Exhibit A

Konstantaras' Motion for Summary Judgment
In the Matter of the Appeal of FOUR SEASONS HOTEL, SEATTLE, et al.,
from a decision by the Director of SDCI

Hearing Examiner File: HC-18-001 through HC-18-007

Major Public Project Construction Noise Variance Application
Viaduct Demolition
WSDOT, October 9, 2017

Alaskan Way Viaduct
REPLACEMENT
PROGRAM

U.S. Department of Transportation Federal Highway Administration | WSDOT | King County | Port of Seattle | City of Seattle

Major Public Project Construction Noise Variance Application Viaduct Demolition

Washington State Department of Transportation

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October 9, 2017

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Exhibits

Acronyms and Abbreviations

dB	decibels
dBA	A-weighted decibels
Hz	Hertz
INM	Independent Noise Monitor
MPPCNV	Major Public Project Construction Noise Variance
NMMP	Noise Management and Mitigation Plan
RCW	Revised Code of Washington
SDCI	Seattle Department of Construction and Inspections
WSDOT	Washington State Department of Transportation

1. Introduction

The Washington State Department of Transportation (WSDOT) is submitting this application to the Seattle Department of Construction and Inspections (SDCI) to request a Major Public Project Construction Noise Variance (MPPCNV) for the Alaskan Way Viaduct Demolition as part of the Alaskan Way Viaduct Replacement Program per the Noise Control Ordinance (Seattle Municipal Code, Chapter 25.08 [SMC 25.08]) and City of Seattle's Director's Rule 3-2009. This noise variance will cover activities occurring as part of the Viaduct demolition phase.

WSDOT requests a one year nighttime noise variance for the proposed Viaduct demolition to allow necessary construction work activities to occur during nighttime hours (between 10 p.m. and 7 a.m. on weekdays and between 10 p.m. and. 9 a.m. on weekends and legal holidays). WSDOT also requests that this MPPCNV allow impact work to occur between 7 a.m. and 10 p.m. on weekdays, weekends and legal holidays in addition to regular daytime hours of 8 a.m. and 5 p.m. on weekdays and 9 a.m. and 5 p.m. on weekends and legal holidays as provided in SMC 25.08.425. As part of the MPPCNV, this application proposes nighttime construction noise level limits for noise-sensitive receivers near construction sites.

WSDOT requests an MPPCNV pursuant to SMC 25.08.590 (Granting of Variance) and SMC 25.08.655 (MPPCNV) to allow construction noise generated on site to exceed the sound level limit as specified in SMC 25.08.410 and as modified by 25.08.420 and 25.08.425.

Completion of all construction activities during only daytime hours would extend the construction period and increase the economic cost to taxpayers.

WSDOT has developed expected construction activities and an estimated schedule for the Viaduct demolition. The analysis demonstrates that means and methods are available to meet the noise limits requested in this noise variance application. The contractor will propose their own construction activities and schedule, and create a detailed Noise Management and Mitigation Plan (NMMP) to meet the commitments WSDOT has made in this MPPCNV application and the noise variance issued by SDCI. Construction activities and equipment used by the contractor may not be specifically identical but are likely to be similar to those identified by WSDOT in the Proposed Construction Activities section.

This noise variance application includes the following:

- An NMMP to demonstrate that means and methods are available to meet the proposed noise limits.
- A description of the proposed construction activities including a description of the noisiest proposed activities.
- Existing baseline sound levels at noise-sensitive land uses within the project areas.

- Proposed sound-level limits for nighttime construction activities that would be unreasonable to limit to daytime construction considering public and worker safety or render the project economically or functionally unreasonable.
- Calculated sound levels that may be expected at noise-sensitive land uses during the noisiest nighttime construction activities.
- Proposed noise-mitigation measures.
- Provisions for compliance tracking and actions taken to resolve public complaints.

WSDOT is working with SDCI to meet the 90-day permit processing timeline for WSDOT projects on a state highway as outlined in Revised Code of Washington (RCW) 47.01.485. The legislative intent behind this law is to expand the opportunities for streamlining the delivery of essential transportation projects while maintaining natural resource protection. This requirement became effective when Governor Inslee signed 2ESSB 5994 into law on July 6, 2015. The following section was added to RCW 47.01.485:

(1) To the greatest extent practicable, a city, town, code city, or county must make a final determination on all permits required for a project on a state highway as defined in RCW 46.04.560 no later than 90 days after the department (WSDOT) submits a complete permit application for a project with an estimated cost of less than $500 million.

2. Project Description and Proposed Construction Activities

2.1 Viaduct Demolition Overview and Project Site Description

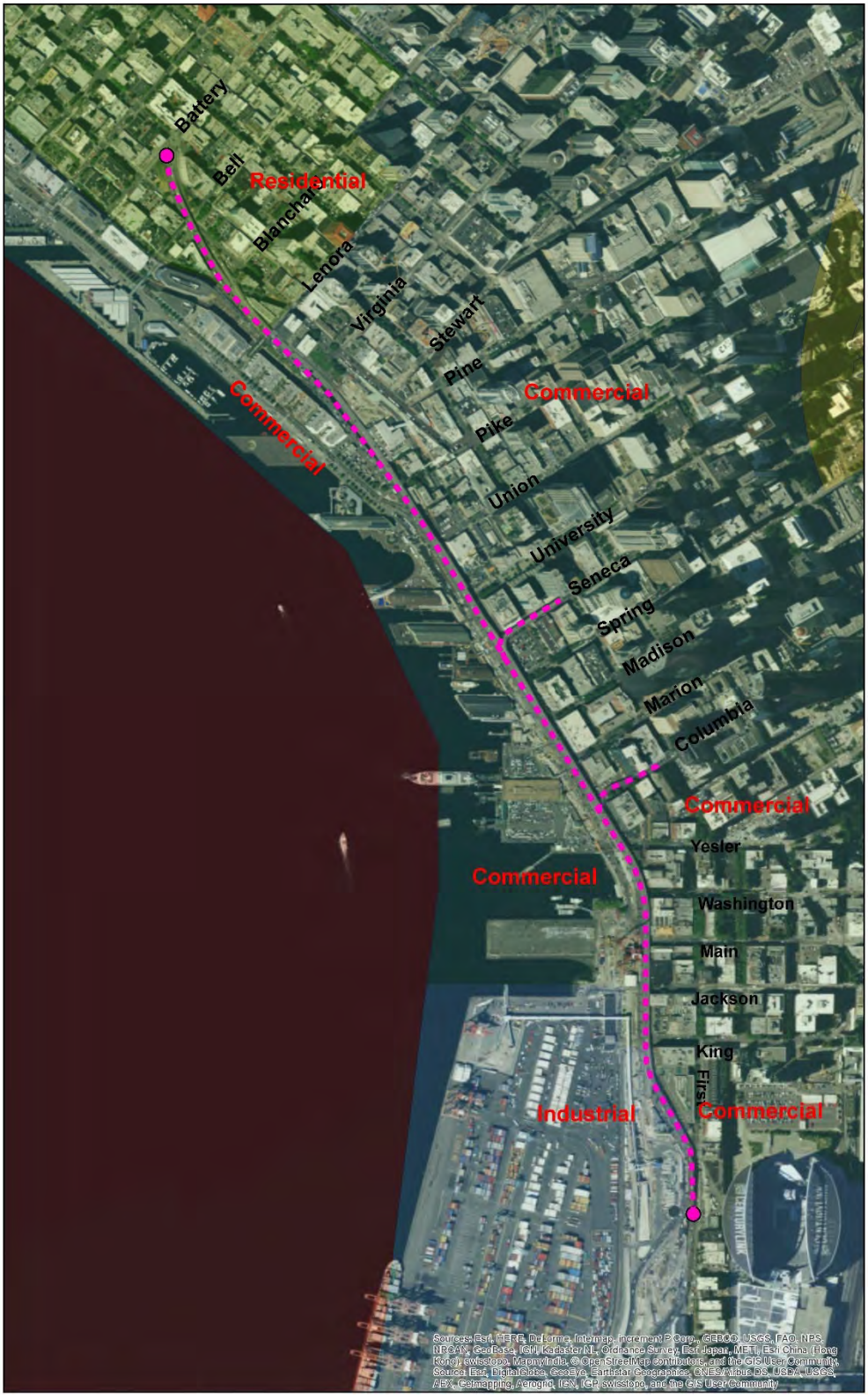
Demolition would occur two blocks at time, closing three intersections in a row (Exhibit 1). Work would take place within and from public rights-of-way or where WSDOT obtains temporary construction easements. The entire work zone would be closed to the public with no crossings for vehicles or pedestrians. Following demolition, the surface would be restored to current conditions.

Access to buildings and property adjacent to active work zones would be limited; in some locations, access would not be possible. WSDOT would provide reasonable modifications to allow tenants or residents to remain in place throughout the demolition. However, in several locations continued occupancy may not be feasible; in which case, alternative accommodations or relief would be developed that address each specific circumstance.

WSDOT plans to issue a design-build contract for viaduct demolition. The specific means and methods will be determined by the contractor.

Land uses and zoning classifications are residential, commercial and industrial near the project area.

Exhibit 1. Project Area and Zoning



3. Expected Construction Activities

The Viaduct demolition will be a design-build contract. WSDOT has carefully reviewed the work to be built as part of this contract and has developed an expected schedule and an expected list of construction activities for this work. A request for proposals is planned to be issued by WSDOT in 2017. WSDOT will evaluate the proposals received based on cost and technical credits. WSDOT expects to award the contract to the selected contractor in 2018. The contractor will develop their own approach and plan for the schedule and construction activities for this work, and update the NMMP accordingly. While the order and timing of activities may differ, the construction activities and equipment used are likely to be similar to those identified by WSDOT.

The length of the variance requested is one year to complete the activities. Work is scheduled to commence in 2018 with work substantially complete in 2019. The three phases of construction include early work, demolition and finish work (Exhibit 2). The contractor will update the schedule, order and timing of activities in the updated NMMP.

Exhibit 2. Schedule

Note: The exact opening date of the Bored Tunnel is to be determined.

Early work includes the Alaskan Way traffic switch which includes installing a series of temporary span wire signal systems along Alaskan Way, between Yesler Way and Pike Street. Additional night time work could include installation of permanent sign posts along Alaskan Way, between S. King Street and Pike Street. A nighttime closure is also expected to perform the actual switch of traffic from under the viaduct onto Alaskan Way. Finish work would include activities during the project closeout, including cleanup, dismantling of staging areas, and restoration where required. Early and Finish work is expected to be quieter than the demolition activities.

The loudest activities would include impact work and would occur during the demolition of the Viaduct. Although the demolition is expected to be completed within six months, the demolition would be transient along the corridor and WSDOT has committed to restoring

access adjacent to individual buildings in no more than 30 days. The proposed major demolition activities are as follows:

- For most of the Viaduct mainline, the deck will be hammered out with the use of excavators and hammers and the inside beams will be cut up with a concrete cracker. The footings will be hammered and the debris will be loaded out. This work would be transient along the majority of the Viaduct alignment for up to six months. WSDOT expects impact equipment would to only be used between 7 a.m. and 10 p.m. on weekdays, weekends and legal holidays.
- Over the railroad tracks, the deck will be saw cut into sections, the sections will be rigged and loaded onto trucks. BNSF railway has indicated that they would only allow work windows over the railroad tracks in the middle of the night, when train traffic is low. Due these restrictions, WSDOT is allowed only to work during nighttime hours over the railroad, and WSDOT is also restricted from working between October 1st and December 31st. Demolition is allowed to occur between 1 a.m. and 4 a.m. on Saturdays, Sundays and Mondays. WSDOT expects a total of approximately 39 nights would be needed to complete this work over a period of 13 weeks. Any increase in the allowable work hours would result in a decrease of the number of nights needed to complete this work.
- For the first 100 feet north of the railroad tracks, the deck will be hammered out with the use of excavators and hammers and the inside beams will be cut up with a concrete cracker. The footings will be hammered and the debris will be loaded out. Due to railroad restrictions, WSDOT is allowed only to work during nighttime hours over the railroad, and WSDOT is also restricted from working between October 1st and December 31st. Demolition is also allowed to occur between 1 a.m. and 4 a.m. on Saturdays, Sundays and Mondays. WSDOT expects a total of approximately 12 nights would be needed to complete this work over a period of one month.
- From the end of railroad restricted work areas to Battery Street Tunnel, excavators with concrete crackers will demolish the structure and it will be loaded out. This work would occur for approximately 3 months. WSDOT expects impact equipment would to only be used between 7 a.m. and 10 p.m. on weekdays, weekends and legal holidays.
- For the Seneca and Columbia Ramps, the bridge decks would be saw cut and lifted out by crane and loaded onto flatbed trucks. There would be limited impact work, the bridge diaphragms would be removed with impact hammers. The footings will be hammered and the debris will be loaded out. WSDOT expects that each ramp would take 40 days to demolish, but each ramp would require a 7 day period with limited impact work could to occur during nighttime hours to limit effects on nearby buildings and residents.

Expected evening impact, limited nighttime impact, and other nighttime activities requiring a noise variance are part of some or all the phases described above. Other nighttime activities would include delivery of equipment and materials, refueling of equipment and restoring the surface to current conditions following demolition.

WSDOT has developed a list of equipment to be used by the contractor as noted in Exhibit 3. The contractor will update the list of equipment in the updated NMMP.

Exhibit 3. List of Construction Equipment

Equipment Type
Asphalt roller
Bulldozer
Compressor
Concrete pump
Concrete saw
Concrete truck
Crawler crane
Delivery truck
Diesel generator
Drill rig
Dump or Debris truck
Excavator with concrete cracker
Excavator with impact hammer
Excavator with thumb
Forklift
Grader
Hydraulic crane
Light plant
Loader
Street sweeper
Vibratory roller
Welder

4. WSDOT Compliance with City of Seattle Criteria for a Major Public Project Construction Noise Variance

4.1 Definition of Major Public Project

4.1.1 SMC 25.08.168: The Definition of a Major Public Project

SMC 25.08.168 defines "major public project" as follows:

> *"Major public project" means a project for a public facility as defined in SMC Title 23, the construction of which the Administrator determines is likely to be of at least six months duration, and is likely to have a substantial impact on the public safety, health and welfare and the provision of public services, including transportation services. In making this determination the Administrator shall consider factors such as the expected size, complexity or cost of the proposed construction or reconstruction; the expected duration of the proposed construction or reconstruction; the magnitude of the expected impacts on traffic and transportation; and/or the degree of impact on the provision of public services during the proposed construction or reconstruction.*

The Viaduct demolition would require up to a year of substantial construction work. This section contains a detailed description of how this application meets the criteria for granting a MPPCNV.

4.1.2 SMC 23.84A.030 "P": The Definition of Public Facility

SMC 23.84A.030 "P" defines "public facility" as follows:

> *"Public facility" means a public project or city facility.*

The proposed Alaskan Way Viaduct Replacement Program is a "major public project" as defined in SMC 25.08.168 and is a "public facility" as defined in SMC 23.84.030.

Work on the Viaduct demolition is scheduled to commence in 2018 with work substantially complete in 2019. The length of the variance requested is one year to complete substantial construction activities.

4.2 Criteria for Granting a Noise Variance

4.2.1 SMC 25.08.590.C: The Criteria for Granting a Noise Variance

SMC 25.08.590.C states:

> *A. The Administrator may grant a variance if the Administrator finds that:*
>
> *1. The noise occurring or proposed to occur does not endanger public health or safety; and*
>
> *2. The applicant demonstrates that the criteria required for the variance are met.*

This noise variance application proposes nighttime construction noise limits for noise-sensitive receivers in proximity to construction areas. The proposed noise limits for the majority of the MPPCNV would include a 6 dBA (A-weighted decibels) increase over existing hourly noise levels measured between the quietest nighttime hours of 12 a.m. to 5 a.m. For 7 days during the Seneca ramp demolition and for 7 days during the Columbia ramp demolition, the proposed noise limits in the areas of the ramp demolitions would include a 16 dBA (A-weighted decibels) increase over existing hourly noise levels measured between the quietest nighttime hours of 12 a.m. to 5 a.m. The proposed descriptors and noise limits for the Viaduct demolition are based on WSDOT and SDCI noise variance coordination efforts which started in summer 2017 and a review of other SDCI decisions on MPPCNV applications for agencies such as WSDOT, Sound Transit and the Seattle Department of Transportation. These other variances were granted an increase of hourly average noise level limits ranging from 6 dBA up to 15 dBA over measured existing baseline noise levels.

4.3 Criteria for a Major Public Project Construction Noise Variance

4.3.1 SMC 25.08.655.A: The Criteria for an MPPCNV

The criteria for an MPPCNV are stated in SMC 25.08.655.A as follows:

> *A. The Administrator may grant a major public project construction variance to provide relief from the exterior sound level limits established by this chapter during the construction periods of major public projects. A major public project construction variance shall provide relief from the exterior sound level limits during the construction or reconstruction of a major public project only to the extent the applicant demonstrates that compliance with the levels would:*
>
> *1. Be unreasonable in light of public or worker safety or cause the applicant to violate other applicable regulations, including but not limited to regulations that reduce impacts on transportation infrastructure or natural resources; or*
>
> *2. Render the project economically or functionally unreasonable due to factors such as the financial cost of compliance or the impact of complying for the duration of the construction or reconstruction of the major public project.*

Completion of all construction activities during only daytime hours would extend the construction period and increase the economic cost to taxpayers.

4.4 WSDOT Term of Proposed Variance

4.4.1 SMC 25.08.655.B: The Term of the Proposed Variance

SMC 25.08.655.B states:

> *B. A major public project construction variance shall set forth the period or periods during which the variance is effective, which period or periods shall be the minimum*

reasonably necessary in light of the standard set forth in subsection A, and the exterior sound level limits that will be in effect during the period of the variance.

Requested Period the Variance Is Effective

In general, WSDOT requests that construction noise generated on the site be allowed to exceed the noise level limits set by Seattle Noise Control Ordinance, SMC 25.08.410, during nighttime hours (between 10 p.m. and 7 a.m. on weekdays and between 10 p.m. and. 9 a.m. on weekends and legal holidays). WSDOT also requests that this MPPCNV allow impact work, including equipment such as impact hammers, and jack hammers, to occur between 7 a.m. and 10 p.m. in addition to regular daytime hours of 8 a.m. and 5 p.m. on weekdays and 9 a.m. and 5 p.m. on weekends and legal holidays as provided in SMC 25.08.425.C.

At select locations, limited impact work would be needed during nighttime hours (between 10 p.m. and 7 a.m. on weekdays and between 10 p.m. and. 9 a.m. on weekends and legal holidays) to minimize impacts to the areas adjacent to the Seneca and Columbia ramps and near rail roads.

Activities are scheduled to begin as early as 2018, with an estimated completion date in 2019. The length of the requested variance is one year which is the anticipated duration necessary to complete the activities.

The contractor would be able to perform nighttime activities if the work is performed within the Viaduct demolition area as described below and covered by this MPPCNV or any temporary noise variances granted by SDCI. Additional coordination with SDCI would continue throughout demolition.

Construction Area and Exterior Nighttime Construction Noise-Level Limits

This noise variance application proposes nighttime construction noise limits for nighttime noise-sensitive receivers in proximity to the Viaduct demolition area. Nighttime noise-sensitive receivers are generally properties where people are sleeping, such as a residence. The next section contains information on the characteristics of noise and sound.

The proposed descriptors and noise limits for the Viaduct demolition are based on WSDOT and SDCI noise variance coordination efforts, and a review of prior SDCI decisions on MPPCNV applications from agencies such as WSDOT, Sound Transit and the Seattle Department of Transportation. In each of these cases, SDCI granted variances with an increase of average hourly noise level limits ranging from 6 dBA up to 15 dBA over measured existing baseline nighttime noise levels.

For nighttime noise levels for the majority of the year, the Viaduct demolition noise variance application proposes a 6 dBA increase over existing hourly average noise levels (L_{eq}) measured during the quietest part of the nighttime hours (the five-hour period from 12 a.m. to 5 a.m.).

Although these proposed noise level limits are based on measurements during only the quietest nighttime hours, the proposed limits would apply to the operation of construction equipment during all nighttime hours, from 10 p.m. to 7 a.m. on weekdays and 10 p.m. and 9 a.m. on weekends and legal holidays. Demolition of the Seneca and Columbia Ramps requires higher noise levels due to building access constraints, and the nighttime noise level limits would need to be increased by an additional 10 dBA for up to 7 days to complete the necessary nighttime work.

During daytime hours, WSDOT also requests that this MPPCNV allow impact work, including equipment such as impact hammers, and jack hammers, to occur between 7 a.m. and 10 p.m. in addition to regular daytime hours of 8 a.m. and 5 p.m. on weekdays and 9 a.m. and 5 p.m. on weekends and legal holidays as provided in SMC 25.08.425.C.

Continuous monitoring and recording of A-weighted sound levels was conducted at seven sites (Exhibit 4). Measurements were taken which comply with American National Standards Institute S1.4 for instrument accuracy. All sound level monitoring equipment was calibrated before and after each measurement. In addition, the noise meters are calibrated annually by an accredited laboratory. Sound levels measured during the late-night hours (12 a.m. to 5 a.m.) provide the most conservative representation of the existing baseline condition. Noise measurement sites were selected based on their proximity to construction activities and availability.

The measured existing nighttime sound levels exceed the City of Seattle nighttime noise control ordinance limits of 45 dBA (L_{eq}) at residential locations and 60 dBA (L_{eq}) at commercial locations. The existing sound levels, which are produced primarily by traffic on public roads, are not subject to the limits of the ordinance (SMC 25.08.410-425). The comparison is presented in Exhibit 5 as a baseline for evaluating potential noise impacts from proposed construction activities.

The noise variance application also proposes a highest 1 percent maximum noise level limit above the nighttime L_{eq} to monitor potential short-term noises. Hourly percentile sound levels, Ln, are the sound levels exceeded for “n” percent of an hour. The L_1 is the sound level exceeded for 1 percent of the measurement duration (i.e., 36 seconds per hour). The proposed L_1 limits are 10 dBA above the L_{eq} noise level limit with a maximum upper limit of 80 dBA in residential areas and 85 dBA in commercial areas, which is the City’s daytime construction hourly L_{eq} noise level limit at residentially and commercially zoned receivers without the impact noise increases.

Exhibit 4. Construction Area and Noise Measurement Locations

Exhibit 5. Measured Hourly Average Baseline Noise Levels and Proposed Exterior Nighttime Noise Level Limits

Site	Zoned Land Use	Measured 12 to 5 AM Log Hourly Average L_{eq} (dBA)	Proposed Nighttime Noise Level Hourly Average Limit L_{eq}/L_1 (dBA)	Proposed Daytime Noise Level Hourly Limit L_{eq}/L_1 (dBA)
1	Residential	65	71/80	90/99
2	Commercial	69	75/85	90/99
3	Commercial	66	72/82*	90/99
4	Commercial	68	74/84*	90/99
5	Commercial	79	85/85	90/99
6	Commercial	67	73/83	90/99
7	Commercial	67	73/83	90/99

*Nighttime noise level limits would be increased by 10 dBA at Site 3 and 4 during Seneca and Columbia Ramp demolition for up to 7 days for each location. During the 7 days, noise level limits would be 82/92 at Site 3 and 84/94 at Site 4.

In addition to the L_{eq}, this noise variance application proposes to track compliance with the terms set by the MPPCNV by monitoring the measured hourly L_1 sound level. The L_1 has been found to be more reliable than the L_{max}, as stated in the Denny Substation Program Noise Monitoring and Mitigation Plan, revised February 11, 2015:

> *For the purpose of monitoring construction sound levels, the hourly L_1 has been found to be more reliable than the hourly L_{max} in tracking compliance with MPPCNV limits. As with the L_{max}, the hourly L_1 provides a representative measure of the worst-case sound levels produced by a construction activity; unlike the L_{max}, the L_1 is not susceptible to distortion by one-time, atypical events such as a tool or load being dropped, and it is more representative of sound levels produced during higher-intensity construction activities each hour.*

Noise measurements at four sites were taken in June, July and August 2017. The sites listed below were identified as representing nighttime noise-sensitive receivers near the Viaduct demolition. The Elliott Pointe Apartments were in a residential zone. The other sites are in commercial zones.

- Site 1 – Elliott Pointe Apartments
- Site 2 – Waterfront Landings Condominiums
- Site 3 – 1201 Western Avenue
- Site 4 – 815 Western Avenue

In addition to the noise measurements taken above, SDCI approved on April 6, 2017 an extension of the SR 99 Bored Tunnel Alternative MPPCNV. This application proposes that the same baseline noise measurements and noise levels limits in the south portal vicinity be used,

to eliminate any additional nighttime construction occurring as part of the 2017 SR 99 Bored Tunnel Alternative MPPCNV. These sites are in commercial zones.

- Site 5 –Compass Center, 210 Alaskan Way S.
- Site 6 – Our Home Hotel Condominiums, 75 S Main
- Site 7 – Triangle Building, 553 First Avenue S

Public health and safety

SDCI's decision on the Sound Transit project at 6600 Roosevelt Way NE includes the following assessment of noise levels related to public health and safety:

> *It is generally accepted that very high levels of noise have adverse physical impacts on humans including, but not limited to, hearing damage. Many standards apply to occupational exposures at high levels for prolonged periods of time. For example, the Occupational Safety and Health Act mandates a hearing conservation program by employers if sound levels exceed 85 dBA continuously over an 8-hour workday. If sound levels exceed 90 dBA continuously over an 8-hour workday, hearing protection is required.*

The proposed nighttime noise level limits anticipated by this MPPCNV application would maintain sound levels below these identified levels, as shown in Exhibit 5. The 6 dBA increases from on-site nighttime project noise levels that are requested for the majority of the construction activities and the resulting noise levels will likely be noticed by some residents, but would not cause a danger to public health or safety.

5. Characteristics of Sound and Noise

5.1 Definition of Sound

Sound is created when objects vibrate, resulting in a minute variation in surrounding atmospheric pressure, called sound pressure. The human response to sound depends on the magnitude of a sound as a function of its frequency and time pattern. Magnitude is a measure of the physical sound energy in the air. The range of magnitude the ear can hear, from the faintest to the loudest sound, is so large that sound pressure is expressed on a logarithmic scale in units called decibels (dB). Loudness refers to how people subjectively judge a sound and varies between people.

Sound is measured using the logarithmic decibel scale, so doubling the number of noise sources, such as the number of cars on a roadway, increases noise levels by 3 dBA. Therefore, when you combine two noise sources emitting 60 dBA, the combined noise level is 63 dBA, not 120 dBA. The human ear can barely perceive a 3 dBA increase, while a 5 dBA increase is about one and one-half times as loud. A 10-dBA increase appears to be a doubling in noise level to most listeners. A tenfold increase in the number of noise sources will add 10 dBA.

In addition to magnitude, humans also respond to a sound's frequency or pitch. The human ear is very effective at perceiving frequencies between 1,000 and 5,000 hertz (Hz), with less efficiency outside this range. Environmental noise is composed of many frequencies. A-weighting (dBA) of sound levels is applied electronically by a sound level meter and combines the many frequencies into one sound level that simulates how an average person hears sounds of low to moderate magnitude.

The smallest "just noticeable" increase in sound is about 3 dBA. A 6 dBA increase is clearly noticeable, and a 10 dBA increase causes a doubling of judged loudness. For example, 80 dBA is judged to be twice as loud as 70 dBA and four times as loud as 60 dBA. Exhibit 6 summarizes how increases in perceived loudness correlate with sound level increases.

Exhibit 6. Perceived Loudness Increases

Sound Level Increase (dBA)	Perceived Loudness Increase
0 to 2	Not noticeable
3	Just noticeable
6	Noticeable
10	Twice as loud
20	Four times as loud

5.1.1 Definition of Noise

Noise is unwanted or unpleasant sound. Noise is a subjective term because, as described above, sound levels are perceived differently by different people. Magnitudes of typical noise levels are presented in Exhibit 7.

Exhibit 7. Typical Noise Levels

NOISE SOURCE OR ACTIVITY		SUBJECTIVE IMPRESSION	RELATIVE LOUDNESS (human judgment of different sound levels)
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain	64 times as loud
50-horsepower siren (100 feet)	130		32 times as loud
Loud rock concert near stage Jet takeoff (200 feet)	120	Uncomfortably loud	16 times as loud
Float plane takeoff (100 feet)	110		8 times as loud
Jet takeoff (2,000 feet)	100	Very loud	4 times as loud
Heavy truck or motorcycle (25 feet)*	90		2 times as loud
Garbage disposal (2 feet) **Pneumatic drill (50 feet)**	80	**Moderately loud**	**Reference loudness**
Vacuum cleaner (10 feet) Passenger car at 65 mph (25 feet)*	70		1/2 as loud
Typical office environment	60		1/4 as loud
Light auto traffic (100 feet)*	50	Quiet	1/8 as loud
Bedroom or quiet living room Bird calls	40		1/16 as loud
Quiet library, soft whisper (15 feet)	30	Very quiet	
High quality recording studio	20		
Acoustic test chamber	10	Just audible	
	0	Threshold of hearing	

5.1.2 Noise Level Descriptors

Because sound levels fluctuate over time, several A-weighted sound level descriptors are used to characterize the sound.

The L_{eq} is a measure of the average noise level during a specified period of time. A one-hour period, or hourly L_{eq}, is used to measure construction noise. L_{eq} is a measure of total noise during a time period that places more emphasis on occasional high noise levels that accompany general background noise levels. For example, if you have two different sounds, and one contains twice as much energy, but lasts only half as long as the other, the two would have the same L_{eq} noise levels.

Either the total noise energy or the highest instantaneous noise level can describe short-term noise levels. L_{max} is the maximum sound level that occurs during a single event and is related to impacts on speech interference and sleep disruption.

With Ln, "n" is the percent of time that a sound level is exceeded and is used to describe the range and pattern of sound levels experienced during the measurement period. For example, the L_1 level is the noise level that is exceeded 1 percent of the time. Sound varies in the environment and people will generally find a higher, but constant, sound level more tolerable than a quiet background level interrupted by higher sound level events. For example, steady traffic noise from a highway is normally less bothersome than occasional aircraft flyovers in an otherwise quiet area if both environments have the same L_{eq}.

6. City of Seattle Noise Control Ordinance

The City of Seattle limits noise levels at property lines of neighboring properties (Seattle Noise Control Ordinance, SMC 25.08.410). The sound level limit depends on the land uses of both the noise source and the receiving property (Exhibit 8). The project area and the surrounding properties are zoned residential, commercial and industrial. The City's sound level limits apply to construction activities occurring between 10 p.m. and 7 a.m. on weekdays or 10 p.m. and 9 a.m. on weekends and legal holidays. Legal holidays are defined in SMC 25.08.155 as New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and the day after, and Christmas Day. Construction activities during nighttime hours that would exceed these levels require a noise variance from the City.

Exhibit 8. Seattle Noise Control Ordinance – Exterior Sound Level Limits

District of Sound Source	District of Receiving Property			
	Residential Daytime L_{eq} (dBA)	Residential Nighttime L_{eq} (dBA)	Commercial L_{eq} (dBA)	Industrial L_{eq} (dBA)
Residential	55	45	57	60
Commercial	57	47	60	65
Industrial	60	50	65	70

Nighttime hours are 10 p.m. to 7 a.m. during weekdays and 10 p.m. to 9 a.m. during weekends and legal holidays
dBA = A-weighted decibels
L_{eq} = equivalent sound level
During a measurement interval, L_{max} may exceed the exterior sound level limits shown by no more than 15 dBA.

6.1 Exceptions to the Seattle Noise Control Ordinance

6.1.1 Daytime Noise

Noise levels shown in Exhibit 8 may be exceeded by construction equipment between 7 a.m. and 10 p.m. on weekdays and between 9 a.m. and 10 p.m. on weekends and legal holidays. Threshold levels for equipment are listed below:

> *25 A-weighted decibels (dBA) for equipment on construction sites, including but not limited to, crawlers, tractors, dozers, rotary drills and augers, loaders, power shovels, cranes, derricks, graders, off-highway trucks, ditchers, trenchers, compactors, compressors, derrick barges, tug boats, and pneumatic-powered equipment*

Daytime construction activities are allowed to exceed the noise-level limits in the Seattle Noise Control Ordinance (SMC 25.08.425) (Exhibit 8). These levels should be measured from the real property of another person or at a distance of 50 feet from the equipment, whichever is greater. Construction activities for the Viaduct demolition would occur in residential and commercial districts.

6.1.2 Impact Type Noise

In addition, the Seattle Noise Control Ordinance (SMC 25.08.425) regulates sound created by impact types of construction equipment (e.g., pavement breakers, pile drivers, jackhammers, and sandblasting tools) or those that otherwise create impulse or impact noise (as measured at the property line or 50 feet from the equipment, whichever is greater). The equipment may exceed the sound level limits (equivalent sound level [L_{eq}] described in Exhibit 8) in any 1-hour period between 8 a.m. and 5 p.m. on weekdays and 9 a.m. and 5 p.m. on weekends and legal holidays. The sound level is in no event to exceed the following:

- L_{eq} = 90 dBA continuously
- L_{eq} = 93 dBA for 30 minutes
- L_{eq} = 96 dBA for 15 minutes
- L_{eq} = 99 dBA for 7.5 minutes

Sound levels in excess of L_{eq} = 99 dBA are prohibited unless authorized by variance. The standard of measurement is a 1-hour L_{eq} measured for time periods not less than 1 minute in order to project an hourly L_{eq}.

6.2 Proposed Daytime Noise Level Limits

WSDOT requests that this MPPCNV allow impact work noise level limits of SMC 25.08.425, including equipment such as pile drivers, impact hammers, and jack hammers, to occur between 7 a.m. and 10 p.m. in addition to regular daytime hours of 8 a.m. and 5 p.m. on weekdays and 9 a.m. and 5 p.m. on weekends and legal holidays as provided in SMC 25.08.425.C.

6.3 Proposed Nighttime Noise Level Limits

Noise level limits were established in the previous section, WSDOT Compliance with City of Seattle Criteria for a Major Public Project Construction Noise Variance. This noise variance application proposes a 6 dBA increase over existing hourly average noise levels (L_{eq}) measured during the quietest part of the nighttime hours (the five-hour period from 12 a.m. to 5 a.m.). The proposed L_1 limits are 10 dBA above the L_{eq} noise level limit with a maximum upper limit of 80 dBA in residentially zoned and 85 dBA in commercially zoned areas, which is the City's daytime construction hourly L_{eq} noise level limit at residentially and commercially zoned receivers. Demolition of the Seneca and Columbia Ramps requires higher noise levels due to building access constraints, and the nighttime noise level limits would need to be increased by an additional 10 dBA for up to 7 days for each Ramp to complete the necessary nighttime work.

7. Noise Management and Mitigation Plan

This section provides a summary of the NMMP in Attachment 1 and summarizes a noise analysis for the expected construction activities of the Viaduct demolition. This section was prepared according to the requirements of Section 25.08.655 of the Seattle Municipal Code and Director's Rule DR3-2009, both pertaining to Major Public Project Construction Noise Variances from the City of Seattle Noise Code.

WSDOT has developed expected construction activities and a schedule for the Viaduct demolition. The analysis in this NMMP section demonstrates that means and methods are available to meet the noise limits requested in this MPPCNV. The contractor will propose their own construction activities and schedule, and create a detailed NMMP to meet the commitments WSDOT has made in this noise variance application and the MPPCNV issued by SDCI. Construction activities and equipment used may not be specifically identical but are likely to be similar to those identified by WSDOT, and will be required to comply with the same noise level limits.

7.1 Expected Noisiest Nighttime Construction Periods

Projected nighttime major construction L_{eq} and L_1 noise levels were modeled for selected noise-sensitive receivers using SoundPLAN Version 7.4, a three-dimensional graphics-oriented program for outdoor noise propagation. SoundPLAN calculates the L_{eq} by averaging the use of each individual piece of equipment and evenly distributes the activity over an hour. SoundPLAN calculates the L_1 using the loudest 1 percent same hour as used to calculate the L_{eq}. The L_1 results from SoundPLAN are an additional 10 dBA over the L_{eq}, this is a conservative high level estimate for the L_1. For nighttime construction noise estimates, the noisiest nighttime construction activity that would occur at the surface of each construction site and the noisiest equipment during this activity was assumed.

The noisiest major construction activities were modeled to provide a conservative estimate of noise levels. A variety of construction activities are anticipated to occur within the footprint of the Viaduct demolition, potentially using the equipment outlined in Exhibit 9. Construction noise includes truck operations within the construction site and not on haul routes. Haul routes are not regulated under the Seattle Noise Control Ordinance and therefore are not included in this application.

Major construction activities that are expected to be the loudest during the project were modeled for construction periods to estimate the anticipated highest construction noise levels.

Exhibit 9. Modeled Nighttime Demolition Equipment Noise Levels

Equipment Type	Typical Noise Level (dBA) at 50 Feet
Loader	79
Concrete Saw	90
Crawler crane	83
Dump or Debris truck	88
Excavator with crusher	96
Excavator with thumb	96
Excavator with Impact hammer	101
Excavator with Concrete Cracker	101
Hydraulic crane	81
Flat Bed Truck	74
Man Lift	68

Source: August 2006 FHWA Construction Noise Handbook, Section 9: https://www.fhwa.dot.gov/Environment/noise/construction_noise/handbook/

Construction during other phases of work would generate less noise than those selected for noise modeling. The modeled levels represent the loudest nighttime construction activities that are anticipated over the construction period.

The noise levels for the expected loudest construction periods are described in the following subsections. Each subsection lists the number and type of construction equipment modeled to estimate the expected highest nighttime construction noise levels.

7.2 Modeled Noise Levels

Projected nighttime major construction L_{eq} and L_1 noise levels were modeled for noise-sensitive receivers and were reported at the closest location to the demolition activities. Because the demolition is transient along the Viaduct alignment, modeled noise levels were also report 200 feet along the alignment from the loudest equipment.

8. WSDOT Noise Modeling Summary

8.1 Viaduct Demolition – Mainline Demolition

Mainline demolition would occur in commercially zoned areas. Noise levels were modeled at Spring Street and are representative of mainline demolition activities throughout the corridor. The highest modeled exterior noise levels experienced at buildings closest to the Viaduct during demolition of the mainline in Exhibit 10. This area was modeled to represent the typical daytime and nighttime noise levels that would be experienced along the entire corridor for this type of work.

The deck will be hammered out with the use of excavators and hammers and the inside beams will be cut up with a concrete cracker. The footings will be hammered and the debris will be loaded out. Equipment during daytime hours (from 7 a.m. to 10 p.m.) used was estimated to include:

- Deck hammered out: two excavators with impact hammers,
- Removal of the large beams and columns: two excavators with impact hammers
- Removal of inside beams on the east side: one crane with concrete cracker
- Removal of Footings: two excavators with impact hammers
- Load out: two excavators with bucket and thumb and two dump trucks

Equipment during nighttime hours (from 10 p.m. to 7 a.m.) used was estimated to include:

- Load out: two excavators with bucket and thumb and two dump trucks

Exhibit 10. Exterior Noise Levels for Mainline Demolition

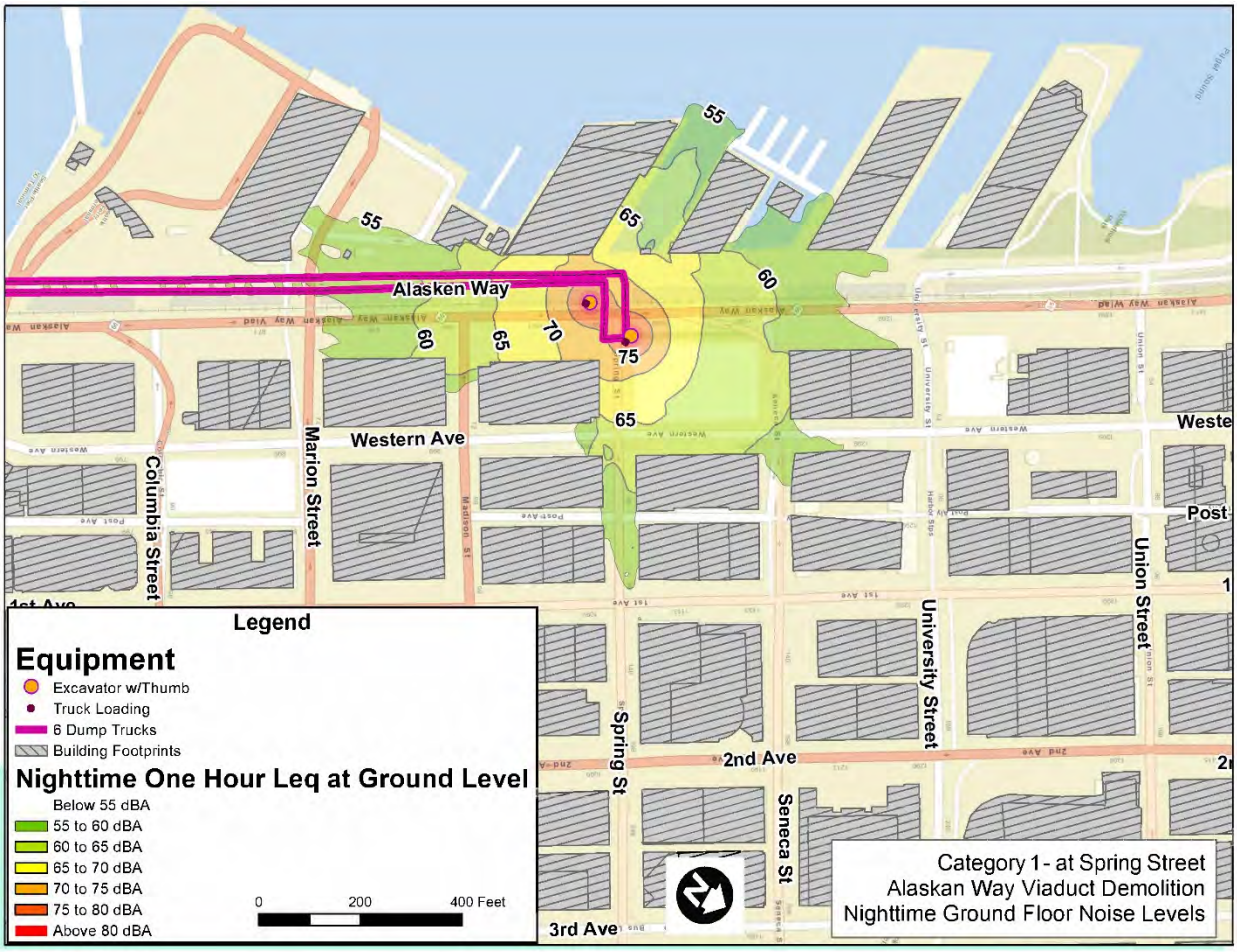
Site	L_{eq} Modeled Noise Level (dBA)	Sites 2 to 7 L_{eq} Commercially Zoned Noise Level Limit Range (dBA)	L_1 Modeled Noise Levels (dBA)	Sites 2 to 7 L_1 Commercially Zoned Noise Level Limit Range (dBA)
Daytime				
Maximum Noise level modeled	82	90	92	99
200 feet north of maximum	75	90	85	99
200 feet south of maximum	75	90	85	99
Nighttime				
Maximum Noise level modeled	72	72 to 85*	82	82 to 85
200 feet north of maximum	64	72 to 85*	74	82 to 85
200 feet south of maximum	64	72 to 85*	74	82 to 85

Note: *L_{eq} Noise level limits range from 72 dBA to 85 dBA and L_1 range from 82 to 85 for Sites 2, 3, 4, 5, 6, and 7.

Demolition noise levels would meet the proposed daytime and nighttime Leq noise level limits in the commercially zoned areas (Exhibit 11 and Exhibit 12).

Exhibit 11. Daytime Viaduct Mainline Demolition Noise Levels

Exhibit 12. Nighttime Viaduct Mainline Demolition Noise Levels



8.2 Viaduct Demolition Over Railroad Tracks

Viaduct demolition over the railroad tracks would occur in commercially zoned areas. Noise levels were modeled over the railroad tracks near the Waterfront Landings Condominiums. The highest modeled exterior noise levels experienced at buildings closest to the Viaduct during demolition are shown in Exhibit 13. BNSF railway has indicated that they would only allow work windows over the railroad tracks in the middle of the night, when train traffic is low. Due these restrictions, WSDOT is allowed only to work during nighttime hours over the railroad. Demolition is allowed to occur between 1 a.m. and 4 a.m. on Saturdays, Sundays and Mondays.

Over the railroad tracks, the deck will be saw cut into sections, the sections will be rigged and loaded onto trucks. Equipment during daytime hours and nighttime hours:

- Deck removed: six concrete saws, excavator, two man lifts, and one crane
- Load out: four flatbed trucks

Exhibit 13. Viaduct Demolition Over Railroad Tracks Modeled Noise Levels

Site	L_{eq} Modeled Noise Level (dBA)	Site 2 L_{eq} Commercially Zoned Noise Level Limit Range (dBA)	L_1 Modeled Noise Levels (dBA)	Site 2 L_1 Commercially Zoned Noise Level Limit Range (dBA)
Nighttime without mitigation				
Maximum Noise level modeled	78	75	88	85
200 feet north of maximum	75	75	85	85
200 feet south of maximum	75	75	85	85
Nighttime with mitigation				
Maximum Noise level modeled	71	75	81	85
200 feet north of maximum	69	75	79	85
200 feet south of maximum	69	75	79	85

Demolition noise levels would meet the proposed daytime Leq noise level limits, but would exceed the nighttime Leq noise level limits. Nighttime noise levels were modeled using with mitigation, the mitigation is reducing the point source noise emission by 10 dB, with a better muffler. The muffler can affect the performance of the equipment, so it is not used during the daytime or on equipment that goes on public roadways. Exhibit 14 shows the modeled noise levels for the nighttime with mitigation.

Exhibit 14. Viaduct Demolition Over Railroad Tracks Modeled Noise Levels with Mitigation

8.3 Viaduct Demolition within 100 Feet North of Railroad Tracks

Viaduct demolition within 100 feet north of the railroad tracks would occur in commercially zoned areas. Noise levels were modeled over the railroad tracks near the Waterfront Landings Condominiums. The highest modeled exterior noise levels experienced at buildings closest to the Viaduct during demolition are shown in Exhibit 15. BNSF railway has indicated that they would only allow work windows over the railroad tracks in the middle of the night, when train traffic is low. Due these restrictions, WSDOT is allowed only to work during nighttime hours over the railroad. Demolition is allowed to occur between 1 a.m. and 4 a.m. on Saturdays, Sundays and Mondays. WSDOT expects a total of 12 nights would be needed to complete this work over a period of one month.

Within 100 feet north of the railroad tracks, the deck will be hammered out with the use of excavators and hammers and the steel beams will be cut up with a concrete cracker. The debris will be loaded out. Equipment expected to be used include:

- Three excavators with impact hammers,
- One crane with concrete cracker
- Load out: two excavators with bucket and thumb and two dump trucks

Exhibit 15. Viaduct Demolition within 100 Feet North of Railroad Tracks Modeled Noise Levels

Site	L_{eq} Modeled Noise Level (dBA)	Site 2 L_{eq} Commercially Zoned Noise Level Limit Range (dBA)	L_1 Modeled Noise Levels (dBA)	Site 2 L_1 Commercially Zoned Noise Level Limit Range (dBA)
Nighttime without mitigation				
Maximum Noise level modeled	81	75	84	85
200 feet north of maximum	76	75	78	85
200 feet south of maximum	76	75	78	85
Nighttime with mitigation				
Maximum Noise level modeled	72	75	74	85
200 feet north of maximum	66	75	69	85
200 feet south of maximum	66	75	69	85

Demolition noise levels would meet the proposed daytime Leq noise level limits, but would exceed the nighttime Leq noise level limits. Nighttime noise levels were modeled using with mitigation, the mitigation is reducing the point source noise emission by 10 dB, with a better muffler. The muffler can affect the performance of the equipment, so it is not used during the daytime or on equipment that goes on public roadways. Exhibit 16 shows the modeled noise levels for the nighttime with mitigation.

Exhibit 16. Viaduct Demolition within 100 Feet North of Railroad Tracks Modeled Noise Levels with Mitigation

8.4 North End Demolition from Railroad Tracks to Battery Street Tunnel

Viaduct demolition from the railroad tracks to the Battery Street Tunnel would occur in a residentially zoned area. Noise levels were modeled near the Elliott Pointe Apartments. The highest modeled exterior noise levels experienced at buildings closest to the Viaduct during demolition are shown in Exhibit 17.

The Viaduct in this area will use excavators with hammers and concrete crackers, and the debris will be loaded out. Equipment used during daytime hours (from 7 a.m. to 10 p.m.) was estimated to include:

- Demolition of the Viaduct: three excavators with impact hammers, three excavators with concrete crackers
- Load out: three excavators with bucket and thumb and five dump trucks

Equipment during nighttime hours (from 10 p.m. to 7 a.m.) used was estimated to include:

- Load out: three excavators with bucket and thumb and five dump trucks

Exhibit 17. Exterior Noise Levels from Demolition from Railroad Tracks to Battery Street Tunnel

Site	L_{eq} Modeled Noise Level (dBA)	Site 1 L_{eq} Residentially Zoned Noise Level Limit Range (dBA)	L_1 Modeled Noise Levels (dBA)	Site 1 L_1 Residentially Zoned Noise Level Limit Range (dBA)
Daytime without mitigation				
Maximum Noise level modeled	94	90	104	99
200 feet north of maximum	80	90	90	99
200 feet south of maximum	80	90	90	99
Daytime with mitigation				
Maximum Noise level modeled	88	90	98	99
200 feet north of maximum	76	90	86	99
200 feet south of maximum	76	90	86	99
Nighttime without mitigation				
Maximum Noise level modeled	69	71	79	81
200 feet north of maximum	62	71	72	81
200 feet south of maximum	62	71	72	81

Demolition noise levels would not meet the proposed daytime and nighttime Leq noise level limits. Daytime noise levels were modeled using with mitigation, the mitigation is reducing the point source noise emission by 10 dB, with a better muffler. Exhibit 18 and Exhibit 19 show the modeled noise levels for the daytime with mitigation and nighttime.

Exhibit 18. Daytime Demolition from Railroad Tracks to Battery Street Tunnel Daytime Noise Levels with Mitigation

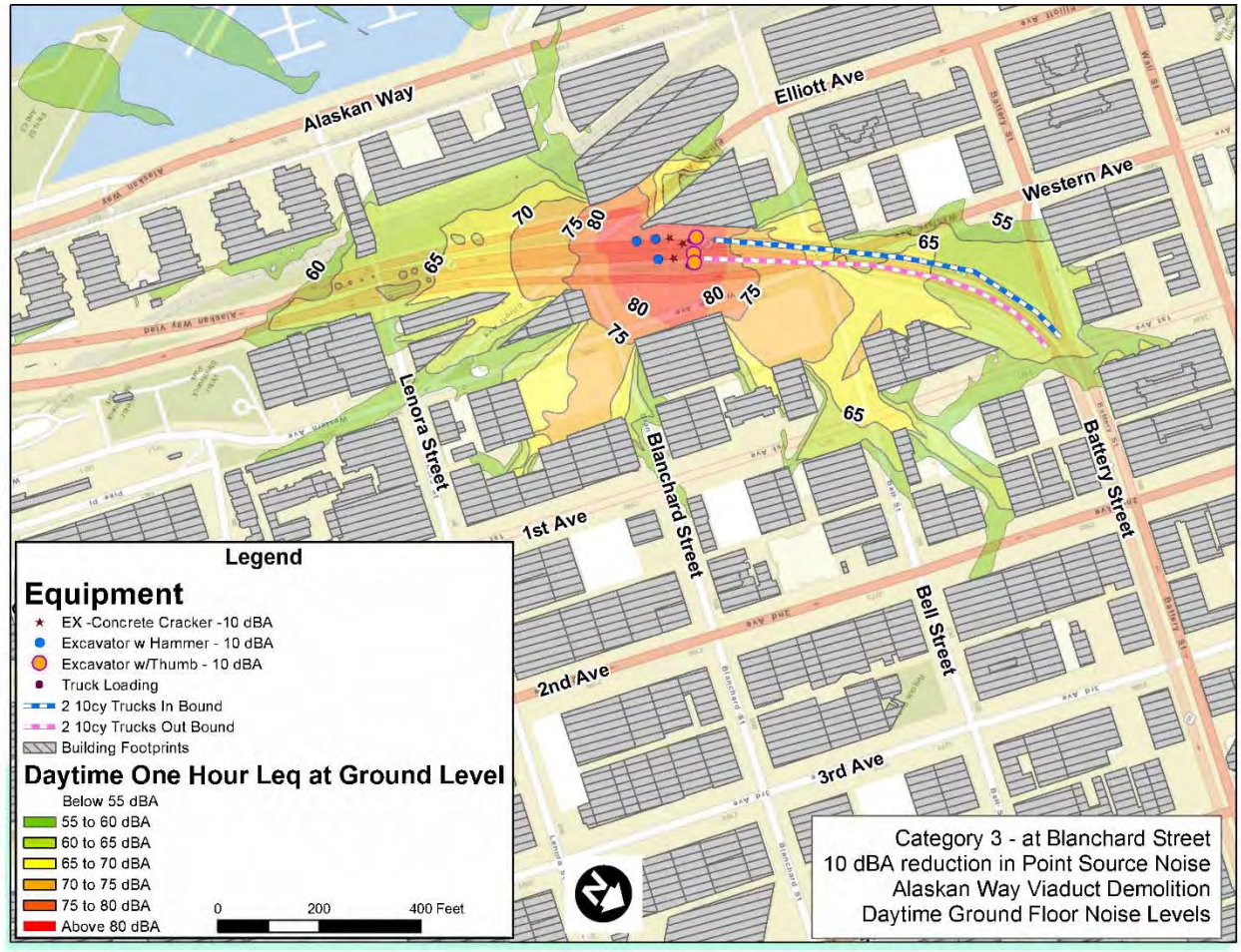
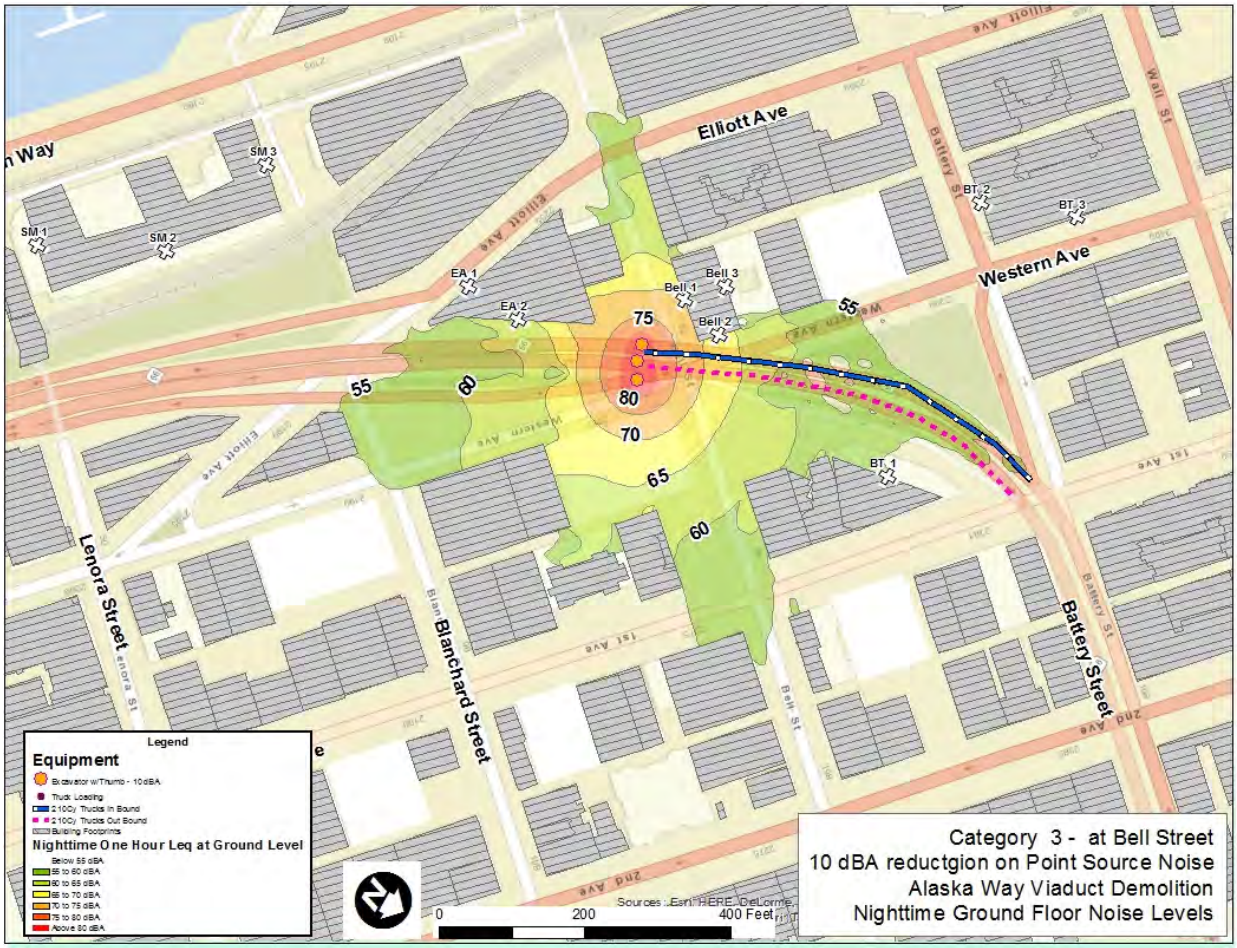


Exhibit 19. Nighttime Demolition from Railroad Tracks to Battery Street Tunnel Daytime Noise Levels with Mitigation



8.5 Seneca and Columbia Ramps Demolition

Seneca and Columbia Ramps demolition would occur in a commercially zoned area and highest nighttime noise levels would occur during a maximum of 7 days. The highest modeled exterior noise levels experienced at buildings closest to the Viaduct during demolition are shown in Exhibit 20. Due to restrictions from working near buildings and to keep access restriction to a minimum, the daytime and nighttime hours would use the same equipment.

For the Seneca and Columbia Ramps, the bridge decks would be saw cut and lifted out by crane and loaded onto flatbed trucks. There would be very limited impact work, the bridge diaphragms would be removed with impact hammers. Debris will be loaded out. Equipment during daytime hours and nighttime hours:

- Demolition of the Ramp: one crane, six concrete saws, one excavator with concrete cracker and one excavator with impact hammer
- Load out: three flatbed semi-trucks and two dump trucks

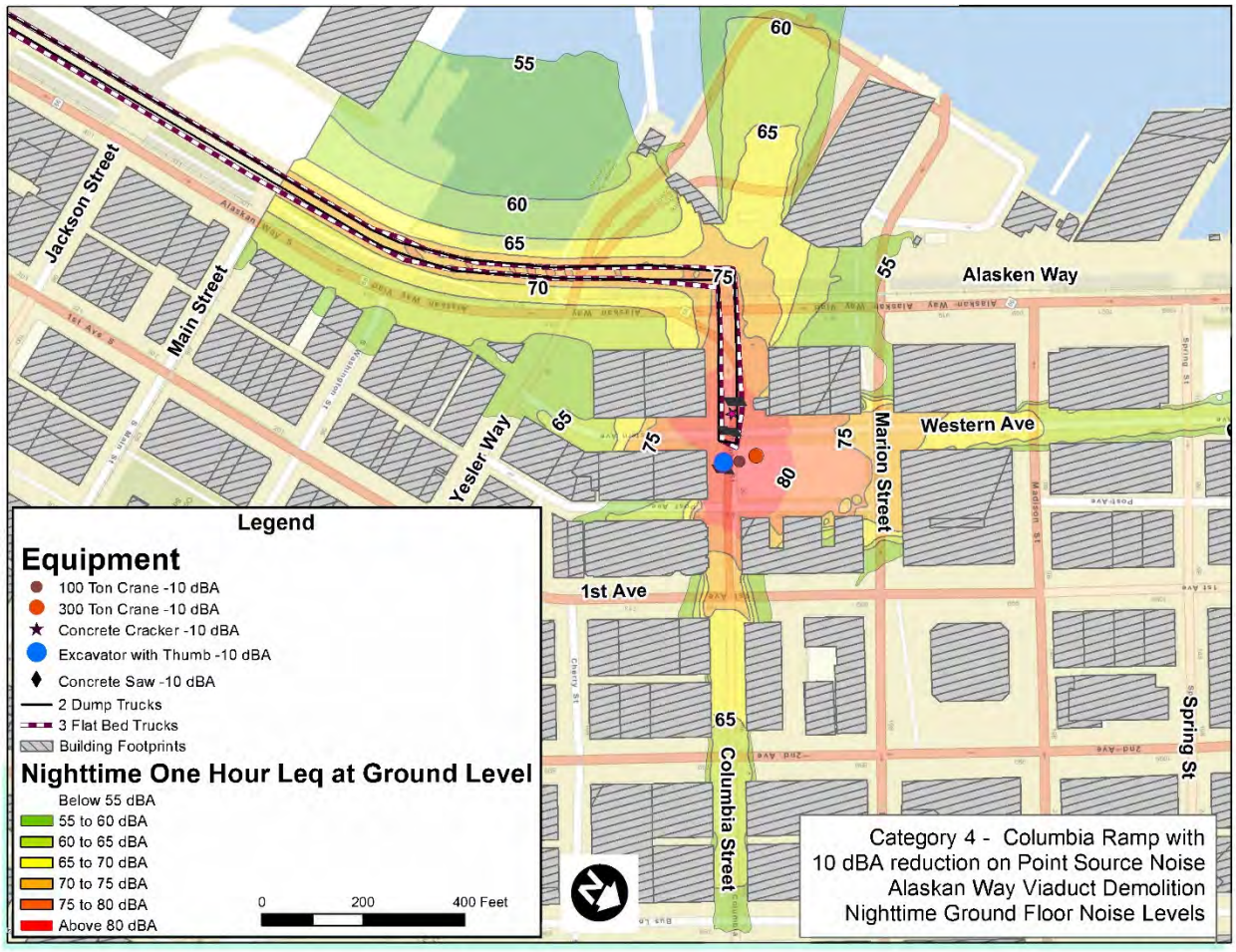
Exhibit 20. Seneca and Columbia Ramps Demolition Modeled Noise Levels

Site	L_{eq} Modeled Noise Level (dBA)	Site 3 and Site 4 L_{eq} Commercially Zoned near ramps Noise Level Limit Range (dBA)	L_1 Modeled Noise Levels (dBA)	Site 3 and Site 4 L_1 Commercially Zoned near ramps Noise Level Limit Range (dBA)
Daytime				
Maximum Noise level modeled	86	90	96	99
200 feet east of maximum	78	90	88	99
200 feet west of maximum	78	90	88	99
Nighttime without mitigation				
Maximum Noise level modeled	86	82 at Seneca 84 at Columbia	96	92 at Seneca 94 at Columbia
200 feet east of maximum	78	82 at Seneca 84 at Columbia	88	92 at Seneca 94 at Columbia
200 feet west of maximum	78	82 at Seneca 84 at Columbia	88	92 at Seneca 94 at Columbia
Nighttime with muffler mitigation				
Maximum Noise level modeled	82	82 at Seneca 84 at Columbia	92	92 at Seneca 94 at Columbia
200 feet east of maximum	78	82 at Seneca 84 at Columbia	88	92 at Seneca 94 at Columbia
200 feet west of maximum	78	82 at Seneca 84 at Columbia	88	92 at Seneca 94 at Columbia

Demolition noise levels would meet the proposed daytime and temporary 7 day nighttime Leq noise level limits for Seneca and Columbia Ramp demolition. Nighttime noise levels were modeled using with mitigation, the mitigation is reducing the point source noise emission by 10 dB, with a better muffler. Exhibit 21 and Exhibit 22 show the modeled noise levels for the daytime and nighttime with mitigation.

Exhibit 21. Seneca Ramp Demolition Nighttime Noise Level Contours with Mitigation

Exhibit 22. Columbia Ramp Demolition Noise Level Contours with Mitigation



9. Proposed Noise Mitigation Measures

9.1 Required Minimum Mitigation Measures

The contractor will perform the following minimum mitigation measures to minimize nighttime construction noise, except in the case of emergency, as defined by the Seattle Noise Control Ordinance (SMC 25.08.110), whenever the contractors work between 10 p.m. and 7 a.m. Monday through Friday, or between 10 p.m. and 9 a.m. Saturday through Sunday and legal holidays, and exceeds the local ordinance noise levels:

- The contractor will meet the noise levels limits established in the noise variance.
- The contractor will use broadband or strobe backup warning devices, or use backup observers in lieu of backup warning devices for all equipment, in compliance with Washington Administration Code, Sections 296-155-610 and 296-155-615. For dump trucks, if the surrounding noise level is so loud that broadband or strobe backup warning devices are not effective, then an observer must be used (WAC 296-155-610). This condition will apply to activity conducted between 10 p.m. and 7 a.m., Monday through Friday, and between 10 p.m. and 9 a.m. on Saturday, Sunday, and legal holidays. No pure-tone backup warning devices will be used after 10 p.m. and before 7 a.m. weekdays or 9 a.m. weekends and legal holidays.
- The contractor will use better mufflers and will reduce the point source noise emission by 10 dB for equipment to reduce noise levels to meet the noise levels limits established in the noise variance when needed and during temporary 7 day nighttime Leq noise level limits for Seneca and Columbia Ramp demolition.
- The contractor will securely fasten truck tailgates.
- The contractor will not use compression brakes.
- The contractor will not leave equipment to idle for longer than five minutes,

9.2 Additional Noise-control Measures

The contractor will submit to WSDOT an updated NMMP to reflect their specific construction means and methods and will detail the additional mitigation measures needed to meet the noise level limits established in the noise variance. Once WSDOT has reviewed and accepted the NMMP, the contractor will submit it to SDCI. Additional mitigation measures that the contractor could also use as necessary are listed below:

- Equip nighttime surface equipment with high-grade engine-exhaust silencers and engine-casing sound insulation.

- Use electric welders powered from utility main lines instead of gas, diesel, or internal combustion generators/welders.
- Use critical or double mufflers where practicable on machinery for off-road use, such as cranes.
- Use noise blankets, skirts, or other available means for mobile equipment to mitigate noise that does not unreasonably interfere with the operation of the engine.
- Use temporary mobile noise barriers in the immediate vicinity of loud activities nearby residences.
- Use temporary noise barriers.
- Provide earplugs and white noise machines to residents near the project area.
- Install temporary sound dampening drapes for residents.
- Provide hotel rooms for residents during high impact or extremely noisy operations.

9.3 Compliance Monitoring and Reporting

Director's Rule 3-2009, Section C.2, requires that WSDOT provide for an Independent Noise Monitor (INM), who may be an individual, firm, or contracted staff member within SDCI independent from the contractor whose responsibility is to oversee the monitoring of sound levels from construction covered by the MPPCNV and to report directly to the SDCI Coordinator for Noise Abatement. WSDOT plans to dedicate the resources needed to have a WSDOT trained inspector on-site to perform the duties of the INM.

The contractor will update the Noise Monitoring Plan based on the NMMP submitted by WSDOT. The contractor will take noise measurements continuously during nighttime hours using automated noise monitoring equipment that is consistent with the American National Standards Institute Standards to Type 1 and that allows for remote access to real time results available to SDCI, WSDOT, and the contractor. The noise monitoring equipment will have the capability to log continuous L_{eq} and L_1 sound levels and to initiate a recording of audio files when the L_{eq} or L_1 sound-level thresholds are exceeded. Sound level thresholds will be set at 5 dBA below the MPPCNV nighttime L_{eq} and L_1 noise levels limits. The Noise Monitoring Plan will identify the type and location of monitoring equipment, and will identify the INM. There will be a minimum of three noise monitoring stations placed at or near the residences affected by the Viaduct demolition when activities are occurring during nighttime hours. Generally, monitors will be placed at 3 locations near the activities, one at or near the building with sensitive nighttime uses such as residences or hotel rooms, one two hundred feet east and two hundred feet west of the loudest demolition activities. Monitors will be activated and relocated as

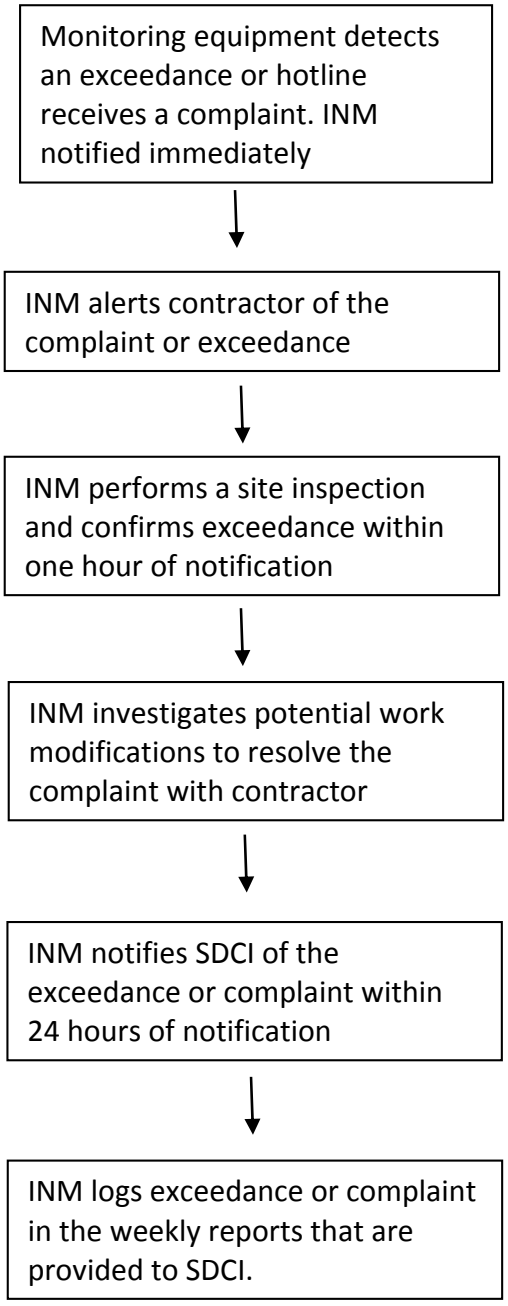
appropriate to provide data for the nearest affected residences when nighttime construction occurs.

If the monitoring equipment detects an exceedance of the MPPCNV nighttime noise level limits, or if a caller to the hotline has a noise-related complaint and requests additional information, the INM will be notified. The INM will be on-site during all periods of scheduled night work. If the INM receives a complaint call during nighttime work hours, the INM will notify the contractor and other WSDOT inspection staff on the job, perform a site inspection within 60 minutes of receiving the complaint, conduct short-term noise measurements (minimum 15 minutes per location) while on-site to confirm whether an exceedance of the MPPCNV sound-level limits is occurring, and investigate potential work modifications to resolve the complaint. INM's regular duties include, but are not limited to:

- Coordinating with WSDOT and contractor's night time crews about planned work operations.
- Coordinating with WSDOT Communications Team on any updates or concerns from neighborhood and residents.
- Coordinating with SDCI on any questions or concerns from the City regarding project noise.
- Conducting nightly verification of fixed noise monitoring stations with hand held noise monitor to validate noise monitoring results from the fixed locations.
- Conducting regular spot-check noise monitoring at various locations of the project site with hand held monitor.
- Addressing noise exceedances and monitoring alarms in the field.

The Noise Monitoring Plan will also include a provision to generate weekly and annual reports that are required as part of Director's Rule 3-2009. The reports will be provided to SDCI and will include any monitored L_{eq} and L_1 exceedances, noise complaints logged in the program database, and work modifications completed to resolve complaints. The reporting structure for noncompliance or a noise complaint is detailed in Exhibit 23. The weekly reports will be publicly available on-line.

Exhibit 23. Reporting Structure for Non-compliance



9.4 Public Outreach and Community Involvement

WSDOT believes public involvement is essential to a project's development and has implemented a comprehensive and ongoing public involvement program for the Alaskan Way Viaduct Replacement Program. During the Viaduct demolition, WSDOT's communications team, in coordination with the selected contractor, will provide up-to-date information on construction activities and construction noise to neighbors and stakeholders.

WSDOT will keep the public informed of construction activities, promote two-way communication with the community, and work to minimize construction impacts.

The key elements of the communications plan are outlined below.

9.4.1 Written Materials

WSDOT uses a variety of written materials to provide advance notification and keep people informed of construction activities. All written materials have program contact information, including the email address, website, and the 24-hour live telephone construction hotline number. Examples of these types of materials include:

- Fact sheets to provide background information for the type of work occurring and project benefits.
- Fliers which are often delivered door-to-door when there are localized construction impacts.
- Mailers which are sent to neighbors in compliance with permitting requirements.

In summer 2017, WSDOT conducted an extensive public outreach effort to share project information and solicit feedback from the public about early plans for viaduct demolition. More than 12,000 people visited an online open house, and 150 people attended an in-person open house on Aug. 10.

WSDOT received 410 responses to an eight-question survey about the demolition project. Eighty-four percent of respondents said they would prefer that some noisy work be allowed later at night if it means demolition will be completed sooner.

9.5 Online and Electronic Communications

WSDOT uses a combination of the following online and electronic communications to keep community members informed of upcoming and ongoing construction activities:

- WSDOT maintains an electronic mailing list, and regular e-mail updates are sent to provide status updates and information on current activities.
- The project website is updated regularly and provides the latest design and construction information.

- WSDOT collaborates with other agencies and organizations to provide information in their respective e-mail updates or websites.
- The 24-hour live telephone construction hotline will be maintained for the Viaduct demolition. Real-time responses to immediate concerns and updates of the project status and current construction activities and impacts will be provided.
- Detailed responses will be provided to emails received via the project e-mail address.

10. Conclusion

WSDOT is completing the application process for a nighttime noise variance because construction crews will work at night within the City of Seattle limits during the Viaduct demolition. Completion of all construction activities during only daytime hours would extend the construction period and increase the economic cost to taxpayers. Since evening impact and nighttime work will be required, WSDOT would receive this variance from SDCI to set limits on the noise levels for nighttime construction activities.

WSDOT understands that constructing this project in a dense, urban environment has an effect on those who live, work, travel, and play near the Viaduct. This variance requires WSDOT to implement nighttime noise limits, requires our contractor to implement noise-control measures, and ensures appropriate monitoring and enforcement of our nighttime construction activities, while also ensuring the safety of the public and our crews.

10.1 Temporary Noise Variances

In addition to the Viaduct demolition, WSDOT will complete the Battery Street Tunnel decommissioning, and construct north surface streets. Each of these projects may require up to three two week Temporary Noise Variances to complete the work.

Battery Street Tunnel decommissioning includes removing existing piping and duct work in the tunnel, removing soot from the walls and ceiling of the tunnel, breaking up the tunnel floor slab to facilitate drainage if water gets into the tunnel and, backfilling the lower section of the tunnel with compacted concrete rubble, gravel borrow, common borrow, or other suitable material. When headroom in the tunnel becomes limited the ends would be sealed and the remaining space would be filled with controlled density fill or some other flowable material until the entire tunnel is backfilled. The tunnel lid would remain in place except where the contractor needs to remove small sections of the lid to facilitate the backfilling operation. The ventilation grates on the surface (Battery Street) and on the adjacent sidewalks would be removed and filled in with concrete. Finally, new ADA ramps would be constructed at all intersections along the length of the tunnel and a small escape house at 4th and Battery Street would be removed.

North Surface Street Reconstruct includes Aurora Avenue North between Denny Way and Harrison Street. Work could begin any time after the new tunnel opens. The reconstruction includes adding signalized intersections at Thomas and John cross streets and replacing the signal at Denny Way to align with the reconstructed configuration. Another component includes rechannelization and minor reconfiguration of the Aurora Avenue block south of Denny Way, which overlies the Battery Street Tunnel. The Battery Street Tunnel lid would remain in place after decommissioning, thus work would be limited to pavement overlay supplemented with partial curb and sidewalk reconstruction. Finally, approximately 16 curb ramps in vicinity would be evaluated for maximum extent feasible ADA upgrades.

Alaskan Way Viaduct
REPLACEMENT
PROGRAM

U.S. Department of Transportation Federal Highway Administration | WSDOT | King County | Port of Seattle | City of Seattle

Attachment A – Viaduct Demolition Noise Management and Mitigation Plan

Washington State Department of Transportation

Prepared by:
Ginette Lalonde, WSP USA

October 9, 2017

Table of Contents

Exhibits

Acronyms and Abbreviations

dB	decibels
dBA	A-weighted decibels
INM	Independent Noise Monitor
MPPCNV	Major Public Project Construction Noise Variance
NMMP	Noise Management and Mitigation Plan
RCW	Revised Code of Washington
SDCI	Seattle Department of Construction and Inspections
WSDOT	Washington State Department of Transportation

1. Introduction

The Washington State Department of Transportation (WSDOT) is submitting this application to the Seattle Department of Construction and Inspections (SDCI) to request a Major Public Project Construction Noise Variance (MPPCNV) for the Alaskan Way Viaduct Demolition as part of the Alaskan Way Viaduct Replacement Program per the Noise Control Ordinance (Seattle Municipal Code, Chapter 25.08 [SMC 25.08]) and City of Seattle's Director's Rule 3-2009. This noise variance will cover activities occurring as part of the Viaduct demolition phase.

WSDOT requests a one year nighttime noise variance for the proposed Viaduct demolition to allow necessary construction work activities to occur during nighttime hours (between 10 p.m. and 7 a.m. on weekdays and between 10 p.m. and. 9 a.m. on weekends and legal holidays). WSDOT also requests that this MPPCNV allow impact work to occur between 7 a.m. and 10 p.m. on weekdays, weekends and legal holidays in addition to regular daytime hours of 8 a.m. and 5 p.m. on weekdays and 9 a.m. and 5 p.m. on weekends and legal holidays as provided in SMC 25.08.425. As part of the MPPCNV, this application proposes nighttime construction noise level limits for noise-sensitive receivers near construction sites.

WSDOT requests an MPPCNV pursuant to SMC 25.08.590 (Granting of Variance) and SMC 25.08.655 (MPPCNV) to allow construction noise generated on site to exceed the sound level limit as specified in SMC 25.08.410 and as modified by 25.08.420 and 25.08.425.

Completion of all construction activities during only daytime hours would extend the construction period and increase the economic cost to taxpayers.

WSDOT has developed expected construction activities and an estimated schedule for the Viaduct demolition. The analysis demonstrates that means and methods are available to meet the noise limits requested in this noise variance application. The contractor will propose their own construction activities and schedule, and create a detailed Noise Management and Mitigation Plan (NMMP) to meet the commitments WSDOT has made in this MPPCNV application and the noise variance issued by SDCI. Construction activities and equipment used by the contractor may not be specifically identical but are likely to be similar to those identified by WSDOT in the Proposed Construction Activities section.

This noise variance application includes the following:

- A NMMP to demonstrate that means and methods are available to meet the proposed noise limits.
- A description of the proposed construction activities including a description of the noisiest proposed activities.
- Existing baseline sound levels at noise-sensitive land uses within the project areas.

- Proposed sound-level limits for nighttime construction activities that would be unreasonable to limit to daytime construction considering public and worker safety or render the project economically or functionally unreasonable.
- Calculated sound levels that may be expected at noise-sensitive land uses during the noisiest nighttime construction activities.
- Proposed noise-mitigation measures.
- Provisions for compliance tracking and actions taken to resolve public complaints.

WSDOT is working with SDCI to meet the 90-day permit processing timeline for WSDOT projects on a state highway as outlined in Revised Code of Washington (RCW) 47.01.485. The legislative intent behind this law is to expand the opportunities for streamlining the delivery of essential transportation projects while maintaining natural resource protection. This requirement became effective when Governor Inslee signed 2ESSB 5994 into law on July 6, 2015. The following section was added to RCW 47.01.485:

(1) To the greatest extent practicable, a city, town, code city, or county must make a final determination on all permits required for a project on a state highway as defined in RCW 46.04.560 no later than 90 days after the department (WSDOT) submits a complete permit application for a project with an estimated cost of less than $500 million.

2. Project Description and Proposed Construction Activities

2.1 Viaduct Demolition Overview and Project Site Description

Demolition would occur two blocks at time, closing three intersections in a row (Exhibit 1). Work would take place within and from public rights-of-way or where WSDOT obtains temporary construction easements. The entire work zone would be closed to the public with no crossings for vehicles or pedestrians. Following demolition, the surface would be restored to current conditions.

Access to buildings and property adjacent to active work zones would be limited; in some locations, access would not be possible. WSDOT would provide reasonable modifications to allow tenants or residents to remain in place throughout the demolition. However, in several locations continued occupancy may not be feasible; in which case, alternative accommodations or relief would be developed that address each specific circumstance.

WSDOT plans to issue a design-build contract for viaduct demolition. The specific means and methods will be determined by the contractor.

Land uses and zoning classifications are residential, commercial and industrial near the project area.

Exhibit 1. Project Area and Zoning

3. Expected Construction Activities

The Viaduct demolition will be a design-build contract. WSDOT has carefully reviewed the work to be built as part of this contract and has developed an expected schedule and an expected list of construction activities for this work. A request for proposals is planned to be issued by WSDOT in 2017. WSDOT will evaluate the proposals received based on cost and technical credits. WSDOT expects to award the contract to the selected contractor in 2018. The contractor will develop their own approach and plan for the schedule and construction activities for this work, and update the NMMP accordingly. While the order and timing of activities may differ, the construction activities and equipment used are likely to be similar to those identified by WSDOT.

The length of the variance requested is one year to complete the activities. Work is scheduled to commence in 2018 with work substantially complete in 2019. The three phases of construction include early work, demolition and finish work (Exhibit 2). The contractor will update the schedule, order and timing of activities in the updated NMMP.

Exhibit 2. Schedule

Note: The exact opening date of the Bored Tunnel is to be determined.

Early work includes the Alaskan Way traffic switch which includes installing a series of temporary span wire signal systems along Alaskan Way, between Yesler Way and Pike Street. Additional night time work could include installation of permanent sign posts along Alaskan Way, between S. King Street and Pike Street. A nighttime closure is also expected to perform the actual switch of traffic from under the viaduct onto Alaskan Way. Finish work would include activities during the project closeout, including cleanup, dismantling of staging areas, and restoration where required. Early and Finish work is expected to be quieter than the demolition activities.

The loudest activities would include impact work and would occur during the demolition of the Viaduct. Although the demolition is expected to be completed within six months, the demolition would be transient along the corridor and WSDOT has committed to restoring access adjacent to individual buildings in no more than 30 days. The proposed major demolition activities are as follows:

- For most of the Viaduct mainline, the deck will be hammered out with the use of excavators and hammers and the inside beams will be cut up with a concrete cracker. The footings will be hammered and the debris will be loaded out. This work would be transient along the majority of the Viaduct alignment for up to six months. WSDOT expects impact equipment would to only be used between 7 a.m. and 10 p.m. on weekdays, weekends and legal holidays.
- Over the railroad tracks, the deck will be saw cut into sections, the sections will be rigged and loaded onto trucks. BNSF railway has indicated that they would only allow work windows over the railroad tracks in the middle of the night, when train traffic is low. Due these restrictions, WSDOT is allowed only to work during nighttime hours over the railroad, and WSDOT is also restricted from working between October 1st and December 31st. Demolition is allowed to occur between 1 a.m. and 4 a.m. on Saturdays, Sundays and Mondays. WSDOT expects a total of approximately 39 nights would be needed to complete this work over a period of 13 weeks. Any increase in the allowable work hours would result in a decrease of the number of nights needed to complete this work.
- For the first 100 feet north of the railroad tracks, the deck will be hammered out with the use of excavators and hammers and the inside beams will be cut up with a concrete cracker. The footings will be hammered and the debris will be loaded out. Due to railroad restrictions, WSDOT is allowed only to work during nighttime hours over the railroad, and WSDOT is also restricted from working between October 1st and December 31st. Demolition is also allowed to occur between 1 a.m. and 4 a.m. on Saturdays, Sundays and Mondays. WSDOT expects a total of approximately 12 nights would be needed to complete this work over a period of one month.
- From the end of railroad restricted work areas to Battery Street Tunnel, excavators with concrete crackers will demolish the structure and it will be loaded out. This work would occur for approximately 3 months. WSDOT expects impact equipment would to only be used between 7 a.m. and 10 p.m. on weekdays, weekends and legal holidays.
- For the Seneca and Columbia Ramps, the bridge decks would be saw cut and lifted out by crane and loaded onto flatbed trucks. There would be limited impact work, the bridge diaphragms would be removed with impact hammers. The footings will be hammered and the debris will be loaded out. WSDOT expects that each ramp would take 40 days to demolish, but each ramp would require a 7 day period with limited impact work could to occur during nighttime hours to limit effects on nearby buildings and residents.

Expected evening impact, limited nighttime impact, and other nighttime activities requiring a noise variance are part of some or all the phases described above. Other nighttime activities would include delivery of equipment and materials, refueling of equipment and restoring the surface to current conditions following demolition.

WSDOT has developed a list of equipment to be used by the contractor as noted in Exhibit 3. The contractor will update the list of equipment in the updated NMMP.

Exhibit 3. List of Construction Equipment

Equipment Type
Asphalt roller
Bulldozer
Compressor
Concrete pump
Concrete saw
Concrete truck
Crawler crane
Delivery truck
Diesel generator
Drill rig
Dump or Debris truck
Excavator with concrete cracker
Excavator with impact hammer
Excavator with thumb
Forklift
Grader
Hydraulic crane
Light plant
Loader
Street sweeper
Vibratory roller
Welder

4. Characteristics of Sound and Noise

4.1 Definition of Sound

Sound is created when objects vibrate, resulting in a minute variation in surrounding atmospheric pressure, called sound pressure. The human response to sound depends on the magnitude of a sound as a function of its frequency and time pattern. Magnitude is a measure of the physical sound energy in the air. The range of magnitude the ear can hear, from the faintest to the loudest sound, is so large that sound pressure is expressed on a logarithmic scale in units called decibels (dB). Loudness refers to how people subjectively judge a sound and varies between people.

Sound is measured using the logarithmic decibel scale, so doubling the number of noise sources, such as the number of cars on a roadway, increases noise levels by 3 dBA. Therefore, when you combine two noise sources emitting 60 dBA, the combined noise level is 63 dBA, not 120 dBA. The human ear can barely perceive a 3 dBA increase, while a 5 dBA increase is about one and one-half times as loud. A 10-dBA increase appears to be a doubling in noise level to most listeners. A tenfold increase in the number of noise sources will add 10 dBA.

In addition to magnitude, humans also respond to a sound's frequency or pitch. The human ear is very effective at perceiving frequencies between 1,000 and 5,000 hertz, with less efficiency outside this range. Environmental noise is composed of many frequencies. A-weighting (dBA) of sound levels is applied electronically by a sound level meter and combines the many frequencies into one sound level that simulates how an average person hears sounds of low to moderate magnitude.

The smallest "just noticeable" increase in sound is about 3 dBA. A 6 dBA increase is clearly noticeable, and a 10 dBA increase causes a doubling of judged loudness. For example, 80 dBA is judged to be twice as loud as 70 dBA and four times as loud as 60 dBA. Exhibit 4 summarizes how increases in perceived loudness correlate with sound level increases.

Exhibit 4. Perceived Loudness Increases

Sound Level Increase (dBA)	Perceived Loudness Increase
0 to 2	Not noticeable
3	Just noticeable
6	Noticeable
10	Twice as loud
20	Four times as loud

4.1.1 Definition of Noise

Noise is unwanted or unpleasant sound. Noise is a subjective term because, as described above, sound levels are perceived differently by different people. Magnitudes of typical noise levels are presented in Exhibit 5.

Exhibit 5. Typical Noise Levels

NOISE SOURCE OR ACTIVITY		SUBJECTIVE IMPRESSION	RELATIVE LOUDNESS (human judgment of different sound levels)
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain	64 times as loud
50-horsepower siren (100 feet)	130		32 times as loud
Loud rock concert near stage Jet takeoff (200 feet)	120	Uncomfortably loud	16 times as loud
Float plane takeoff (100 feet)	110		8 times as loud
Jet takeoff (2,000 feet)	100	Very loud	4 times as loud
Heavy truck or motorcycle (25 feet)*	90		2 times as loud
Garbage disposal (2 feet) **Pneumatic drill (50 feet)**	80	**Moderately loud**	**Reference loudness**
Vacuum cleaner (10 feet) Passenger car at 65 mph (25 feet)*	70		1/2 as loud
Typical office environment	60		1/4 as loud
Light auto traffic (100 feet)*	50	Quiet	1/8 as loud
Bedroom or quiet living room Bird calls	40		1/16 as loud
Quiet library, soft whisper (15 feet)	30	Very quiet	
High quality recording studio	20		
Acoustic test chamber	10	Just audible	
	0	Threshold of hearing	

4.1.2 Noise Level Descriptors

Because sound levels fluctuate over time, several A-weighted sound level descriptors are used to characterize the sound.

The L_{eq} is a measure of the average noise level during a specified period of time. A one-hour period, or hourly L_{eq}, is used to measure construction noise. L_{eq} is a measure of total noise during a time period that places more emphasis on occasional high noise levels that accompany general background noise levels. For example, if you have two different sounds, and one contains twice as much energy, but lasts only half as long as the other, the two would have the same L_{eq} noise levels.

Either the total noise energy or the highest instantaneous noise level can describe short-term noise levels. L_{max} is the maximum sound level that occurs during a single event and is related to impacts on speech interference and sleep disruption.

With Ln, "n" is the percent of time that a sound level is exceeded and is used to describe the range and pattern of sound levels experienced during the measurement period. For example, the L_1 level is the noise level that is exceeded 1 percent of the time. Sound varies in the environment and people will generally find a higher, but constant, sound level more tolerable than a quiet background level interrupted by higher sound level events. For example, steady traffic noise from a highway is normally less bothersome than occasional aircraft flyovers in an otherwise quiet area if both environments have the same L_{eq}.

5. City of Seattle Noise Control Ordinance

The City of Seattle limits noise levels at property lines of neighboring properties (Seattle Noise Control Ordinance, SMC 25.08.410). The sound level limit depends on the land uses of both the noise source and the receiving property (Exhibit 6). The project area and the surrounding properties are zoned residential, commercial and industrial. The City's sound level limits apply to construction activities occurring between 10 p.m. and 7 a.m. on weekdays or 10 p.m. and 9 a.m. on weekends and legal holidays. Legal holidays are defined in SMC 25.08.155 as New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and the day after, and Christmas Day. Construction activities during nighttime hours that would exceed these levels require a noise variance from the City.

Exhibit 6. Seattle Noise Control Ordinance – Exterior Sound Level Limits

District of Sound Source	District of Receiving Property			
	Residential Daytime L_{eq} (dBA)	Residential Nighttime L_{eq} (dBA)	Commercial L_{eq} (dBA)	Industrial L_{eq} (dBA)
Residential	55	45	57	60
Commercial	57	47	60	65
Industrial	60	50	65	70

Nighttime hours are 10 p.m. to 7 a.m. during weekdays and 10 p.m. to 9 a.m. during weekends and legal holidays
dBA = A-weighted decibels
L_{eq} = equivalent sound level
During a measurement interval, L_{max} may exceed the exterior sound level limits shown by no more than 15 dBA.

5.1 Exceptions to the Seattle Noise Control Ordinance

5.1.1 Daytime Noise

Noise levels shown in Exhibit 6 may be exceeded by construction equipment between 7 a.m. and 10 p.m. on weekdays and between 9 a.m. and 10 p.m. on weekends and legal holidays. Threshold levels for equipment are listed below:

> *25 A-weighted decibels (dBA) for equipment on construction sites, including but not limited to, crawlers, tractors, dozers, rotary drills and augers, loaders, power shovels, cranes, derricks, graders, off-highway trucks, ditchers, trenchers, compactors, compressors, derrick barges, tug boats, and pneumatic-powered equipment*

Daytime construction activities are allowed to exceed the noise-level limits in the Seattle Noise Control Ordinance (SMC 25.08.425) (Exhibit 6). These levels should be measured from the real property of another person or at a distance of 50 feet from the equipment, whichever is greater. Construction activities for the Viaduct demolition would occur in residential and commercial districts.

5.1.2 Impact Type Noise

In addition, the Seattle Noise Control Ordinance (SMC 25.08.425) regulates sound created by impact types of construction equipment (e.g., pavement breakers, pile drivers, jackhammers, and sandblasting tools) or those that otherwise create impulse or impact noise (as measured at the property line or 50 feet from the equipment, whichever is greater). The equipment may exceed the sound level limits (equivalent sound level [L_{eq}] described in Exhibit 6) in any 1-hour period between 8 a.m. and 5 p.m. on weekdays and 9 a.m. and 5 p.m. on weekends and legal holidays. The sound level is in no event to exceed the following:

- L_{eq} = 90 dBA continuously
- L_{eq} = 93 dBA for 30 minutes
- L_{eq} = 96 dBA for 15 minutes
- L_{eq} = 99 dBA for 7.5 minutes

Sound levels in excess of L_{eq} = 99 dBA are prohibited unless authorized by variance. The standard of measurement is a 1-hour L_{eq} measured for time periods not less than 1 minute in order to project an hourly L_{eq}.

5.2 Proposed Daytime Noise Level Limits

WSDOT requests that this MPPCNV allow impact work noise level limits of SMC 25.08.425, including equipment such as pile drivers, impact hammers, and jack hammers, to occur between 7 a.m. and 10 p.m. in addition to regular daytime hours of 8 a.m. and 5 p.m. on weekdays and 9 a.m. and 5 p.m. on weekends and legal holidays as provided in SMC 25.08.425.C.

5.3 Proposed Nighttime Noise Level Limits

Noise level limits were established in the previous section, WSDOT Compliance with City of Seattle Criteria for a Major Public Project Construction Noise Variance. This noise variance application proposes a 6 dBA increase over existing hourly average noise levels (L_{eq}) measured during the quietest part of the nighttime hours (the five-hour period from 12 a.m. to 5 a.m.). The proposed L_1 limits are 10 dBA above the L_{eq} noise level limit with a maximum upper limit of 80 dBA in residentially zoned and 85 dBA in commercially zoned areas, which is the City's daytime construction hourly L_{eq} noise level limit at residentially and commercially zoned receivers. Demolition of the Seneca and Columbia Ramps requires higher noise levels due to building access constraints, and the nighttime noise level limits would need to be increased by an additional 10 dBA for up to 7 days for each Ramp to complete the necessary nighttime work.

5.4 Requested Period the Variance Is Effective

In general, WSDOT requests that construction noise generated on the site be allowed to exceed the noise level limits set by Seattle Noise Control Ordinance, SMC 25.08.410, during nighttime hours (between 10 p.m. and 7 a.m. on weekdays and between 10 p.m. and. 9 a.m. on weekends and legal holidays). WSDOT also requests that this MPPCNV allow impact work, including equipment such as impact hammers, and jack hammers, to occur between 7 a.m. and 10 p.m. in addition to regular daytime hours of 8 a.m. and 5 p.m. on weekdays and 9 a.m. and 5 p.m. on weekends and legal holidays as provided in SMC 25.08.425.C.

At select locations, limited impact work would be needed during nighttime hours (between 10 p.m. and 7 a.m. on weekdays and between 10 p.m. and 9 a.m. on weekends and legal holidays) to minimize impacts to the areas adjacent to the Seneca and Columbia ramps and near rail roads.

Activities are scheduled to begin as early as 2018, with an estimated completion date in 2019. The length of the requested variance is one year which is the anticipated duration necessary to complete the activities.

The contractor would be able to perform nighttime activities if the work is performed within the Viaduct demolition area as described below and covered by this MPPCNV or any temporary noise variances granted by SDCI. Additional coordination with SDCI would continue throughout demolition.

5.4.1 Construction Area and Exterior Nighttime Construction Noise-Level Limits

This noise variance application proposes nighttime construction noise limits for nighttime noise-sensitive receivers in proximity to the Viaduct demolition area. Nighttime noise-sensitive receivers are generally properties where people are sleeping, such as a residence. The next section contains information on the characteristics of noise and sound.

The proposed descriptors and noise limits for the Viaduct demolition are based on WSDOT and SDCI noise variance coordination efforts, and a review of prior SDCI decisions on MPPCNV applications from agencies such as WSDOT, Sound Transit and the Seattle Department of Transportation. In each of these cases, SDCI granted variances with an increase of average hourly noise level limits ranging from 6 dBA up to 15 dBA over measured existing baseline nighttime noise levels.

For nighttime noise levels for the majority of the year, the Viaduct demolition noise variance application proposes a 6 dBA increase over existing hourly average noise levels (L_{eq}) measured during the quietest part of the nighttime hours (the five-hour period from 12 a.m. to 5 a.m.). Although these proposed noise level limits are based on measurements during only the quietest nighttime hours, the proposed limits would apply to the operation of construction equipment

during all nighttime hours, from 10 p.m. to 7 a.m. on weekdays and 10 p.m. and 9 a.m. on weekends and legal holidays. Demolition of the Seneca and Columbia Ramps requires higher noise levels due to building access constraints, and the nighttime noise level limits would need to be increased by an additional 10 dBA for up to 7 days to complete the necessary nighttime work.

During daytime hours, WSDOT also requests that this MPPCNV allow impact work, including equipment such as impact hammers, and jack hammers, to occur between 7 a.m. and 10 p.m. in addition to regular daytime hours of 8 a.m. and 5 p.m. on weekdays and 9 a.m. and 5 p.m. on weekends and legal holidays as provided in SMC 25.08.425.C.

Continuous monitoring and recording of A-weighted sound levels was conducted at seven sites (Exhibit 7). Measurements were taken which comply with American National Standards Institute S1.4 for instrument accuracy. All sound level monitoring equipment was calibrated before and after each measurement. In addition, the noise meters are calibrated annually by an accredited laboratory. Sound levels measured during the late-night hours (12 a.m. to 5 a.m.) provide the most conservative representation of the existing baseline condition. Noise measurement sites were selected based on their proximity to construction activities and availability.

The measured existing nighttime sound levels exceed the City of Seattle nighttime noise control ordinance limits of 45 dBA (L_{eq}) at residential locations and 60 dBA (L_{eq}) at commercial locations. The existing sound levels, which are produced primarily by traffic on public roads, are not subject to the limits of the ordinance (SMC 25.08.410-425). The comparison is presented in Exhibit 10 as a baseline for evaluating potential noise impacts from proposed construction activities.

The noise variance application also proposes a highest 1 percent maximum noise level limit above the nighttime L_{eq} to monitor potential short-term noises. Hourly percentile sound levels, Ln, are the sound levels exceeded for “n” percent of an hour. The L_1 is the sound level exceeded for 1 percent of the measurement duration (i.e., 36 seconds per hour). The proposed L_1 limits are 10 dBA above the L_{eq} noise level limit with a maximum upper limit of 80 dBA in residential areas and 85 dBA in commercial areas, which is the City’s daytime construction hourly L_{eq} noise level limit at residentially and commercially zoned receivers without the impact noise increases.

Exhibit 7. Construction Area and Noise Measurement Locations

In addition to the L_{eq}, this noise variance application proposes to track compliance with the terms set by the MPPCNV by monitoring the measured hourly L_1 sound level. The L_1 has been found to be more reliable than the L_{max}, as stated in the Denny Substation Program Noise Monitoring and Mitigation Plan, revised February 11, 2015:

> *For the purpose of monitoring construction sound levels, the hourly L_1 has been found to be more reliable than the hourly L_{max} in tracking compliance with MPPCNV limits. As with the L_{max}, the hourly L_1 provides a representative measure of the worst-case sound levels produced by a construction activity; unlike the L_{max}, the L_1 is not susceptible to distortion by one-time, atypical events such as a tool or load being dropped, and it is more representative of sound levels produced during higher-intensity construction activities each hour.*

6. Existing Baseline Sound Levels

Noise measurements at four sites were taken in June, July and August 2017. The sites listed below were identified as representing nighttime noise-sensitive receivers near the Viaduct demolition. The Elliott Pointe Apartments were in a residential zone. The other sites are in commercial zones.

- Site 1 – Elliott Pointe Apartments
- Site 2 – Waterfront Landings Condominiums
- Site 3 – 1201 Western Avenue
- Site 4 – 815 Western Avenue

Sound levels measured during the late night hours (12 a.m. to 5 a.m.) provide the most conservative representation of the existing baseline condition. Noise measurement sites were selected based on their proximity to construction activities along the Viaduct alignment. A summary of the measured existing nighttime sound levels is shown in Exhibit 8 and Exhibit 9. Detailed noise measurement data is found in Appendix A.

Exhibit 8. Measured Hourly Average Baseline Noise Levels and Proposed Nighttime Noise Level Limits Measured

Site	Measured 12 to 1 AM Log Hourly Average L_{eq} (dBA)	Measured 1 to 2 AM Log Hourly Average L_{eq} (dBA)	Measured 2 to 3 AM Log Hourly Average L_{eq} (dBA)	Measured 3 to 4 AM Log Hourly Average L_{eq}(dBA)	Measured 4 to 5 AM Log Hourly Average L_{eq}(dBA)	Measured 12 to 5 AM Log Hourly Average L_{eq} (dBA)	Proposed Nighttime Noise Level Hourly Average Limit L_{eq} (dBA)
1	67	65	65	64	66	65	71
2	70	69	68	67	71	69	75
3	67	65	65	65	68	66	72 (82 for 7 days)*
4	68	67	67	67	68	68	74 (84 for 7 days)*

*Nighttime noise level limits would be increased by 10 dBA during Seneca and Columbia Ramp demolition for up to 7 days for each location.

Exhibit 9. Measured L_{max} Noise Levels and Proposed L_1 Nighttime Noise Level Limits

Site	Measured 12 to 5 AM L_{max} range (dBA)	Proposed Nighttime Noise Level Hourly Limit L_1 (dBA)
1	75 to 89	80
2	81 to 100	85
3	74 to 86	82 (92 for 7 days)*
4	72 to 93	84 (94 for 7 days)*

In addition to the noise measurements taken above, SDCI approved on April 6, 2017, an extension of the SR 99 Bored Tunnel Alternative MPPCNV. This application proposes that the same baseline noise measurements and noise levels limits in the south portal vicinity be used, to eliminate any additional nighttime construction occurring as part of the 2017 SR 99 Bored Tunnel Alternative MPPCNV. These sites are in commercial zones.

- Site 5 – Compass Center, 210 Alaskan Way S.
- Site 6 – Our Home Hotel Condominiums, 75 S Main
- Site 7 – Triangle Building, 553 First Avenue S

Public health and safety

SDCI's decision on the Sound Transit project at 6600 Roosevelt Way NE includes the following assessment of noise levels related to public health and safety:

> *It is generally accepted that very high levels of noise have adverse physical impacts on humans including, but not limited to, hearing damage. Many standards apply to occupational exposures at high levels for prolonged periods of time. For example, the Occupational Safety and Health Act mandates a hearing conservation program by employers if sound levels exceed 85 dBA continuously over an 8-hour workday. If sound levels exceed 90 dBA continuously over an 8-hour workday, hearing protection is required.*

The proposed nighttime noise level limits anticipated by this MPPCNV application would maintain sound levels below these identified levels, as shown in Exhibit 10. The 6 dBA increases from on-site nighttime project noise levels that are requested for the majority of the construction activities and the resulting noise levels will likely be noticed by some residents, but would not cause a danger to public health or safety.

Exhibit 10. Measured Hourly Average Baseline Noise Levels and Proposed Exterior Nighttime Noise Level Limits

Site	Zoned Land Use	Measured 12 to 5 AM Log Hourly Average L_{eq} (dBA)	Proposed Nighttime Noise Level Hourly Average Limit L_{eq}/L_1 (dBA)	Proposed Daytime Noise Level Hourly Limit L_{eq}/L_1 (dBA)
5	Commercial	79	85/85	90/99
6	Commercial	67	73/83	90/99
7	Commercial	67	73/83	90/99

*Ambient baseline measurement data is available in the SR 99 Bored Tunnel Alternative MPPCNV application.

7. WSDOT Noise Modeling Summary

This section summarizes a noise analysis for the expected construction activities of the Viaduct demolition. This section was prepared according to the requirements of Section 25.08.655 of the Seattle Municipal Code and Director's Rule DR3-2009, both pertaining to Major Public Project Construction Noise Variances from the City of Seattle Noise Code.

WSDOT has developed expected construction activities and a schedule for the Viaduct demolition. The analysis in this NMMP section demonstrates that means and methods are available to meet the noise limits requested in this MPPCNV. The contractor will propose their own construction activities and schedule, and create a detailed NMMP to meet the commitments WSDOT has made in this noise variance application and the MPPCNV issued by SDCI. Construction activities and equipment used may not be specifically identical but are likely to be similar to those identified by WSDOT, and will be required to comply with the same noise level limits.

7.1 Expected Noisiest Nighttime Construction Periods

Projected nighttime major construction L_{eq} and L_1 noise levels were modeled for selected noise-sensitive receivers using SoundPLAN Version 7.4, a three-dimensional graphics-oriented program for outdoor noise propagation. SoundPLAN calculates the L_{eq} by averaging the use of each individual piece of equipment and evenly distributes the activity over an hour. SoundPLAN calculates the L_1 using the loudest 1 percent same hour as used to calculate the L_{eq}. The L_1 results from SoundPLAN are an additional 10 dBA over the L_{eq}, this is a conservative high level estimate for the L_1. For nighttime construction noise estimates, the noisiest nighttime construction activity that would occur at the surface of each construction site and the noisiest equipment during this activity was assumed.

The noisiest major construction activities were modeled to provide a conservative estimate of noise levels. A variety of construction activities are anticipated to occur within the footprint of the Viaduct demolition, potentially using the equipment outlined in Exhibit 11. Construction noise includes truck operations within the construction site and not on haul routes. Haul routes are not regulated under the Seattle Noise Control Ordinance and therefore are not included in this application.

Major construction activities that are expected to be the loudest during the project were modeled for construction periods to estimate the anticipated highest construction noise levels.

Construction during other phases of work would generate less noise than those selected for noise modeling. The modeled levels represent the loudest nighttime construction activities that are anticipated over the construction period.

Exhibit 11. Modeled Nighttime Demolition Equipment Noise Levels

Equipment Type	Typical Noise Level (dBA) at 50 Feet
Loader	79
Concrete Saw	90
Crawler crane	83
Dump or Debris truck	88
Excavator with crusher	96
Excavator with thumb	96
Excavator with Impact hammer	101
Excavator with Concrete Cracker	101
Hydraulic crane	81
Flat Bed Truck	74
Man Lift	68

Source: August 2006 FHWA Construction Noise Handbook, Section 9: https://www.fhwa.dot.gov/Environment/noise/construction_noise/handbook/

The noise levels for the expected loudest construction periods are described in the following subsections. Each subsection lists the number and type of construction equipment modeled to estimate the expected highest nighttime construction noise levels.

7.2 Modeled Noise Levels

Projected nighttime major construction L_{eq} and L_1 noise levels were modeled for noise-sensitive receivers and were reported at the closest location to the demolition activities. Because the demolition is transient along the Viaduct alignment, modeled noise levels were also report 200 feet along the alignment from the loudest equipment.

7.3 Viaduct Demolition – Mainline Demolition

Mainline demolition would occur in commercially zoned areas. Noise levels were modeled at Spring Street and are representative of mainline demolition activities throughout the corridor. The highest modeled exterior noise levels experienced at buildings closest to the Viaduct during demolition of the mainline in Exhibit 12. This area was modeled to represent the typical daytime and nighttime noise levels that would be experienced along the entire corridor for this type of work.

The deck will be hammered out with the use of excavators and hammers and the inside beams will be cut up with a concrete cracker. The footings will be hammered and the debris will be loaded out. Equipment during daytime hours (from 7 a.m. to 10 p.m.) used was estimated to include:

- Deck hammered out: two excavators with impact hammers,
- Removal of the large beams and columns: two excavators with impact hammers
- Removal of inside beams on the east side: one crane with concrete cracker
- Removal of Footings: two excavators with impact hammers
- Load out: two excavators with bucket and thumb and two dump trucks

Equipment during nighttime hours (from 10 p.m. to 7 a.m.) used was estimated to include:

- Load out: two excavators with bucket and thumb and two dump trucks

Exhibit 12. Exterior Noise Levels for Mainline Demolition

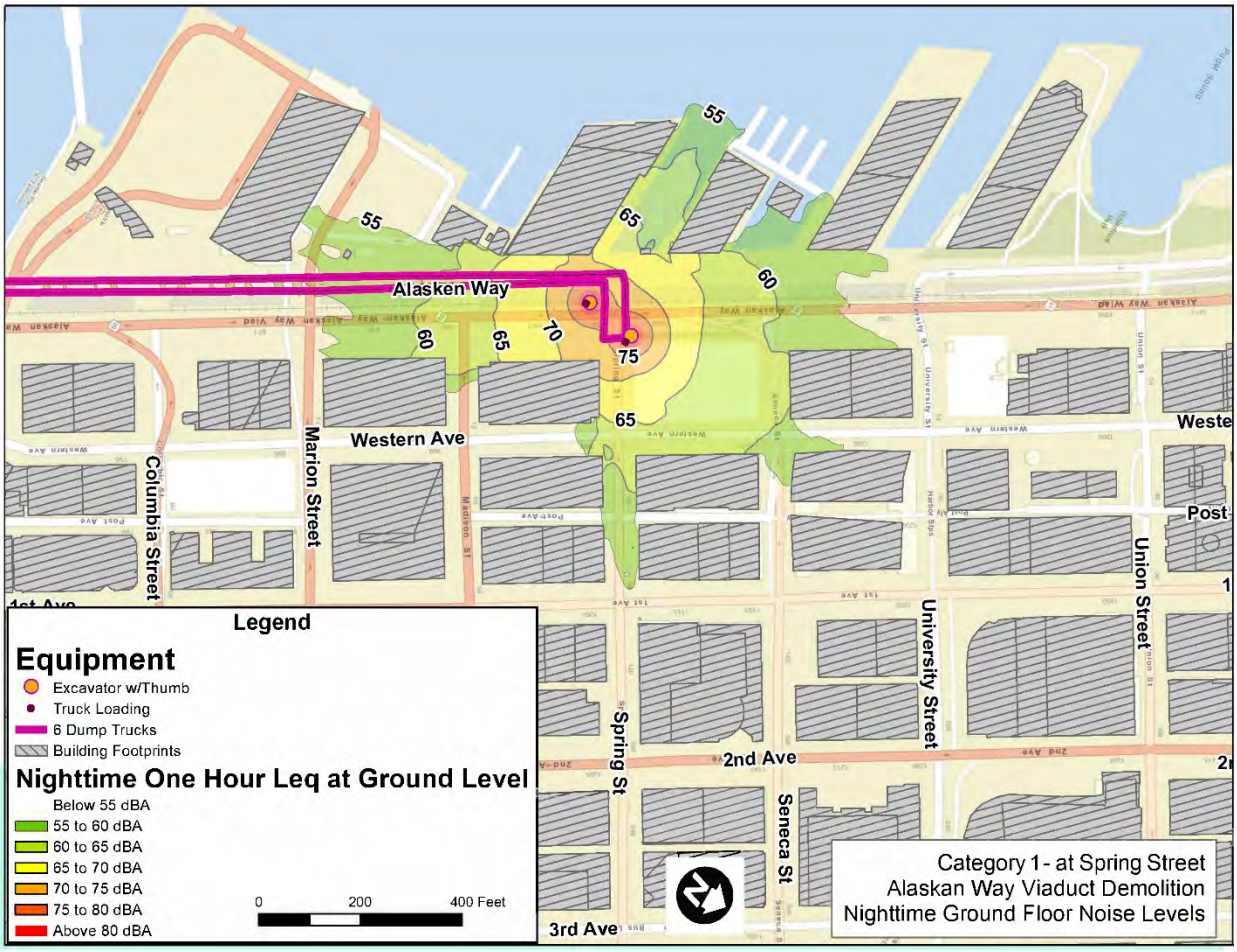
Site	L_{eq} Modeled Noise Level (dBA)	Sites 2 to 7 L_{eq} Commercially Zoned Noise Level Limit Range (dBA)	L_1 Modeled Noise Levels (dBA)	Sites 2 to 7 L_1 Commercially Zoned Noise Level Limit Range (dBA)
Daytime				
Maximum Noise level modeled	82	90	92	99
200 feet north of maximum	75	90	85	99
200 feet south of maximum	75	90	85	99
Nighttime				
Maximum Noise level modeled	72	72 to 85*	82	82 to 85
200 feet north of maximum	64	72 to 85*	74	82 to 85
200 feet south of maximum	64	72 to 85*	74	82 to 85

Note: *L_{eq} Noise level limits range from 72 dBA to 85 dBA and L_1 range from 82 to 85 for Sites 2, 3, 4, 5, 6, and 7.

Demolition noise levels would meet the proposed daytime and nighttime L_{eq} noise level limits in the commercially zoned areas.

Exhibit 13. Daytime Viaduct Mainline Demolition Noise Levels

Exhibit 14. Nighttime Viaduct Mainline Demolition Noise Levels



7.4 Viaduct Demolition Over Railroad Tracks

Viaduct demolition over the railroad tracks would occur in commercially zoned areas. Noise levels were modeled over the railroad tracks near the Waterfront Landings Condominiums. The highest modeled exterior noise levels experienced at buildings closest to the Viaduct during demolition are shown in Exhibit 15. BNSF railway has indicated that they would only allow work windows over the railroad tracks in the middle of the night, when train traffic is low. Due these restrictions, WSDOT is allowed only to work during nighttime hours over the railroad. Demolition is allowed to occur between 1 a.m. and 4 a.m. on Saturdays, Sundays and Mondays.

Over the railroad tracks, the deck will be saw cut into sections, the sections will be rigged and loaded onto trucks. Equipment during daytime hours and nighttime hours:

- Deck removed: six concrete saws, excavator, two man lifts, and one crane
- Load out: four flatbed trucks

Exhibit 15. Viaduct Demolition Over Railroad Tracks Modeled Noise Levels

Site	L_{eq} Modeled Noise Level (dBA)	Site 2 L_{eq} Commercially Zoned Noise Level Limit Range (dBA)	L_1 Modeled Noise Levels (dBA)	Site 2 L_1 Commercially Zoned Noise Level Limit Range (dBA)
Nighttime without mitigation				
Maximum Noise level modeled	78	75	88	85
200 feet north of maximum	75	75	85	85
200 feet south of maximum	75	75	85	85
Nighttime with mitigation				
Maximum Noise level modeled	71	75	81	85
200 feet north of maximum	69	75	79	85
200 feet south of maximum	69	75	79	85

Demolition noise levels would meet the proposed daytime Leq noise level limits, but would exceed the nighttime Leq noise level limits. Nighttime noise levels were modeled using with mitigation, the mitigation is reducing the point source noise emission by 10 dB, with a better muffler. The muffler can affect the performance of the equipment, so it is not used during the daytime or on equipment that goes on public roadways. Exhibit 16 shows the modeled noise levels for the nighttime with mitigation.

Exhibit 16. Viaduct Demolition Over Railroad Tracks Modeled Noise Levels with Mitigation

7.5 Viaduct Demolition within 100 Feet North of Railroad Tracks

Viaduct demolition within 100 feet north of the railroad tracks would occur in commercially zoned areas. Noise levels were modeled over the railroad tracks near the Waterfront Landings Condominiums. The highest modeled exterior noise levels experienced at buildings closest to the Viaduct during demolition are shown in Exhibit 17. BNSF railway has indicated that they would only allow work windows over the railroad tracks in the middle of the night, when train traffic is low. Due these restrictions, WSDOT is allowed only to work during nighttime hours over the railroad. Demolition is allowed to occur between 1 a.m. and 4 a.m. on Saturdays, Sundays and Mondays. WSDOT expects a total of 12 nights would be needed to complete this work over a period of one month.

Within 100 feet north of the railroad tracks, the deck will be hammered out with the use of excavators and hammers and the steel beams will be cut up with a concrete cracker. The debris will be loaded out. Equipment expected to be used include:

- Three excavators with impact hammers,
- One crane with concrete cracker
- Load out: two excavators with bucket and thumb and two dump trucks

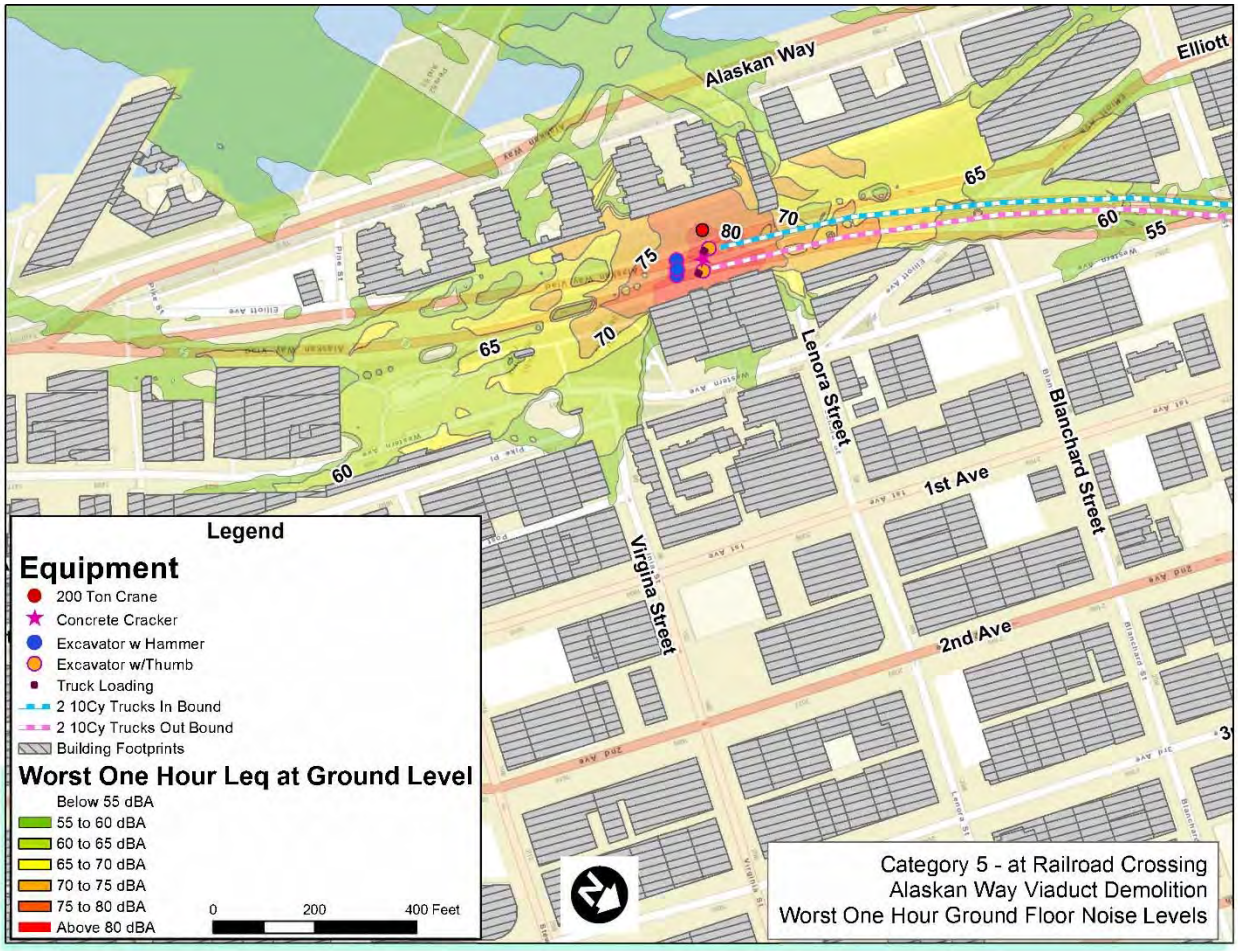
Exhibit 17. Viaduct Demolition within 100 Feet North of Railroad Tracks Modeled Noise Levels

Site	L_{eq} Modeled Noise Level (dBA)	Site 2 L_{eq} Commercially Zoned Noise Level Limit Range (dBA)	L_1 Modeled Noise Levels (dBA)	Site 2 L_1 Commercially Zoned Noise Level Limit Range (dBA)
Nighttime without mitigation				
Maximum Noise level modeled	81	75	84	85
200 feet north of maximum	76	75	78	85
200 feet south of maximum	76	75	78	85
Nighttime with mitigation				
Maximum Noise level modeled	72	75	74	85
200 feet north of maximum	66	75	69	85
200 feet south of maximum	66	75	69	85

Demolition noise levels would meet the proposed daytime Leq noise level limits, but would exceed the nighttime L_{eq} noise level limits. Nighttime noise levels were modeled using with mitigation, the mitigation is reducing the point source noise emission by 10 dB, with a better muffler. The muffler can affect the performance of the equipment, so it is not used during the

daytime or on equipment that goes on public roadways. Exhibit 18 shows the modeled noise levels for the nighttime with mitigation.

Exhibit 18. Viaduct Demolition within 100 Feet North of Railroad Tracks Modeled Noise Levels with Mitigation



7.6 North End Demolition from Railroad Tracks to Battery Street Tunnel

Viaduct demolition from the railroad tracks to the Battery Street Tunnel would occur in a residentially zoned area. Noise levels were modeled near the Elliott Pointe Apartments. The highest modeled exterior noise levels experienced at buildings closest to the Viaduct during demolition are shown in Exhibit 19.

The Viaduct in this area will use excavators with hammers and concrete crackers, and the debris will be loaded out. Equipment used during daytime hours (from 7 a.m. to 10 p.m.) was estimated to include:

- Demolition of the Viaduct: three excavators with impact hammers, three excavators with concrete crackers
- Load out: three excavators with bucket and thumb and five dump trucks

Equipment during nighttime hours (from 10 p.m. to 7 a.m.) used was estimated to include:

- Load out: three excavators with bucket and thumb and five dump trucks

Exhibit 19. Exterior Noise Levels from Demolition from Railroad Tracks to Battery Street Tunnel

Site	L_{eq} Modeled Noise Level (dBA)	Site 1 L_{eq} Residentially Zoned Noise Level Limit Range (dBA)	L_1 Modeled Noise Levels (dBA)	Site 1 L_1 Residentially Zoned Noise Level Limit Range (dBA)
Daytime without mitigation				
Maximum Noise level modeled	94	90	104	99
200 feet north of maximum	80	90	90	99
200 feet south of maximum	80	90	90	99
Daytime with mitigation				
Maximum Noise level modeled	88	90	98	99
200 feet north of maximum	76	90	86	99
200 feet south of maximum	76	90	86	99
Nighttime without mitigation				
Maximum Noise level modeled	69	71	79	81
200 feet north of maximum	62	71	72	81
200 feet south of maximum	62	71	72	81

Demolition noise levels would not meet the proposed daytime and nighttime Leq noise level limits. Daytime noise levels were modeled using with mitigation, the mitigation is reducing the point source noise emission by 10 dB, with a better muffler. Exhibit 20 and Exhibit 21 show the modeled noise levels for the daytime with mitigation and nighttime.

Exhibit 20. Daytime Demolition from Railroad Tracks to Battery Street Tunnel Daytime Noise Levels with Mitigation

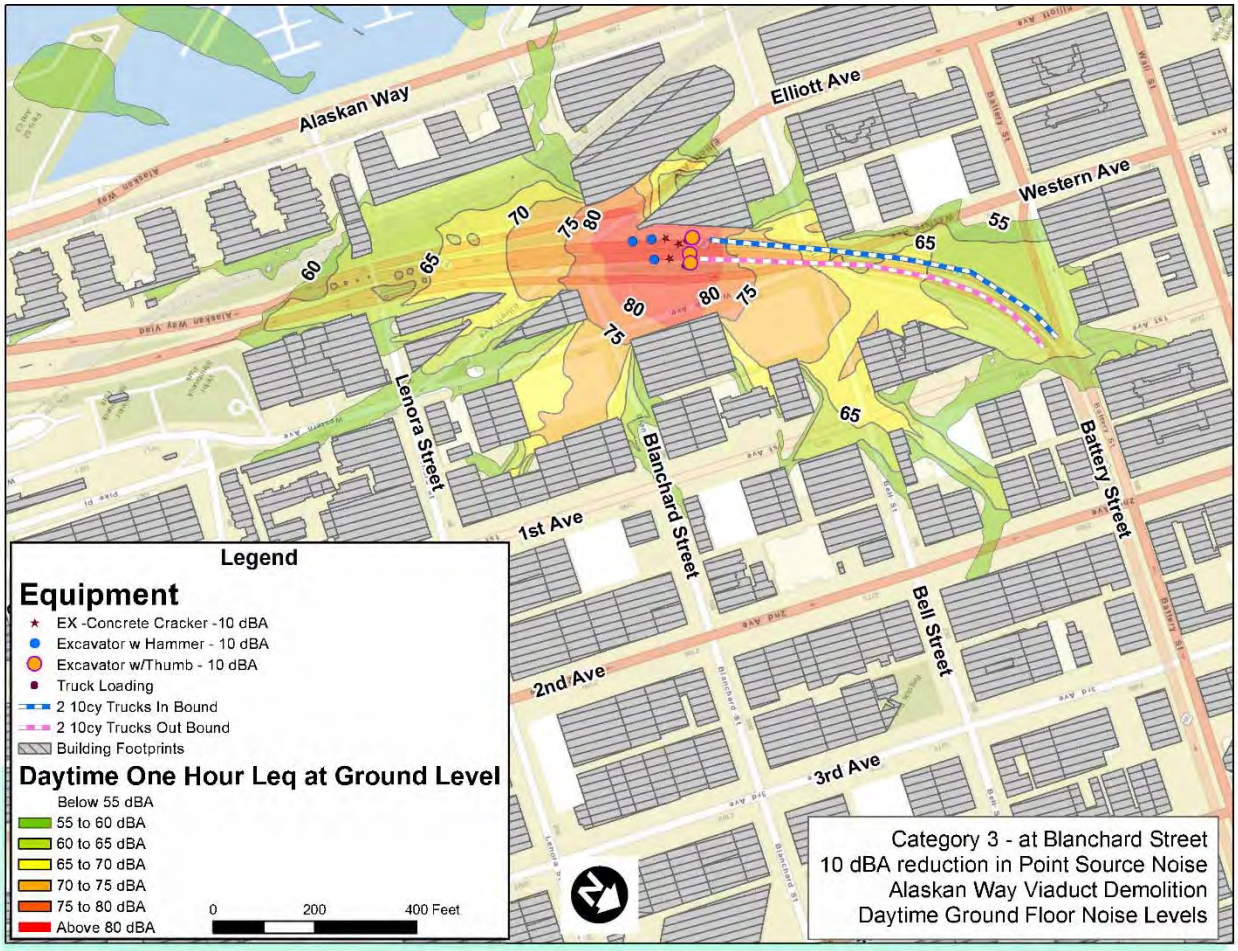
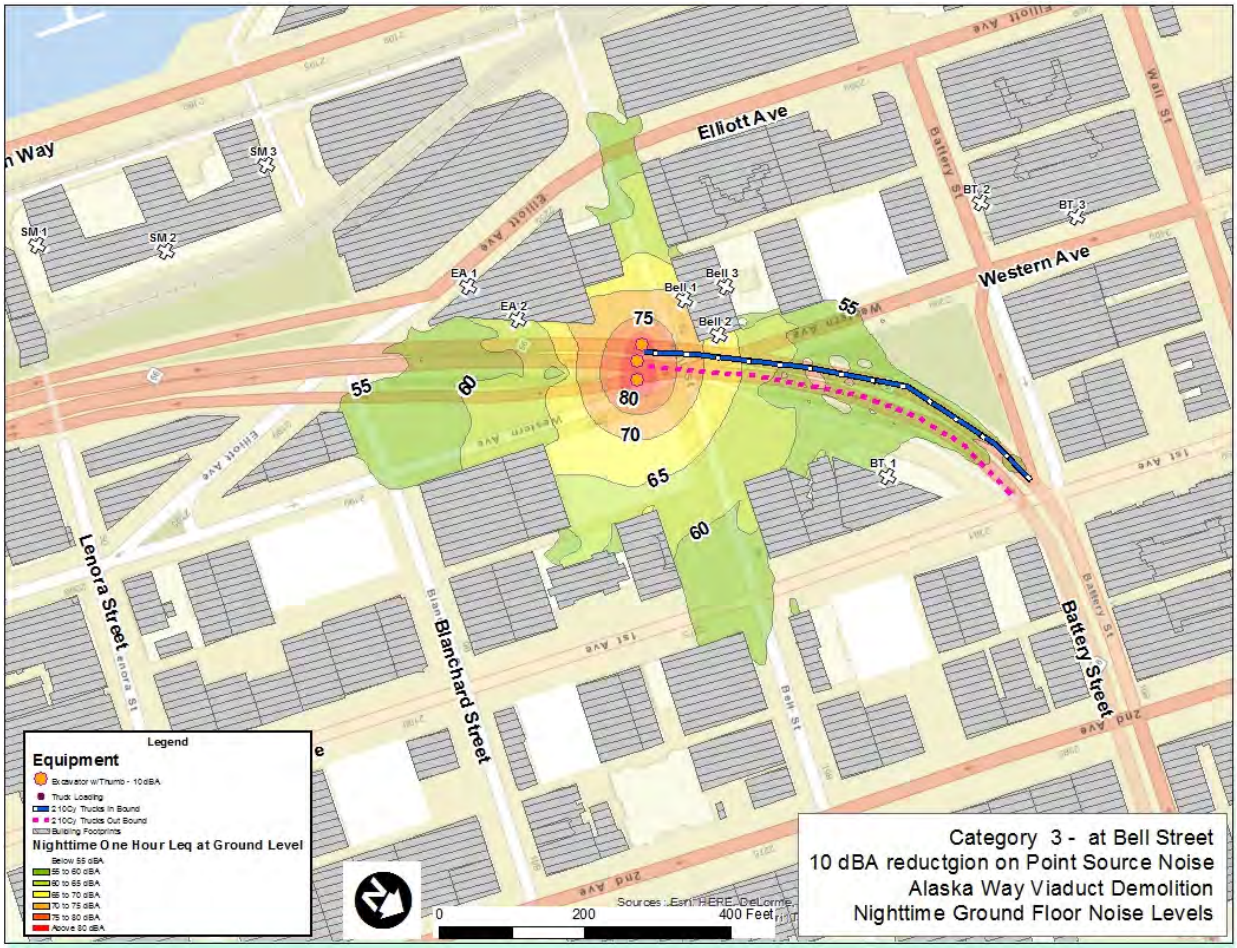


Exhibit 21. Nighttime Demolition from Railroad Tracks to Battery Street Tunnel Daytime Noise Levels with Mitigation



7.7 Seneca and Columbia Ramps Demolition

Seneca and Columbia Ramps demolition would occur in a commercially zoned area and highest nighttime noise levels would occur during a maximum of 7 days. The highest modeled exterior noise levels experienced at buildings closest to the Viaduct during demolition are shown in Exhibit 22. Due to restrictions from working near buildings and to keep access restriction to a minimum, the daytime and nighttime hours would use the same equipment.

For the Seneca and Columbia Ramps, the bridge decks would be saw cut and lifted out by crane and loaded onto flatbed trucks. There would be very limited impact work, the bridge diaphragms would be removed with impact hammers. Debris will be loaded out. Equipment during daytime hours and nighttime hours:

- Demolition of the Ramp: one crane, six concrete saws, one excavator with concrete cracker and one excavator with impact hammer
- Load out: three flatbed semi-trucks and two dump trucks

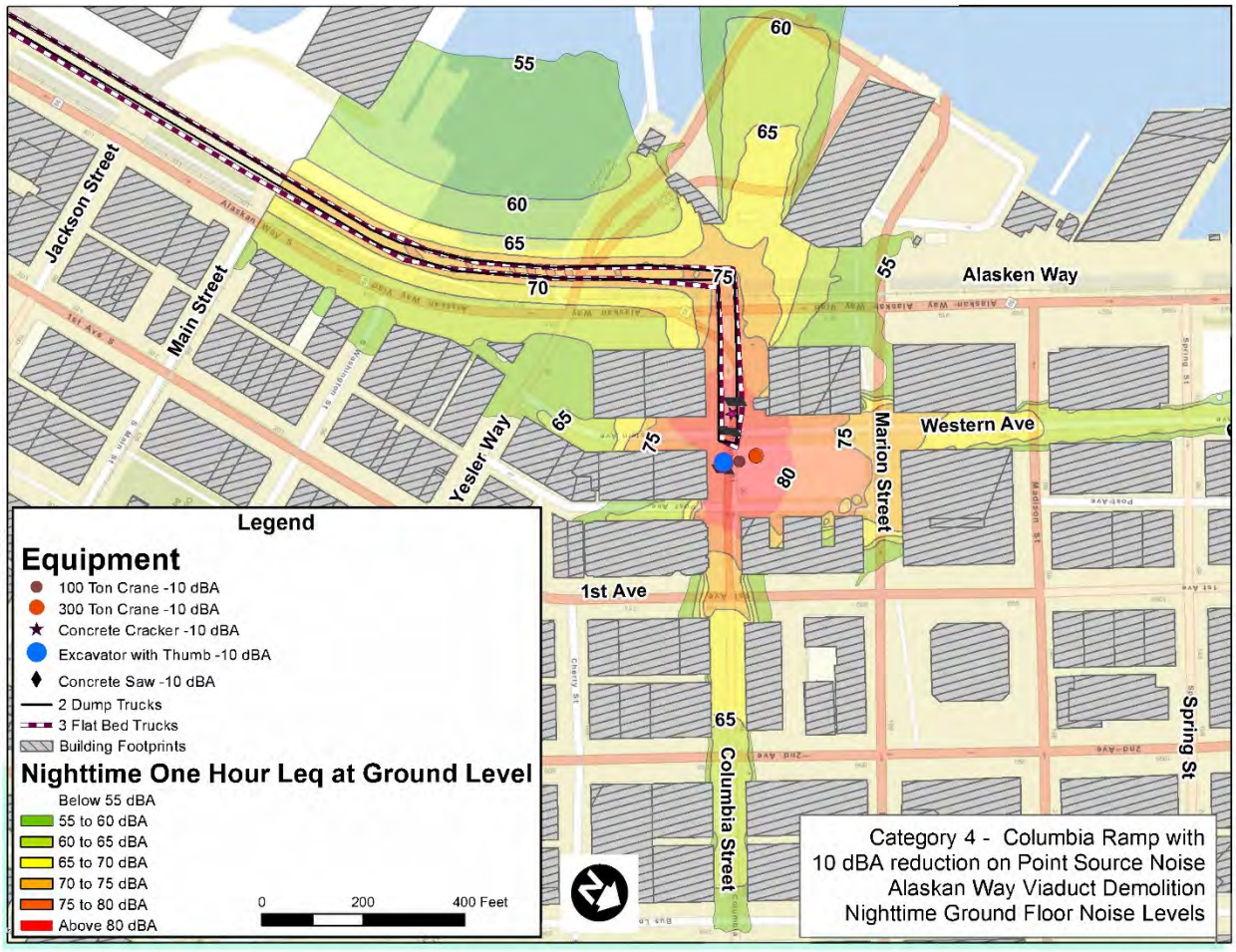
Exhibit 22. Seneca and Columbia Ramps Demolition Modeled Noise Levels

Site	L_{eq} Modeled Noise Level (dBA)	Site 3 and Site 4 L_{eq} Commercially Zoned near ramps Noise Level Limit Range (dBA)	L_1 Modeled Noise Levels (dBA)	Site 3 and Site 4 L_1 Commercially Zoned near ramps Noise Level Limit Range (dBA)
Daytime				
Maximum Noise level modeled	86	90	96	99
200 feet east of maximum	78	90	88	99
200 feet west of maximum	78	90	88	99
Nighttime without mitigation				
Maximum Noise level modeled	86	82 at Seneca 84 at Columbia	96	92 at Seneca 94 at Columbia
200 feet east of maximum	78	82 at Seneca 84 at Columbia	88	92 at Seneca 94 at Columbia
200 feet west of maximum	78	82 at Seneca 84 at Columbia	88	92 at Seneca 94 at Columbia
Nighttime with muffler mitigation				
Maximum Noise level modeled	82	82 at Seneca 84 at Columbia	92	92 at Seneca 94 at Columbia
200 feet east of maximum	78	82 at Seneca 84 at Columbia	88	92 at Seneca 94 at Columbia
200 feet west of maximum	78	82 at Seneca 84 at Columbia	88	92 at Seneca 94 at Columbia

Demolition noise levels would meet the proposed daytime and temporary 7 day nighttime Leq noise level limits for Seneca and Columbia Ramp demolition. Nighttime noise levels were modeled using with mitigation, the mitigation is reducing the point source noise emission by 10 dB, with a better muffler. Exhibit 23 and Exhibit 24 show the modeled noise levels for the daytime and nighttime with mitigation.

Exhibit 23. Seneca Ramp Demolition Nighttime Noise Level Contours with Mitigation

Exhibit 24. Columbia Ramp Demolition Noise Level Contours with Mitigation



8. Proposed Noise Mitigation Measures

8.1 Required Minimum Mitigation Measures

The contractor will perform the following minimum mitigation measures to minimize nighttime construction noise, except in the case of emergency, as defined by the Seattle Noise Control Ordinance (SMC 25.08.110), whenever the contractors work between 10 p.m. and 7 a.m. Monday through Friday, or between 10 p.m. and 9 a.m. Saturday through Sunday and legal holidays, and exceeds the local ordinance noise levels:

- The contractor will meet the noise levels limits established in the noise variance.
- The contractor will use broadband or strobe backup warning devices, or use backup observers in lieu of backup warning devices for all equipment, in compliance with Washington Administration Code, Sections 296-155-610 and 296-155-615. For dump trucks, if the surrounding noise level is so loud that broadband or strobe backup warning devices are not effective, then an observer must be used (WAC 296-155-610). This condition will apply to activity conducted between 10 p.m. and 7 a.m., Monday through Friday, and between 10 p.m. and 9 a.m. on Saturday, Sunday, and legal holidays. No pure-tone backup warning devices will be used after 10 p.m. and before 7 a.m. weekdays or 9 a.m. weekends and legal holidays.
- The contractor will use better mufflers and will reduce the point source noise emission by 10 dB for equipment to reduce noise levels to meet the noise levels limits established in the noise variance when needed and during temporary 7 day nighttime Leq noise level limits for Seneca and Columbia Ramp demolition.
- The contractor will securely fasten truck tailgates.
- The contractor will not use compression brakes.
- The contractor will not leave equipment to idle for longer than five minutes,

8.2 Additional Noise-Control Measures

The contractor will submit to WSDOT an updated NMMP to reflect their specific construction means and methods and will detail the additional mitigation measures needed to meet the noise level limits established in the noise variance. Once WSDOT has reviewed and accepted the NMMP, the contractor will submit it to SDCI. Additional mitigation measures that the contractor could also use as necessary are listed below:

- Equip nighttime surface equipment with high-grade engine-exhaust silencers and engine-casing sound insulation.

- Use electric welders powered from utility main lines instead of gas, diesel, or internal combustion generators/welders.
- Use critical or double mufflers where practicable on machinery for off-road use, such as cranes.
- Use noise blankets, skirts, or other available means for mobile equipment to mitigate noise that does not unreasonably interfere with the operation of the engine.
- Use temporary mobile noise barriers in the immediate vicinity of loud activities nearby residences.
- Use temporary noise barriers.
- Provide earplugs and white noise machines to residents near the project area.
- Install temporary sound dampening drapes for residents.
- Provide hotel rooms for residents during high impact or extremely noisy operations.

8.3 Compliance Monitoring and Reporting

Director's Rule 3-2009, Section C.2, requires that WSDOT provide for an Independent Noise Monitor (INM), who may be an individual, firm, or contracted staff member within SDCI independent from the contractor whose responsibility is to oversee the monitoring of sound levels from construction covered by the MPPCNV and to report directly to the SDCI Coordinator for Noise Abatement. WSDOT plans to dedicate the resources needed to have a WSDOT trained inspector on-site to perform the duties of the INM.

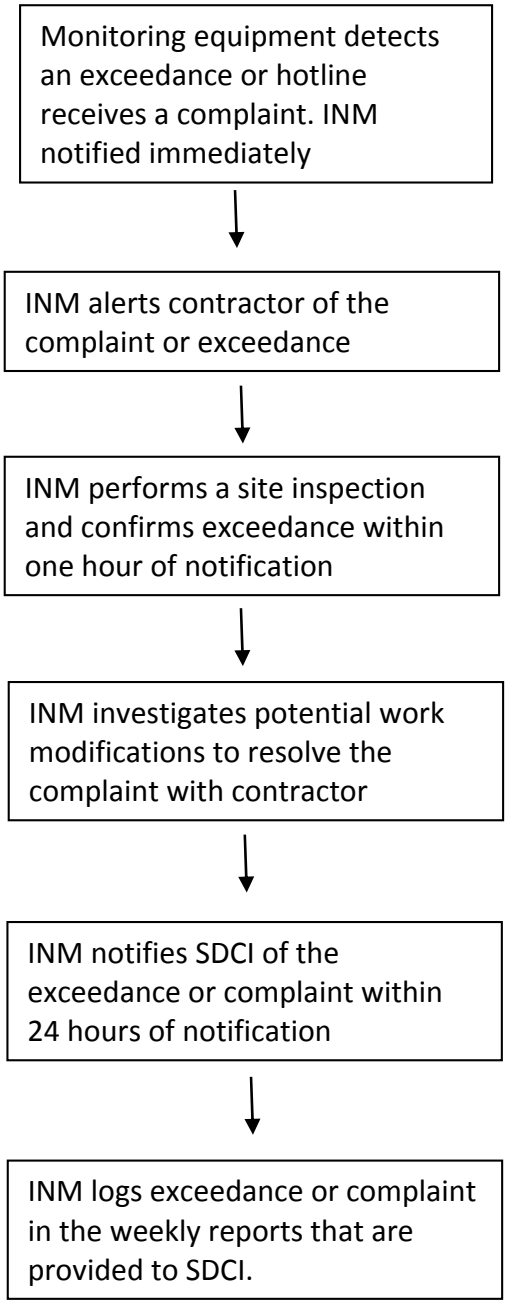
The contractor will create the Noise Monitoring Plan based on the NMMP submitted by WSDOT. The contractor will take noise measurements continuously during nighttime hours using automated noise monitoring equipment that is consistent with the American National Standards Institute Standards to Type 1 and that allows for remote access to real time results available to SDCI, WSDOT, and the contractor. The noise monitoring equipment will have the capability to log continuous L_{eq} and L_1 sound levels and to initiate a recording of audio files when the L_{eq} or L_1 sound-level thresholds are exceeded. Sound level thresholds will be set at 5 dBA below the MPPCNV nighttime L_{eq} and L_1 noise levels limits. The Noise Monitoring Plan will identify the type and location of monitoring equipment. There will be a minimum of three noise monitoring stations placed at or near the residences affected by the Viaduct demolition when activities are occurring during nighttime hours. Generally, monitors will be placed at 3 locations near the activities, one at or near the building with sensitive nighttime uses such as residences or hotel rooms, one two hundred feet east and two hundred feet west of the loudest demolition activities. Monitors will be activated and relocated as appropriate to provide data for the nearest affected residences when nighttime construction occurs.

If the monitoring equipment detects an exceedance of the MPPCNV nighttime noise level limits, or if a caller to the hotline has a noise-related complaint and requests additional information, the INM will be notified. The INM will be on-site during all periods of scheduled night work. If the INM receives a complaint call during nighttime work hours, the INM will notify the contractor and other WSDOT inspection staff on the job, perform a site inspection within 60 minutes of receiving the complaint, conduct short-term noise measurements (minimum 15 minutes per location) while on-site to confirm whether an exceedance of the MPPCNV sound-level limits is occurring, and investigate potential work modifications to resolve the complaint. INM's regular duties include, but are not limited to:

- Coordinating with WSDOT and contractor's night time crews about planned work operations.
- Coordinating with WSDOT Communications Team on any updates or concerns from neighborhood and residents.
- Coordinating with SDCI on any questions or concerns from the City regarding project noise.
- Conducting nightly verification of fixed noise monitoring stations with hand held noise monitor to validate noise monitoring results from the fixed locations.
- Conducting regular spot-check noise monitoring at various locations of the project site with hand held monitor.
- Addressing noise exceedances and monitoring alarms in the field.

The Noise Monitoring Plan will also include a provision to generate weekly and annual reports that are required as part of Director's Rule 3-2009. The reports will be provided to SDCI and will include any monitored L_{eq} and L_1 exceedances, noise complaints logged in the program database, and work modifications completed to resolve complaints. The reporting structure for noncompliance or a noise complaint is detailed in Exhibit 25. The weekly reports will be publicly available on-line.

Exhibit 25. Reporting Structure for Non-compliance



8.4 Public Outreach and Community Involvement

WSDOT believes public involvement is essential to a project's development and has implemented a comprehensive and ongoing public involvement program for the Alaskan Way Viaduct Replacement Program. During the Viaduct demolition, WSDOT's communications team, in coordination with the selected contractor, will provide up-to-date information on construction activities and construction noise to neighbors and stakeholders.

WSDOT will keep the public informed of construction activities, promote two-way communication with the community, and work to minimize construction impacts.

The key elements of the communications plan are outlined below.

8.4.1 Written Materials

WSDOT uses a variety of written materials to provide advance notification and keep people informed of construction activities. All written materials have program contact information, including the email address, website, and the 24-hour live telephone construction hotline number. Examples of these types of materials include:

- Fact sheets to provide background information for the type of work occurring and project benefits.
- Fliers which are often delivered door-to-door when there are localized construction impacts.
- Mailers which are sent to neighbors in compliance with permitting requirements.

In summer 2017, WSDOT conducted an extensive public outreach effort to share project information and solicit feedback from the public about early plans for viaduct demolition. More than 12,000 people visited an online open house, and 150 people attended an in-person open house on August 10.

WSDOT received 410 responses to an eight-question survey about the demolition project. Eighty-four percent of respondents said they would prefer that some noisy work be allowed later at night if it means demolition will be completed sooner.

8.5 Online and Electronic Communications

WSDOT uses a combination of the following online and electronic communications to keep community members informed of upcoming and ongoing construction activities:

- WSDOT maintains an electronic mailing list, and regular email updates are sent to provide status updates and information on current activities.
- The project website is updated regularly and provides the latest design and construction information.

- WSDOT collaborates with other agencies and organizations to provide information in their respective email updates or websites.
- The 24-hour live telephone construction hotline will be maintained for the Viaduct demolition. Real-time responses to immediate concerns and updates of the project status and current construction activities and impacts will be provided.
- Detailed responses will be provided to emails received via the project email address.

9. Conclusion

WSDOT is completing the application process for a nighttime noise variance because construction crews will work at night within the City of Seattle limits during the Viaduct demolition. Completion of all construction activities during only daytime hours would extend the construction period and increase the economic cost to taxpayers. Since evening impact and nighttime work will be required, WSDOT would receive this variance from SDCI to set limits on the noise levels for nighttime construction activities.

WSDOT understands that constructing this project in a dense, urban environment has an effect on those who live, work, travel, and play near the Viaduct. This variance requires WSDOT to implement nighttime noise limits, requires our contractor to implement noise-control measures, and ensures appropriate monitoring and enforcement of our nighttime construction activities, while also ensuring the safety of the public and our crews.

9.1 Temporary Noise Variances

In addition to the Viaduct demolition, WSDOT will complete the Battery Street Tunnel decommissioning, and construct north surface streets. Each of these projects may require up to three two week Temporary Noise Variances to complete the work.

Battery Street Tunnel decommissioning includes removing existing piping and duct work in the tunnel, removing soot from the walls and ceiling of the tunnel, breaking up the tunnel floor slab to facilitate drainage if water gets into the tunnel and, backfilling the lower section of the tunnel with compacted concrete rubble, gravel borrow, common borrow, or other suitable material. When headroom in the tunnel becomes limited the ends would be sealed and the remaining space would be filled with controlled density fill or some other flowable material until the entire tunnel is backfilled. The tunnel lid would remain in place except where the contractor needs to remove small sections of the lid to facilitate the backfilling operation. The ventilation grates on the surface (Battery Street) and on the adjacent sidewalks would be removed and filled in with concrete. Finally, new ADA ramps would be constructed at all intersections along the length of the tunnel and a small escape house at 4th and Battery Street would be removed.

North Surface Street Reconstruct includes Aurora Avenue North between Denny Way and Harrison Street. Work could begin any time after the new tunnel opens. The reconstruction includes adding signalized intersections at Thomas and John cross streets and replacing the signal at Denny Way to align with the reconstructed configuration. Another component includes rechannelization and minor reconfiguration of the Aurora Avenue block south of Denny Way, which overlies the Battery Street Tunnel. The Battery Street Tunnel lid would remain in place after decommissioning, thus work would be limited to pavement overlay supplemented with partial curb and sidewalk reconstruction. Finally, approximately 16 curb ramps in vicinity would be evaluated for maximum extent feasible ADA upgrades.

Appendix A

Raw Existing Baseline Noise Monitoring Data

Noise Management and Mitigation Plan for Alaskan Way Viaduct Replacement Viaduct Demolition

Prepared for

Washington State Department of Transportation

Lead Author

Ginette Lalonde
WSP USA

October, 2017

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Table A-1: Existing Sound Levels at Site 1 Elliott Pointe																
	Leq								**Lmax**							
	Wednesday, August 02, 2017	Thursday, August 03, 2017	Friday, August 04, 2017	Saturday, August 05, 2017	Sunday, August 06, 2017	Monday, August 07, 2017	Tuesday, August 08, 2017	Wednesday, August 09, 2017	Wednesday, August 02, 2017	Thursday, August 03, 2017	Friday, August 04, 2017	Saturday, August 05, 2017	Sunday, August 06, 2017	Monday, August 07, 2017	Tuesday, August 08, 2017	Wednesday, August 09, 2017
0:00:00		67.3	67.3	66.9	67.5	65.7	65.4	65.6		78.4	74.9	78.4	77.6	80.9	76.2	76.8
1:00:00		65.7	65.4	66.2	66.1	63.8	63.8	63.7		77.9	75.6	87.4	77.5	76.5	74.9	75.4
2:00:00		65.3	64.7	65.0	65.2	63.8	63.4	63.8		79.4	75.6	75.2	79.0	76.8	76.5	83.7
3:00:00		64.9	64.7	64.4	64.3	64.3	63.4	64.3		75.5	76.6	75.0	85.1	79.2	77.5	88.6
4:00:00		67.7	66.5	65.5	63.5	66.5	66.4	65.9		82.6	77.6	87.7	76.1	80.4	77.2	75.4
5:00:00		70.9	70.3	66.9	65.4	70.4	70.3	70.4		82.8	82.5	77.7	84.3	80.5	79.9	81.2
6:00:00		73.4	73.0	68.9	67.0	73.4	73.5	73.3		80.5	85.9	80.0	77.4	80.3	81.2	86.8
7:00:00		74.0	73.7	69.8	67.7	74.1	74.0	73.8		84.9	91.4	87.1	77.6	89.0	86.7	85.5
8:00:00		73.3	73.4	70.8	69.1	73.5	73.5	73.3		80.4	82.2	78.3	79.1	83.3	87.7	82.4
9:00:00		73.1	72.8	71.4	70.6	72.9	72.6	73.2		82.2	81.0	85.9	86.3	84.6	83.1	82.5
10:00:00		72.8	72.5	71.7	71.1	72.3	72.3	72.5		83.9	87.2	78.2	87.3	82.5	78.6	88.1
11:00:00		72.3	72.3	71.8	71.4	71.9	71.7	72.2		91.2	81.6	85.7	87.6	88.5	80.2	83.3
12:00:00		72.5	70.6	71.8	71.4	71.3	71.6	72.3		91.1	94.4	87.1	80.7	78.6	85.1	82.8
13:00:00		74.0	71.8	73.2	73.6	71.6	71.7	71.9		99.3	95.7	95.6	100.0	80.9	81.1	87.7
14:00:00		70.0	70.7	73.1	72.0	71.5	70.5	69.3		84.8	93.0	98.2	89.3	88.7	80.1	80.0
15:00:00	70.2	69.5	69.8	71.5	71.7	69.7	70.0		82.0	80.9	94.3	83.9	84.1	81.5	82.0	
16:00:00	67.7	69.3	69.2	71.7	71.7	69.9	69.4		84.9	79.1	82.6	89.8	89.7	77.5	80.6	
17:00:00	65.5	68.5	68.4	71.1	71.4	66.9	65.6		81.2	80.1	84.2	93.5	83.5	76.4	77.5	
18:00:00	71.4	70.8	70.7	70.7	70.9	68.1	69.8		88.2	79.4	83.1	83.4	81.6	77.2	82.7	
19:00:00	71.2	71.2	70.7	70.2	70.2	70.5	70.4		90.6	92.2	83.8	82.0	81.5	86.2	79.7	
20:00:00	70.3	70.0	69.4	70.0	69.9	69.7	69.7		85.8	81.6	79.5	84.3	80.7	78.0	82.7	
21:00:00	70.4	69.6	69.5	70.4	69.4	68.6	69.9		80.0	77.1	78.7	92.6	88.5	77.4	83.7	
22:00:00	69.3	69.0	69.2	69.6	68.8	68.8	68.6		83.4	75.6	87.3	86.8	78.0	86.7	77.5	
23:00:00	68.3	68.1	68.2	68.7	67.3	67.5	67.7		88.8	78.1	80.2	83.1	80.3	79.8	80.0	

Table A-2: Existing Sound Levels at Site 2 Waterfront Landings Condominiums																
	Leq								**Lmax**							
	Wednesday, July 19, 2017	Thursday, July 20, 2017	Friday, July 21, 2017	Saturday, July 22, 2017	Sunday, July 23, 2017	Monday, July 24, 2017	Tuesday, July 25, 2017	Wednesday, July 26, 2017	Wednesday, July 19, 2017	Thursday, July 20, 2017	Friday, July 21, 2017	Saturday, July 22, 2017	Sunday, July 23, 2017	Monday, July 24, 2017	Tuesday, July 25, 2017	Wednesday, July 26, 2017
0:00:00		69.7	70.1	71.4	70.9	69.6	69.8	70.3		90.2	82.8	86.2	86.6	82.9	86.1	85.2
1:00:00		68	68.9	70.4	70	68	67.5	68.3		87.2	90.6	82.8	82.7	82.9	86.3	85
2:00:00		67.8	68.1	69	68.9	66.4	65.9	66.8		86.2	84.2	82	82.6	83.5	84	83.5
3:00:00		67	67.8	67.3	67.4	67.5	67.2	66.5		81.8	82.5	81.5	81	82	81.8	82.7
4:00:00		70.8	70.4	68.6	67.6	70.4	70.4	73.5		81.8	87.9	81.7	81.3	82.2	83.8	99.8
5:00:00		74.5	74.6	70.7	70.4	74.8	74.4	74.6		84.5	84.6	84.1	83.7	84.8	86	86.2
6:00:00		77.5	77.2	72.2	72.5	77.3	77	77.4		92.4	99	82	84.8	85.2	88.4	87.6
7:00:00		77.6	77.3	72.9	72.8	77.6	77.5	77.6		90.3	84.7	86.4	89.8	90.9	94.3	89.9
8:00:00		76.9	77	74	74.5	76.5	76.6	75.4		92.1	84.9	84.8	85.4	89.7	87.2	88.9
9:00:00		76.6	76.2	74.4	75.3	76	76	73.4		87	88.2	93.9	86.2	97.1	89.3	93.1
10:00:00		76.2	75.5	75.2	75.5	75.8	75.6	75.6		89.3	86.1	85.7	83.5	83.6	87.7	86.5
11:00:00		76.1	75.9	74.6	75.7	75.6	75	72.7		92.9	90.8	91	100	89.6	85.8	86.4
12:00:00		76	75	74.6	75.6	75.7	75	68.6		84.4	95.3	87.8	102.7	87.9	86.1	82.9
13:00:00		74.3	69.2	75	75.1	76.2	75.4	68.6		84.1	93.7	93	93.3	86.5	90.1	82.5
14:00:00		69.4	68.2	73.5	75.3	70.9	71.3	69.6		82.5	83.7	89.8	91.6	87.5	81	84.6
15:00:00		69.3	68	67.3	73.8	70.4	70.2	70		91.7	84	85.1	89.6	81.6	86.7	80.7
16:00:00	67.3	69.7	68	67.9	67.6	68.7	69.8		83.1	81.1	84.9	82.6	82.3	80.9	79.5	
17:00:00	69.2	68	67.9	68.9	69.4	67.3	67.9		83	83.5	83.9	83.7	78.2	77.4	79.9	
18:00:00	69.3	68.4	70.4	75.7	69.7	69.2	69.2		88.2	80.8	93.4	90.9	81.4	84.3	83.2	
19:00:00	74.2	69.7	73	75.2	72.9	74.3	73		100.9	87.2	84.3	97.9	83.1	94.1	91.9	
20:00:00	75.5	75.7	75.2	74.7	74.6	74.2	75		87.7	93.7	93.3	91.3	98.5	88.9	102.7	
21:00:00	74.9	75	74.6	74.6	73.7	73.8	73.9		93.2	86.6	86.7	86.6	83.1	84	87.4	
22:00:00	73.9	74.5	74.3	74	73.4	73.5	73.1		91.6	85.9	96.4	90.5	85.8	87.8	82.4	
23:00:00	72.3	72.7	72.6	72.6	72.1	71.4	72.4		82.9	82.7	86.9	83	93.9	87.7	87.4	

Table A-3: Existing Sound Levels at Site 3 1201 Western																
	Leq								Lmax							
	Wednesday, August 23, 2017	Thursday, August 24, 2017	Friday, August 25, 2017	Saturday, August 26, 2017	Sunday, August 27, 2017	Monday, August 28, 2017	Tuesday, August 29, 2017	Wednesday, August 30, 2017	Wednesday, August 23, 2017	Thursday, August 24, 2017	Friday, August 25, 2017	Saturday, August 26, 2017	Sunday, August 27, 2017	Monday, August 28, 2017	Tuesday, August 29, 2017	Wednesday, August 30, 2017
0:00:00		66.4	66.8	68.5	67.6	67.1	65.4	67.3		78.1	77.5	76.9	76.5	82.2	80.2	76.7
1:00:00		64.7	65.7	66.6	66.1	64.4	63.4	65.8		79.3	78.8	85.7	77.5	83.5	77.3	77.0
2:00:00		64.9	65.5	65.8	65.5	64.5	64.0	66.3		82.0	77.2	79.1	77.3	76.4	78.9	84.8
3:00:00		64.6	65.8	64.3	64.3	64.2	65.3	66.5		75.1	77.7	75.2	73.7	75.0	75.8	77.3
4:00:00		68.0	68.4	65.7	65.5	67.9	68.0	68.5		77.5	81.4	76.3	76.6	77.5	77.6	81.9
5:00:00		71.5	71.9	68.2	67.3	71.8	71.7	72.2		78.5	81.0	78.1	78.7	80.4	87.0	84.3
6:00:00		73.7	73.9	70.5	69.6	74.1	73.7	73.9		80.6	83.2	77.2	77.2	92.9	82.4	84.2
7:00:00		73.9	74.1	71.4	69.9	73.1	73.1	73.3		78.7	82.3	79.2	79.7	78.1	83.2	81.3
8:00:00		73.4	71.7	72.5	71.4	72.1	70.1	72.8		82.8	86.3	84.3	83.2	81.1	81.4	79.2
9:00:00		73.7	72.6	72.7	72.2	72.4	73.0	73.3		82.5	81.1	79.6	87.7	83.5	79.5	88.3
10:00:00		73.3	72.6	72.8	72.1	72.8	73.2	72.8		90.7	83.7	83.0	76.8	80.8	90.2	85.4
11:00:00		73.2	71.5	71.9	71.6	72.2	72.3	72.6		78.1	82.5	93.2	77.4	87.0	81.3	86.9
12:00:00	72.8	72.7	70.5	70.1	72.0	71.9	72.0		81.2	84.0	82.6	89.1	80.8	80.3	81.4	
13:00:00	72.6	72.3	70.8	71.4	71.9	71.8	71.9		81.2	84.4	92.5	90.4	84.9	82.4	82.7	
14:00:00	72.1	70.9	70.7	76.5	71.8	70.5	70.6		85.7	87.2	87.5	97.1	82.9	81.2	81.7	
15:00:00	71.5	70.8	69.6	70.5	71.6	70.7	70.7		90.0	83.6	83.0	89.2	80.7	85.0	81.9	
16:00:00	70.8	71.0	68.5	70.2	71.3	71.1	71.0		87.0	81.5	83.5	83.0	78.2	88.3	80.3	
17:00:00	71.3	70.5	70.3	70.4	70.1	70.4	70.7		79.0	85.3	81.9	78.3	76.6	83.8	78.7	
18:00:00	70.8	70.1	70.4	69.7	71.5	70.8	71.1		80.2	80.3	84.3	91.9	78.2	79.6	81.1	
19:00:00	71.3	70.6	70.8	70.9	71.1	71.6	71.6		79.5	82.0	81.9	89.4	77.1	89.3	87.3	
20:00:00	71.7	71.0	71.2	70.3	70.9	69.7	70.3		79.0	78.3	84.5	77.8	77.8	85.2	77.2	
21:00:00	70.6	70.8	71.3	70.0	71.4	69.3	70.3		76.9	84.6	83.9	78.7	82.4	77.2	84.9	
22:00:00	70.6	70.0	71.0	70.8	69.8	68.7	69.7		78.4	82.5	83.1	87.7	75.7	79.2	83.5	
23:00:00	69.9	68.8	71.1	69.7	69.0	67.2	68.2		85.9	78.1	92.3	83.2	78.3	83.7	83.5	

Table A-4: 815 Western Avenue																
	Leq								**Lmax**							
	Friday, July 07, 2017	Saturday, July 08, 2017	Sunday, July 09, 2017	Monday, July 10, 2017	Tuesday, July 11, 2017	Wednesday, July 12, 2017	Thursday, July 13, 2017	Friday, July 14, 2017	Friday, July 07, 2017	Saturday, July 08, 2017	Sunday, July 09, 2017	Monday, July 10, 2017	Tuesday, July 11, 2017	Wednesday, July 12, 2017	Thursday, July 13, 2017	Friday, July 14, 2017
0:00:00		69.4	69.0	68.0	67.4	67.3	68.4	67.8		79.8	82.7	75.5	80.2	75.5	80.9	82.4
1:00:00		68.3	68.0	67.5	66.6	66.7	67.1	67.3		80.2	76.2	79.7	74.6	74.2	75.4	87.2
2:00:00		67.7	67.9	67.5	66.5	66.5	67.1	66.7		76.8	82.4	92.7	74.6	76.8	77.7	77.2
3:00:00		67.1	66.3	67.5	66.5	66.7	67.2	66.8		83.1	72.1	73.7	75.3	75.2	77.8	72.9
4:00:00		67.5	67.0	69.0	68.0	68.2	68.4	68.3		74.5	74.7	83.4	77.5	75.5	77.1	76.3
5:00:00		68.5	68.2	71.2	70.9	71.0	71.3	71.1		76.6	83.6	80.5	82.0	85.0	82.0	84.4
6:00:00		70.1	70.0	73.2	72.8	73.1	73.0	73.1		81.2	82.5	81.0	81.1	84.0	79.7	81.9
7:00:00		71.0	70.2	73.6	72.9	73.3	73.3	73.2		85.7	83.2	80.7	86.1	84.5	85.0	79.6
8:00:00		72.9	70.8	73.1	73.3	72.5	72.7	72.7		79.0	86.3	82.9	82.7	84.7	82.6	80.1
9:00:00		72.9	71.4	73.3	73.6	73.2	72.9	75.2		90.2	78.7	91.9	86.2	82.3	86.1	83.6
10:00:00		72.4	71.5	72.7	73.0	72.8	72.0	73.2		78.1	82.5	81.8	85.5	88.4	78.7	87.2
11:00:00		71.8	71.3	72.6	72.8	72.5	72.9	72.0		87.2	79.6	84.2	83.1	84.3	81.7	87.6
12:00:00		71.8	71.1	72.4	72.0	72.0	72.6	69.8		80.4	81.0	84.4	79.3	84.0	79.9	81.0
13:00:00		71.7	71.5	72.5	71.9	71.9	72.1	70.6		87.1	87.8	83.9	86.1	82.1	84.1	87.8
14:00:00		72.4	71.3	72.1	71.7	71.6	72.0	70.4		83.9	77.2	85.2	85.3	83.6	84.3	85.1
15:00:00		71.6	71.3	71.1	71.7	71.2	71.4	71.1		80.6	80.9	84.5	93.4	83.9	81.1	87.5
16:00:00	71.3	70.9	71.5	71.4	71.2	71.0	71.6		83.6	83.8	84.3	84.6	79.6	77.9	80.0	
17:00:00	70.6	69.9	71.3	70.5	69.3	70.2	71.1		87.0	84.4	84.7	82.3	79.2	78.8	88.0	
18:00:00	70.2	69.9	71.0	70.2	70.0	70.5	70.5		84.0	86.2	86.8	83.9	84.7	83.9	89.9	
19:00:00	70.2	70.0	70.3	70.9	70.9	69.8	69.8		78.7	83.0	85.3	78.3	87.3	84.6	83.7	
20:00:00	70.7	70.2	69.9	70.5	71.0	69.7	70.6		78.4	80.5	80.9	78.5	85.9	83.9	84.2	
21:00:00	70.4	70.3	70.2	69.9	70.4	70.0	70.3		78.5	87.7	82.4	79.6	81.1	81.8	76.5	
22:00:00	70.7	70.7	70.3	69.9	70.1	70.3	70.6		80.4	83.1	75.5	88.1	75.0	81.8	80.5	
23:00:00	69.9	70.0	69.1	68.7	69.3	69.5	69.6		83.0	79.5	75.4	82.5	82.3	76.0	82.7	