacts during daytime hours and moderate impacts if nighttime work were to occur. Operation of Alternative 1, Option A, or Alternative 3 could cause minor noise impacts. Operation of the distributed generation component (Alternative 2) or the new peak generation plants (Alternative 2) could result in minor to moderate noise impacts.

The sound pressure level has become the most common descriptor used to characterize the loudness of a sound. Sound pressure level is measured in decibels (dB), which is a logarithmic loudness scale. On this scale, 0 dB corresponds roughly to the threshold of human hearing, and 120 to 140 dB corresponds to the threshold of pain (HUD, 1985).

The typical human ear is not equally sensitive to all frequencies of sound. When assessing potential noise impacts, sound is measured using an electronic filter that deemphasizes the frequencies below 1,000 hertz (Hz) and above 5,000 Hz. This mimics the human ear's decreased sensitivity to low and extremely high frequencies. This method of adjusting the sound scale to reflect human hearing is referred to as A-weighting and is expressed in units of A-weighted decibels (dBA).

Community noise levels must be measured over an extended period of time because they are constantly changing. This time-varying characteristic of environmental noise is described using statistical noise descriptors. The most frequently used noise descriptors are as follows (Caltrans, 2013):

Leq: The Leq or equivalent sound level is used to describe noise over a specified period of time, typically 1 hour, in terms of a single numerical value. The Leq is the constant sound level that would contain the same acoustic energy as the varying sound level, during the same time period. It reflects the average noise exposure level for the given time period.

Lmax: The Lmax is the instantaneous maximum noise level measured during the measurement period of interest.

Ldn: The Ldn or day-night average sound level (also written as DNL) is the energy average of the A-weighted sound levels occurring during a 24-hour period. It accounts for the greater sensitivity of most people to nighttime noise by

weighting (penalizing) nighttime noise levels: 10 dBA is added to noise occurring between 10:00 PM and 7:00 AM.

Steady-state sound remains constant (on average) over time; examples include the sound of an air conditioner, fan, or pump. Steady-state sounds are typically described using the Leq descriptor.

Impulse sound is generated over a relatively short period (e.g., a car horn or backup alarm). Impulsive sound is typically characterized using the Lmax.

The effects of noise on people can be placed into three categories: (1) subjective effects of annoyance, nuisance, and dissatisfaction; (2) interference with activities such as speech, sleep, and learning; and (3) physiological effects such as hearing loss or sudden startling.

Because there is such wide variation in how people respond to noise, an important way of predicting human reaction to noise is the way that noise levels compare to the existing environment to which one has adapted, or the *ambient noise level*. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be to the individual. With regard to increases in A-weighted noise levels, the following relationships occur (Caltrans, 2013):

- Except in carefully controlled laboratory experiments, a change of 1 dBA cannot be perceived by the human ear.
- Outside of the laboratory, a 3 dBA change is considered a just-perceivable difference.
- A change of at least 5 dBA is required before any noticeable change in human response is expected.
- People perceive a 10 dBA change as approximately a doubling in loudness and it can cause an adverse response.

9.2 WHAT ARE THE RELEVANT PLANS, POLICIES, AND REGULATIONS?

9.2.1 Washington State

The Washington Administrative Code (WAC) has established limits on maximum permissible noise levels for residential, commercial, and industrial zones (Chapter 173-60 WAC). The exterior sound level limits for specified land use zones or “districts” vary depending on the district generating the sound and the district affected by the sound (Table 9-1). Noise from electrical substations and construction activity occurring between 7 AM and 10 PM are exempt from these limits. However, these levels would apply to new transmission lines that operate continuously.

Table 9-1. Exterior Sound Level Limits (Washington Administrative Code 173-60-040)

Sound Generating District	Sound Receiving District		
	Residential (dBA Leq)	Commercial (dBA Leq)	Industrial (dBA Leq)
Class A (Residential)	55	57	60
Class B (Commercial)	57	60	65
Class C (Industrial)	60	65	70

9.2.2 King County

The King County Comprehensive Plan (2013 Update) addresses noise only from airports and mining operations, and it contains no specific policies regarding construction noise or stationary source noise. Section 12.86 of the King County Code establishes maximum exterior sound level limits for specified land use districts, which vary depending on the district generating the sound and the district affected by the sound (Table 9-2). Temporary noise from construction is allowed to exceed these limits depending on the time of day and type of equipment in use (King County, 2015).

Table 9-2. Exterior Sound Level Limits (King County Code 12.88.020)

Sound Generating District	Sound Receiving District			
	Rural (dBA, Leq)	Residential (dBA Leq)	Commercial (dBA Leq)	Industrial (dBA Leq)
Rural	49	52	55	57
Residential	52	55	57	60
Commercial	55	57	60	65
Industrial	57	60	65	70

9.2.3 City Codes and Policies

Bellevue, Redmond, Kirkland, and Beaux Arts Village have policies in their comprehensive plans regarding excessive noise. These generally address noise that could impair permitted land use activities in all zones, with special emphasis on nighttime noise in residential zones. All study area communities have noise regulations similar to those described for King County. Table 9-3 summarizes noise-related codes and policies of cities in the combined study area (Alternatives 1, 2, and 3 as depicted on Figure 1-4 in Chapter 1). While some cities have adopted the noise standards contained in the Washington Administrative Code, some cities, as indicated in Table 9-3, have different or more stringent standards and these would apply to construction and stationary noise sources in these communities.

Table 9-3. Noise Codes and Policies of Cities in the Combined Study Area

Comprehensive Plan Policies	Code Requirements
Beaux Arts Village	
The 2014 Draft Comprehensive Plan states that noise should be considered during review of public facilities proposed by King County and other agencies.	No applicable code requirements.
Bellevue	
Ensure that excessive noise does not impair the permitted land use activities in residential, commercial, and industrial land use districts. Protect residential neighborhoods from noise levels that interfere with sleep and repose through development standards and code enforcement.	Bellevue City Code Chapter 9.18 provides maximum permissible sound levels for stationary sources generally consistent with Table 9-2 for King County. Bellevue exempts construction noise from these limits between 7:00 AM and 6:00 PM on weekdays, and 9:00 AM and 6:00 PM on Saturdays (not including legal holidays). More stringent noise restrictions apply to Robinsglen Community Park and Lake Hills Greenbelt Access Areas (designated quiet zones).
Clyde Hill	
No applicable comprehensive plan policies.	Municipal Code 8.10.030 prohibits sounds originating from construction sites, except between the hours of 7:00 AM and 6:00 PM on weekdays and 10:00 AM and 4:00 PM on weekends and holidays,
Hunts Point	
No applicable comprehensive plan policies.	Municipal Code 15.50.010 permits site development and building construction activities that transmit noise to surrounding properties (over 55 dB) only during the hours of 7:30 AM to 4:30 PM (Monday through Friday) and from 9:00 AM to 2:00 PM on Saturday (not including legal holidays). Municipal Code 8.40.010 and 8.40.020 adopts by reference the noise standards of the King County Code, Chapters 12.86 through 12.100, which govern excessive noise and noise control by reference. Chapter 12.91, Watercraft Sound Levels, is excluded.
Issaquah	
No applicable comprehensive plan policies.	Issaquah Municipal Code 18.07.36 adopts by reference the noise standards of Chapter 173-60 WAC (Table 9-1). Issaquah Municipal Code Chapter 19.22 prohibits noisy activity in general but does not identify quantitative standards.

Comprehensive Plan Policies	Code Requirements
Kirkland	
Policy CC.4-11: Minimize Impacts on Residential Neighborhoods states that the City should have development regulations and urban design principles to reduce and, in some cases, prohibit impacts such as noise, lighting, glare and odor. Site design, building orientation, underground parking, landscape buffers, solid screen fencing, acoustical sound walls, directional lighting, and limitation on business hours of operation are some of the techniques that may be used.	Kirkland Municipal Code Chapter 115.95 adopts by reference the noise standards of Chapter 173-60 WAC (Table 9-1). Kirkland Municipal Code 11.84A.070 prohibits noisy activity in general but does not identify quantitative standards.
Medina	
No applicable comprehensive plan policies.	Municipal Code 8.06.010 adopts by reference the noise standards of the King County Code, Chapters 12.86 through 12.100. It adds that a technical variance may be granted by the hearing examiner on the grounds that there is no practical means known or available for the adequate prevention, abatement, or control of the noise involved. Municipal Code 12.06.330 requires the permittee to take appropriate measures to reduce noise during excavation work. No noise sufficient to disturb neighboring properties is allowed between the hours of 10:00 PM and 7:00 AM. Municipal Code 20.32.040 states that fences surrounding electrical power and utility substations must be located in a manner that minimizes noise impacts to adjoining properties and streets. Municipal Code 20.71.030 states that a use must not have materially detrimental effects on neighboring properties due to excessive noise if it is to be approved for an administrative special use permit.
Newcastle	
No applicable comprehensive plan policies.	Newcastle Municipal Code 9.05.510 prohibits noisy activity in general but does not identify quantitative standards. It prohibits sounds originating from construction sites, including but not limited to sounds from construction equipment, power tools and hammering, between the hours of 7:00 PM and 7:00 AM on weekdays and 6:00 PM and 9:00 AM on weekends and holidays, unless authorized by the City Manager.

Comprehensive Plan Policies	Code Requirements
Redmond	
Maintain noise regulations to limit noise to levels that protect the public health and that allow residential, commercial and manufacturing areas to be used for their intended purposes. Provide flexibility in the regulations to allow construction at night when necessary to protect worker safety while maintaining the tranquility of the city. Require buffering or other noise reduction and mitigation measures to reduce noise impacts from commercial and industrial zones on residential areas.	Redmond Municipal Code Chapter 9.18 establishes maximum permissible sound levels for stationary sources generally consistent with Table 9-2 for King County. The City exempts construction noise from these limits between 7:00 AM and 10:00 PM if not impacting a residential zone. In residential zones, construction noise is exempt from these limits between the hours of 7:00 AM and 7:00 PM on weekdays, and 9:00 AM and 6:00 PM on Saturdays that are not legal holidays.
Renton	
Policy SH-3: All shoreline policies, regulations, and development shall recognize and protect private rights consistent with the public interest and, to the extent feasible, shall be designed and constructed to protect the rights and privacy of adjacent property owners. Shoreline uses and activities should be discouraged if they would cause significant noise or odor or unsafe conditions that would impede the achievement of shoreline use preferences on the site or on adjacent or abutting sites.	Renton Municipal Code Chapter 8.7 adopts by reference the noise standards of Chapter 173-60 WAC (Table 9-1).
Sammamish	
No applicable comprehensive plan policies.	Sammamish Municipal Code 8.15.020 prohibits public nuisances in general but does not identify quantitative standards.
Yarrow Point	
No applicable comprehensive plan policies.	Yarrow Point Municipal Code 12.31.030 restricts noisy construction activity audible within 50 feet to between the hours of 7:00 AM and 6:00 PM, Monday through Friday, and 9:00 AM and 5:00 PM on Saturdays. Section 8.04 prohibits public nuisances in general but does not identify quantitative standards.

9.3 WHAT IS THE EXISTING NOISE ENVIRONMENT IN THE COMBINED STUDY AREA?

The EIS Consultant Team reviewed multiple recent noise studies performed in Bellevue and surrounding areas. This review revealed that transportation is the primary source of noise in most of the study area communities. Locations within 100 feet of Interstate 90 or I-405 can experience noise levels of 70 dBA Ldn or greater, while more secluded areas, such as lower density residential areas in Bellevue, may not have noise levels above 53 dBA Ldn (Sound Transit, 2011).

Hourly noise fluctuates consistent with daily activity levels. Noise levels during the day (7 AM to 10 PM) typically average between 50 and 60 dBA in suburban residential areas of King County, falling to between 40 and 50 dBA during nighttime hours (King County Department of Natural Resources and Parks, 2012).

9.3.1 Corona Discharge

The potential for noise from corona discharge was identified as a concern during scoping. Corona is the electrical ionization of the air that occurs near the surface of the energized conductor and suspension hardware because of very high electric field strength. Corona discharge occurs when the voltage of the line exceeds the insulating capability of air and may result in audible noise such as random crackling or hissing being produced by the transmission lines.

The amount of corona produced by an overhead transmission line is a function of the voltage of the line, the diameter of the conductors, the locations of the conductors in relation to each other, the elevation of the line above sea level, the condition of the conductors and hardware, and the local weather conditions.

Corona discharge is greater on misty days because the air has a lower insulating ability when wet. Also, particles such as dust or water droplets that might come in contact with a conductor tend to increase corona discharge. Therefore, the potential for noise from corona discharge is greatest during wet weather. However, the noise generated by falling heavy rain hitting the ground will typically be greater than the noise generated by corona, masking the audible noise from the transmission line. Corona generated noise is of concern primarily for transmission lines operating at voltages of 345 kV and above (U.S. DOE, 2006).

Recent analyses in the Pacific Northwest indicate that maximum corona noise produced from 230 kV lines at ground level during wet weather conditions is 29 dBA (Oregon DOE, 2013). This is a relatively low noise level that would not be noticeable in most suburban environments. As a point of reference, the U.S. Department of Housing and Urban Development identifies a noise level of 45 dBA (Ldn) as an interior noise goal for federal housing (HUD, 1985), which is equivalent to a steady state noise level over a 24-hour period of 39 dBA.

9.3.2 Other Equipment Noise

Transformers and their cooling fans generate noise as could any *ancillary* equipment such as air handling equipment or backup generator testing. PSE has established noise standards for autotransformers (upon initial installation) of 70 and 65 dBA at 1 meter with and without cooling, respectively. Monitoring at a relatively small substation in a quiet suburban area in Seattle found that typical daytime noise at the fence line during operation of a bank of three transformers with cooling fans running was 64 dBA Leq[1]. This level of noise could be audible at adjacent sensitive land uses, depending on their distance and the existing ambient noise level.

Electrical substations are exempt from the maximum permissible noise levels established in Chapter 173-60 of the Washington Administrative Code.

9.4 HOW WERE POTENTIAL NOISE IMPACTS ASSESSED?

For this programmatic EIS, a programmatic-level analysis was conducted to provide a general evaluation of potential noise impacts from construction and operation of the proposed project alternatives. The EIS Consultant Team reviewed available data on estimated noise levels generated by construction activities, electrical transmission lines, and substation equipment. Anticipated project noise levels were compared to the existing noise environment for the types of land uses in the study areas.

9.5 WHAT ARE THE LIKELY CONSTRUCTION IMPACTS RELATED TO NOISE?

9.5.1 Construction Impacts Considered

Construction of the proposed project would result in temporary increases in ambient noise levels associated with the operation of heavy-duty construction equipment. Construction noise levels would fluctuate depending on the particular type, number, and duration of use of various pieces of construction equipment. The effect of construction noise would depend upon the type of construction activity on a given day and equipment used, the distance between construction activities and the nearest sensitive land uses, and the existing noise levels around the site. Construction noise would be considered to impact surrounding land uses if noise became noticeable to the extent that conversation or other outdoor activities are disrupted, indoor activities are affected, or sleep is disturbed. An exceedance of noise ordinance requirements, or the need for a variance, would be considered an impact.

Table 9-4 shows the type of equipment that would likely be used for construction of the action alternatives.

[1] Environmental Science Associates monitored noise levels at the Delridge substation in May 2013 as part of a data gathering effort for the preparation of the Environmental Impact Statement for the proposed Denny Substation in Seattle.

Construction noise impacts are assessed according to the following criteria:

Minor –Temporary construction-related noise consistent with local ordinances and occurring during daytime hours.

Moderate –Temporary construction-related noise consistent with local ordinances but potentially occur during nighttime hours in proximity to sensitive land uses

Significant –Temporary construction-related noise that would conflict with local ordinances or occur during nighttime hours in proximity to sensitive land uses for a substantial (greater than 2-week) period.

Table 9-4. Typical Noise Levels from Construction Equipment

Construction Equipment	Noise Level (dBA, Leq at 50 feet)
Grader	85
Auger Drill	84[1]
Scraper	84
Bulldozer	82
Pump Truck	82
Crane, mobile	81
Excavator	81
Generator	81
Roller	80
Concrete Mixer	79
Loader	79
Backhoe	78
Paver	77
Man Lift	75
Vibratory Sheet Pile Driver (Alternative 1, Option C and Option D)	101

Source: Federal Highway Administration (FHWA), 2006.
[1] Noise level from auger drill is reported for engine noise only. Augering can also generate noise from shaking the bit to remove sticky soils.

9.5.2 No Action Alternative

The No Action Alternative would not result in construction activities. Corrective Action Plans, the primary component of the No Action Alternative, would implement operational measures to reduce and/or shift electrical demand and would not involve infrastructure improvements. The No Action Alternative would not result in changes to maintenance activities or require construction of new or relocated maintenance yards. While conductor

replacement could occur under the No Action Alternative, installation methods would likely involve the use of a single-man lift and would cause negligible construction noise.

9.5.3 Alternative 1: New Substation and 230 kV Transmission Lines

Impacts are described according to the major components associated with Alternative 1. The transmission line options are described, with associated major facilities.

9.5.3.1 Option A: New Overhead Transmission Lines

Installation of new overhead transmission lines would require specific construction activities that may include boring holes for geotechnical investigations, removing existing wood poles and replacing them with tubular steel poles (TSPs) and foundations, installing conductors, relocating existing distribution and telecommunications facilities, and associated site preparation activities (e.g., road grading and work pad construction). These activities would require use of much of the equipment presented in Table 9-4. Additionally, construction of the new transformer would require similar equipment, depending on whether the transformer would be added to an existing substation or installed in a new substation.

Table 9-5 provides an estimate of *noise contour* distances from each of the activities associated with transmission line installation. Tower locations would be spaced approximately 1,000 feet apart, and *noise receptors* within the distances indicated in Table 9-5 could be exposed to the noise levels indicated over a period of approximately 1 week while the work is conducted. Additionally, stringing of power lines would likely be completed using cranes, which would generate additional noise.

A **Noise Contour** is a line on a map that represents equal levels of noise exposure.
A **Noise Receptor** is a location where noise can interrupt ongoing activities. Sensitive receptors for noise are generally considered to include hospitals, nursing homes, senior citizen centers, schools, churches, libraries, and residences.

If the selected alignment under Alternative 1, Option A has supporting structures or transformers closer than 180 feet to sensitive receptors, those receptors could be exposed to noise levels in excess of 75 dBA. While likely to be above background noise levels, this would likely be within the restrictions for construction noise in Section 12.88 of the King County Code (and most local codes), which exempt construction noise from quantitative noise exposure limits but restrict construction noise to daytime hours. If nighttime construction work were required, a moderate noise impact could occur. Nighttime construction activity would require a variance or exemption from regional or local codes and would potentially be disruptive to adjacent sensitive land uses during typical sleeping hours.

Table 9-5. Construction Activity Noise Contour Distances

Construction Activity	dBA L_{eq} Contour Distance (feet)				
	75	70	65	60	55
Conductor Removal	183	327	572	975	1,610
Wood Pole Removal	171	307	537	916	1,517
TSP Foundation Installation	173	309	539	924	1,534
TSP Erection	132	239	420	726	1,219
Conductor Installation at Stringing Site	204	364	630	1,067	1,757

Source: Based on SCE, 2013 and 2014.

9.5.3.2 Option B: Existing Seattle City Light 230 kV Transmission Corridor

Rebuilding and reconductoring the existing Seattle City Light transmission lines would require replacing most of the existing structures and all conductors. Consequently the construction-related noise impacts for Alternative 1, Option B would be similar to those described for Option A. Noise impacts would depend on the relative distances of the alignment from sensitive receptors.

9.5.3.3 Option C: Underground Transmission Lines

Construction techniques for Alternative 1, Option C would be different and require substantially more earthwork that either Option A or Option B. Rather than construction occurring at discrete tower locations, Option C would require open-cut trenching techniques over a continuous alignment. Construction activity would likely progress along the alignment at about 100 feet per day, typically affecting nearby receptors for a duration of approximately 1 week.

Trenching typically involves the use of excavators or backhoes, dump trucks, bulldozers, concrete mixers, and cranes. At some locations such as busy intersections, or to cross hills or streams, trenchless techniques such as *jack-and-bore* or horizontal directional drilling may be required. Trenchless techniques can require the brief use of relatively noisy impact equipment such as vibratory sheet pile drivers to install sheet piles around the bore pit. Jackhammers or *hoe rams* are other relatively noisy impact equipment that may be used to remove concrete structures.

The construction noise impacts of Option C would be more substantial than either those of Alternative 1, Option A or Option B because of the increased intensity and duration of construction and the potential use of impact equipment or other noisy construction techniques. However, the overall impact would still be consistent with local codes regarding construction noise and considered a minor impact if the work is restricted to daytime hours. If nighttime construction work were required, a moderate noise impact could occur. Nighttime construction activity would require a variance from regional or local codes and could potentially be disruptive to adjacent sensitive land uses during typical sleeping hours.

9.5.3.4 Option D: Underwater Transmission Lines

Construction techniques for Alternative 1, Option D would require a combination of standard construction equipment, such as backhoes and vacuum trucks, as well as equipment for potential trenchless methods such as horizontal directional drilling. Cable would be installed using a ship designed to lay the cable in one continuous piece. Installation of cable landing points may require sheet or soldier pile driving, and *cofferdams* may be required for bore pits that also would require sheet pile driving. Construction would be centralized at the cable landing points and therefore would impact the fewest sensitive receptors with construction noise.

Although sheet pile driving is relatively noisy and likely under this option, the overall impact would still be consistent with local codes regarding construction noise and considered a minor impact if restricted to daytime hours. If nighttime construction work were required, a moderate noise impact could occur depending on the proximity of sensitive receptors. Nighttime work would require a variance from regional or local codes and could potentially be disruptive to adjacent sensitive land uses during typical sleeping hours.

9.5.4 Alternative 2: Integrated Resource Approach

9.5.4.1 Energy Efficiency and Demand Response Component

Energy efficiency and demand response components would not involve infrastructure improvements, changes to maintenance activities, or construction of new or relocated maintenance yards. Consequently, these components would have no impact with regard to construction noise.

9.5.4.2 Distributed Generation Component

Construction of distributed generation facilities could result in noise impacts within the vicinity of each facility. Impacts would vary in intensity and duration depending on the type and magnitude of facility.

The most likely forms of distributed generation would be gas turbines, anaerobic digesters, microturbines, and fuel cells. These facilities would be relatively small units (ranging from a small rooftop installation up to 1 acre) distributed throughout the study area rather than one large generation facility. Construction of these facilities would vary in duration and require standard construction equipment presented in Table 9-4.

Depending on the distance to the construction area, receptors in the vicinity of each facility could be exposed to noise levels in excess of 75 dBA. While likely to be above background noise levels, this construction noise would likely be within the restrictions for construction noise in Section 12.88 of the King County Code (and most local codes), which exempt construction noise from quantitative noise exposure limits but restrict construction noise to daytime hours. If nighttime construction work were required, a moderate noise impact could occur depending on the proximity of sensitive receptors. Nighttime work would require a variance from regional or local codes and could potentially be disruptive to adjacent sensitive land uses during typical sleeping hours.

9.5.4.3 Energy Storage Component

Construction of an energy storage facility could result in noise impacts within the vicinity of each facility. Impacts would vary in intensity and duration depending on the proximity to receptors. Construction of these facilities would typically take up to 6 months and require many of the standard types of construction equipment presented in Table 9-4.

Depending on the distance to the construction area, receptors in the vicinity of each facility could be exposed to noise levels in excess of 75 dBA. While likely to be above background noise levels, this construction noise would likely be within the restrictions for construction noise in Section 12.88 of the King County Code (and most local codes), which exempt construction noise from quantitative noise exposure limits but restrict construction noise to daytime hours. If nighttime construction work were required, a moderate noise impact could occur depending on the proximity of sensitive receptors. Nighttime work would require a variance from regional or local codes and could potentially be disruptive to adjacent sensitive land uses during typical sleeping hours.

9.5.4.4 Peak Generation Plant Component

Peak generation plants would have construction noise impacts similar to those described above for distributed generation. Construction of these facilities would typically take up to 12 months and require standard construction equipment presented in Table 9-4.

9.5.5 Alternative 3: New 115 kV Lines and Transformers

The construction noise impacts of Alternative 3 would largely be the same as Alternative 1, except that a new transformer would need to be installed at each of three existing substations, thus potentially impacting more receptors. The Sammamish substation is approximately 700 feet from the nearest receptor; the Lake Tradition substation is approximately 3,200 feet from the nearest receptor; and the Talbot Hill substation is approximately 200 feet from the nearest receptor, although this substation is expansive and, depending the location of the transformer, the nearest receptor could be much farther away.

As with Alternative 1, Option A, if the selected alignment would have supporting structures or transformers closer than 180 feet, receptors could be exposed to noise levels in excess of 75 dBA. While likely to be above background noise levels, this would likely be within the restrictions for construction noise in Section 12.88 of the King County Code (and most local codes), which exempt construction noise from quantitative noise exposure limits but restrict construction noise to daytime hours. If nighttime construction work were required, a moderate noise impact could occur depending on the proximity of sensitive receptors. Nighttime work would require a variance from regional or local codes and could potentially be disruptive to adjacent sensitive land uses during typical sleeping hours.

9.6 HOW COULD OPERATION OF THE PROJECT AFFECT THE NOISE ENVIRONMENT?

9.6.1 Operation Impacts Considered

9.6.1.1 Impacts Common to All Alternatives

There are no impacts that would be common to all alternatives because of the diversity of alternatives considered in this Draft EIS. Alternatives involving overhead power lines would have common impacts regarding operational noise from corona discharge. Alternatives involving construction of new facilities (Alternative A), some components of Alternative B (distributed generation), and Alternative C would all have operational noise impacts of varying degrees and durations which are discussed individually below.

Operational noise impacts are assessed according to the following criteria:

Minor – Project would generate operational noise consistent with local ordinances and would increase ambient noise levels by less than 3 dBA (see Section 9.2).

Moderate – Project would generate operational noise consistent with local ordinances and would increase ambient noise levels by less than 5 dBA (see Section 9.2).

Significant – Project would generate operational noise that would conflict with local ordinances or would increase ambient noise levels by 5 dBA or greater at a sensitive land use.

9.6.2 No Action Alternative

The No Action Alternative would rely on Corrective Action Plans to reduce and/or shift electrical demand. This alternative would not involve infrastructure improvements, changes to maintenance activities, or operation of new or relocated maintenance yards. Consequently there would be no operational noise impacts associated with the No Action Alternative.

9.6.3 Alternative 1: New Substation and 230 kV Transmission Lines

Operational impacts for Alternative 1 are described for the major components, with transmission lines discussed first, followed by equipment noise from substations.

9.6.3.1 Option A: New Overhead Transmission Lines

9.6.3.1.1 Corona Discharge

Potential operational impacts from overhead transmission lines associated with any of the transmission line alternatives would occur from corona discharge. The maximum corona noise produced from 230 kV lines at ground level during wet weather conditions a relatively low noise level that would not be noticeable in most suburban environments, see Sections 9.3 and 9.4. Background ambient noise levels in suburban residential areas of King County fall between 40 and 50 dBA during nighttime hours. Even in rural areas, corona noise from 230 kV transmission lines would be unlikely to impact sensitive uses. Consequently, audible corona noise would be a negligible operational noise impact of Alternative 1, Option A.

9.6.3.1.2 Other Equipment Noise

The new substation would be an operational noise source of Alternative 1, Option A. Transformers and their cooling fans generate noise as could any ancillary equipment such as air handling equipment or backup generator testing. PSE has established noise standards for autotransformers (upon initial installation) of 70 and 65 dBA at 1 meter with and without cooling, respectively. This level of noise could be audible at adjacent sensitive land uses, depending on their distance and the existing ambient noise level.

Electrical substations are exempt from the maximum permissible noise levels established in Chapter 173-60 of the Washington Administrative Code. Consequently, substation operations would likely be consistent with local municipal codes governing noise sources. However, the substation could result in a noticeable increase in local ambient noise levels and result in a minor noise impact. Mitigation measures are identified to address this potential (Section 9.8).

9.6.3.2 Option B: Existing Seattle City Light 230 kV Transmission Corridor

Alternative 1, Option B would replace existing Seattle City Light lines with new lines rated for increased electrical capacity. The existing and proposed lines are 230 kV. Option B would reduce the potential for exposing new receptors to corona noise because the improvements would be confined to existing electrical facilities. Also, as discussed under Option A, corona noise would be a negligible noise impact. As with Option A, additional substations would be required under Option B. Therefore, Option B would have a similar noise impacts to Option A (negligible to minor).

9.6.3.3 Option C: Underground Transmission Lines

Alternative 1, Option C would locate transmission lines underground through the entirety of the transmission alignment as well as from the alignment to local substations. There would be no audible noise resulting from operation of Option C for those portions of the line placed underground. If some portions of the transmission line are aboveground, impacts in those segments would be consistent with those described for Option A. Option D: Underwater Transmission Lines. As with Option A, additional substations would be required. Therefore, Option C would have a similar noise impacts to Option A (negligible to minor).

9.6.3.4 Option D: Underwater Transmission Lines

While Alternative 1, Option D would locate transmission lines underwater through most of the transmission alignment, some overhead transmission lines would be required connecting the proposed underground lines to the three substation locations. There would be a small potential for exposing sensitive land uses to corona noise, but this would be a negligible adverse impact as described for Option A. As with Option A, additional substations would be required. Therefore, Option D would have a similar noise impacts to Option A (negligible to minor).

9.6.4 Alternative 2: Integrated Resource Approach

9.6.4.1 Energy Efficiency Component

Energy efficiency improvements would not involve infrastructure improvements, changes to maintenance activities, or new or relocated transformers, substations, or maintenance yards. These components would have no impact with regard to operational noise.

9.6.4.2 Demand Response Component

Demand response measures would entail implementing measures to reduce and/or shift electrical demand and would not involve infrastructure improvements, changes to maintenance activities, or new or relocated transformers, substations, or maintenance yards. Consequently, implementation of demand response systems would have no impact with regard to operational noise.

9.6.4.3 Distributed Generation Component

Distributed generation facilities could result in operational noise impacts within the vicinity of each facility. The impacts would vary in intensity and duration with the type and magnitude of facility. Gas turbines, reciprocating engines, and similar mechanical generators could generate operational noise on an intermittent basis. This noise could be a concern to neighbors or require mitigation to ensure operations are consistent with noise standards in county or municipal codes. This represents a minor to moderate noise impact.

9.6.4.4 Energy Storage Component

Operation of a battery storage facility would be similar to that of a small office building, with worker vehicle trips and vendor trips to perform periodic replacement of degraded cells representing the only meaningful noise source. Energy storage would have a negligible impact with regard to operational noise.

9.6.4.1 Peak Generation Plant Component

The peak generation plants are assumed to be 20 MW simple-cycle gas-fired generators or similar equipment. The primary noise sources of this type of generation plant include the gas turbine generators, gas turbine air inlets, selective catalytic reduction units and their exhaust stacks, electrical transformers, fuel gas compressors and metering equipment, and various pumps and fans. Cumulatively this equipment can result in operational noise levels of approximately 65 dB at 300 feet (Siemens AG, 2005), which is high enough that in some residential areas it would not meet noise regulations. Depending on the location of receptors relative to a generation plant, local noise levels could be elevated, especially during nighttime hours, and represent a moderate noise impact. Mitigation measures are identified to address operational noise from combustion turbine facilities (Section 9.8).

9.6.5 Alternative 3: New 115 kV Lines and Transformers

9.6.5.1 Corona Discharge

Potential operational impacts of 115 kV overhead power lines resulting from corona discharge would be the same as those identified above for 230 kV power lines. Corona discharge from 115 KV lines would be a negligible operational noise impact.

9.6.5.2 Other Equipment Noise

New transformers would be an operational noise source under Alternative 3. As discussed above with respect to Alternative 1, Option A, operational transformer noise could be audible at adjacent sensitive land uses, depending on their distance and the existing ambient noise level. While electrical substations are exempt from the maximum permissible noise levels established in Chapter 173-60 of the Washington Administrative Code, the transformers could result in a noticeable increase in local ambient noise levels and a minor noise impact. Mitigation measures are identified to address this potential (Section 9.8).

9.7 WHAT MITIGATION MEASURES ARE AVAILABLE FOR POTENTIAL NOISE IMPACTS?

9.7.1 Nighttime Construction Noise

For project elements that would require prolonged nighttime construction activities, portable acoustical barriers may be used to reduce noise. Moveable sound barrier curtains can provide 15 dBA of sound attenuation (INC, 2014). Static sound barrier curtains can provide sound transmission loss of 16 to 40 dBA, depending on the frequency of the noise source (ENC, 2014).

9.7.2 Substation/Transformer Operational Noise

Although electrical substations are exempt from the maximum permissible noise levels established in Chapter 173-60 of the Washington Administrative Code, the transformers could result in a noticeable increase in local ambient noise levels and therefore elicit an adverse community reaction. If new transformers are proposed for installation in a new substation facility, siting of that facility should consider the proximity of sensitive land uses. Site plans should include noise attenuation measures as necessary to maintain noise levels at the nearest receptors within 5 dBA of existing ambient noise levels. Static sound barrier curtains can provide sound transmission loss of 16 to 40 dBA, depending on the frequency of the noise source (ENC, 2014).

9.7.3 Distributed Energy Operational Noise

The following distributed generation sources have the potential to result in minor to moderate operational noise impacts: wind turbines, gas turbines, anaerobic digesters, reciprocating engines, and microturbines. Siting of facilities that would operate these types of equipment should consider the proximity of sensitive land uses. Site plans should include noise attenuation measures as necessary to maintain noise levels at the nearest receptors within 5 dBA of existing ambient noise levels. Static sound barrier curtains can provide sound

transmission loss of 16 to 40 dBA, depending on the frequency of the noise source (ENC, 2014). The efficacy of such barriers would depend on the surrounding elevations of the plant and receptors, and air flow requirements of the plant that might prohibit ceiling barriers. Exhaust stack silencers are also widely available for electrical generator engine applications.

9.8 ARE THERE ANY CUMULATIVE IMPACTS FROM NOISE AND CAN THEY BE MITIGATED?

Because local conditions play an important role in assessing potential noise impacts, it would be speculative, at the programmatic level, to identify potential cumulative noise impacts. First, the specific locations of facilities are not yet identified and, therefore, existing ambient noise conditions and sources are also unavailable. Secondly, the contribution from other foreseeable projects that may cumulatively contribute to noise impacts would also depend on the proximity to proposed noise sources and existing or proposed receptors. However, it can be acknowledged that the Eastside is continuing to urbanize, with accompanying increased noise levels from roadway traffic, construction, and aircraft overflights. Additional noise from energy facilities will contribute to that overall trend, but specific quantitative increases cannot reliably be estimated.

9.9 ARE THERE ANY SIGNIFICANT UNAVOIDABLE ADVERSE NOISE IMPACTS?

With prudent siting of new substations and distributed generation facilities, there would be no significant and unavoidable construction-related or operational adverse noise impacts associated with any of the project alternatives. However, peak generation plants, which would need to be located next to substations that are generally within or adjacent to residential areas, could have significant noise impacts that can only be avoided by ensuring that there are no residential uses in close proximity to the plants.