Mitigation

What has been done to avoid or minimize negative effects from noise?

When project-related noise effects are identified, traffic noise mitigation measures must be considered. Mitigation measures that meet applicable feasibility and reasonableness criteria must be recommended for inclusion into the project. Feasibility deals primarily with engineering considerations (such as whether substantial noise-level reductions could be achieved or whether property access would be negatively affected). Reasonableness is a cost-benefit analysis based on predicted future noise levels.

Several different traffic noise abatement measures are evaluated whenever noise effects are expected. Under WSDOT policy, the following abatement measures must be considered:

1. Traffic management measures (for example, traffic-control devices and signing for prohibition of certain vehicle types; time-use restrictions for certain vehicle types; and modified speed limits).
2. Highway design measures (for example, alteration of horizontal or vertical alignments). Although not listed specifically in 23 CFR 772, the construction of highway lids is included in this category for the I-5 to Medina project.
3. Acquisition of property rights (either in fee or lesser interest) for construction of noise barriers.
4. Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development that would be adversely affected by traffic noise. This measure may be included in Type I projects only.
5. Noise insulation of public use or nonprofit institutional structures.
6. Construction of noise barriers (including landscaping for aesthetic purposes), whether within or outside the highway right-of-way. Interstate construction funds may not be used for landscaping.

Traffic Management Measures

Traffic management measures include modifying speed limits, restricting or prohibiting truck traffic, or closing roadways or access ramps during times when noise could have an adverse effect.

Modifying Speed Limits

Speed reduction can reduce noise levels from vehicles. However, this method is not seen as a potential mitigation or design option for this project as it would interfere with the project objectives. Furthermore, the slight noise reduction that would be achieved would not significantly reduce noise levels or noise effects. Therefore, this method is not considered a feasible or reasonable form of noise mitigation for this project.

Restricting Truck Traffic

The SR 520 corridor is an important regional and local truck route. Restricting truck use or closing truck access to ramps on the I-5 to Medina project would reduce noise levels at nearby receivers because trucks are louder than cars. However, placing time-use restrictions on, or prohibiting, truck traffic on SR 520 or its access ramps would displace trucks onto local side streets, which would increase noise levels in areas that currently have lower truck traffic volumes (for example, residential side streets). Therefore, this method is not considered a feasible or reasonable form of noise mitigation for this project.

Highway Design Measures

Highway design measures include altering the roadway alignment, using plants for sound reduction, depressing (lowering) sections of the roadway, and placing lids over portions of the highway.

Altering the Roadway Alignment

Altering the roadway alignment could decrease noise levels by moving the noise source farther from the affected receivers. Because the I-5 to Medina project corridor has a limited right-of-way and noise effects are expected to occur along both sides of the roadway, altering the roadway alignment is not seen as a feasible noise-reducing design option. In addition, realigning the project roadway would lower noise levels for residences on one side of the roadway, but would increase noise levels for residences on the other. Finally, as evidence of the limited right-of-way within which the 6-Lane Alternative alignment

could be constructed, some residential structures would have to be displaced to make room for the new roadway. The highly developed urban setting within this study area would also prohibit roadway alignment options.

Using Plants for Sound Reduction

Another noise mitigation measure often discussed is the use of plants for sound reduction. FHWA has stated that up to a 5-dBA reduction in traffic noise might result for locations that have at least 100 feet of dense evergreen foliage between the roadway and the receiver. While dense foliage could reduce noise levels, creating an effective sound barrier would require a substantial amount of land, which is not available within the study area.

Depressing (Lowering) Sections of the Roadway

A depressed roadway can substantially reduce noise, depending on the amount of depression. Under the 6-Lane Alternative, SR 520 would be depressed at the approach to the I-5 interchange and the Montlake interchange. Compared to the elevated SPUI with Option L, Option K's depressed SPUI and tunnel under the Montlake Cut would substantially reduce noise levels in the immediate surrounding areas. Exhibit 46 illustrates how a depressed roadway reduces noise.

Placing Lids over Portions of the Highway

Another design element of the 6-Lane Alternative is five landscaped lids over depressed sections of the roadway. Each lid would be approximately 500 feet long over the highway. These lids would be short enough so that ventilation was not required, but long enough to help reconnect the communities along SR 520. The five lids would be located at:

- I-5/East Roanoke Street
- 10th Avenue East/Delmar Drive East (Delmar lid)
- Montlake vicinity (Montlake lid)
- Montlake Boulevard NE/NE Pacific Street (Options K and L only) (Pacific Street lid)
- Foster Island (land bridge) (Option K only)

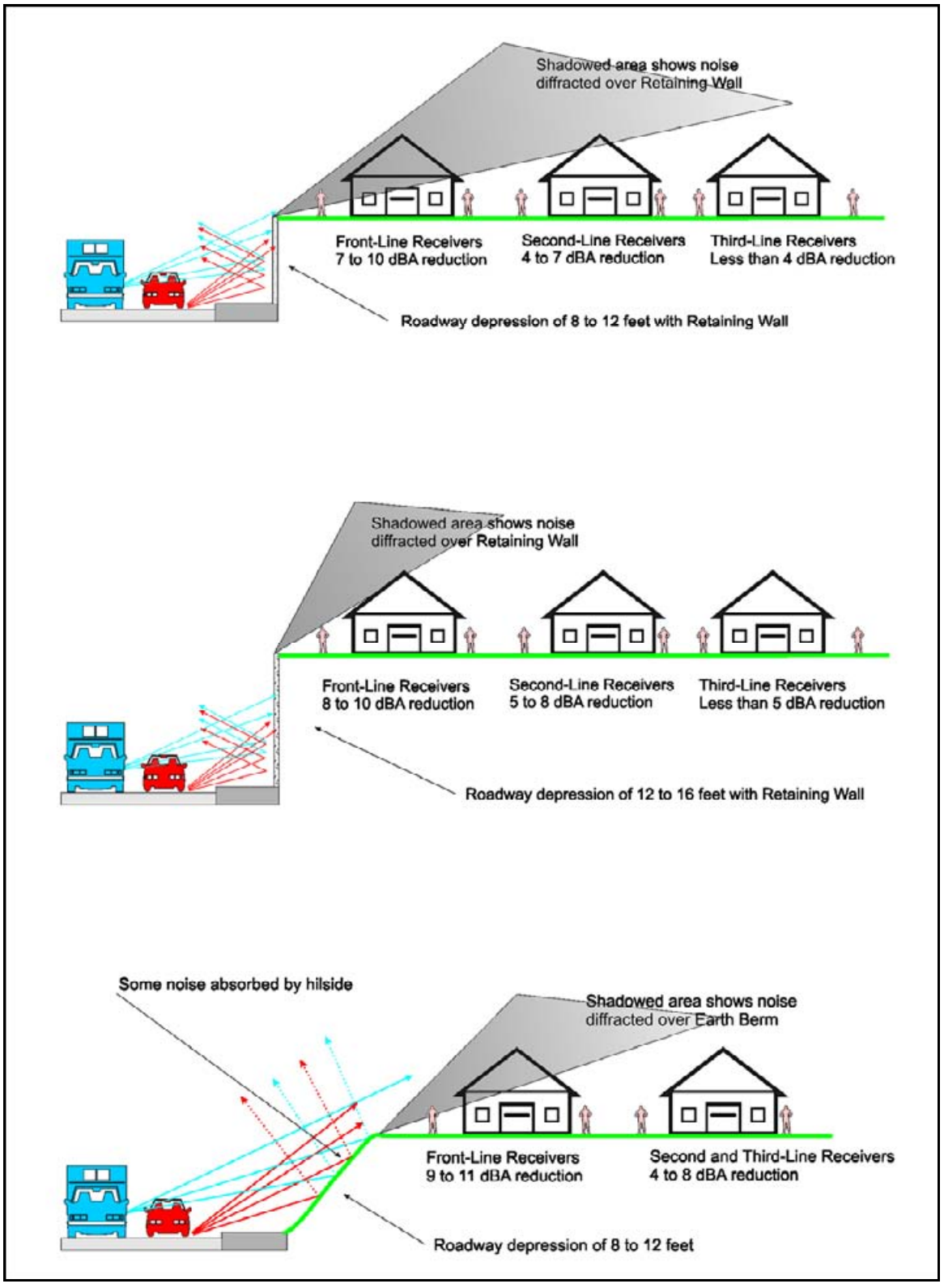


Exhibit 46. Examples of Depressed Roadways and Typical Noise-Reduction Characteristics

Although these lids were included in the 6-Lane Alternative as community enhancements, they are also very effective at preventing noise from reaching noise-sensitive receiver locations near the lidded area. The TNM analysis includes the lids as currently proposed under the 6-Lane Alternative with the three design options. Exhibit 47 shows an example of a depressed roadway with a lid and how the vehicle noise would be contained.

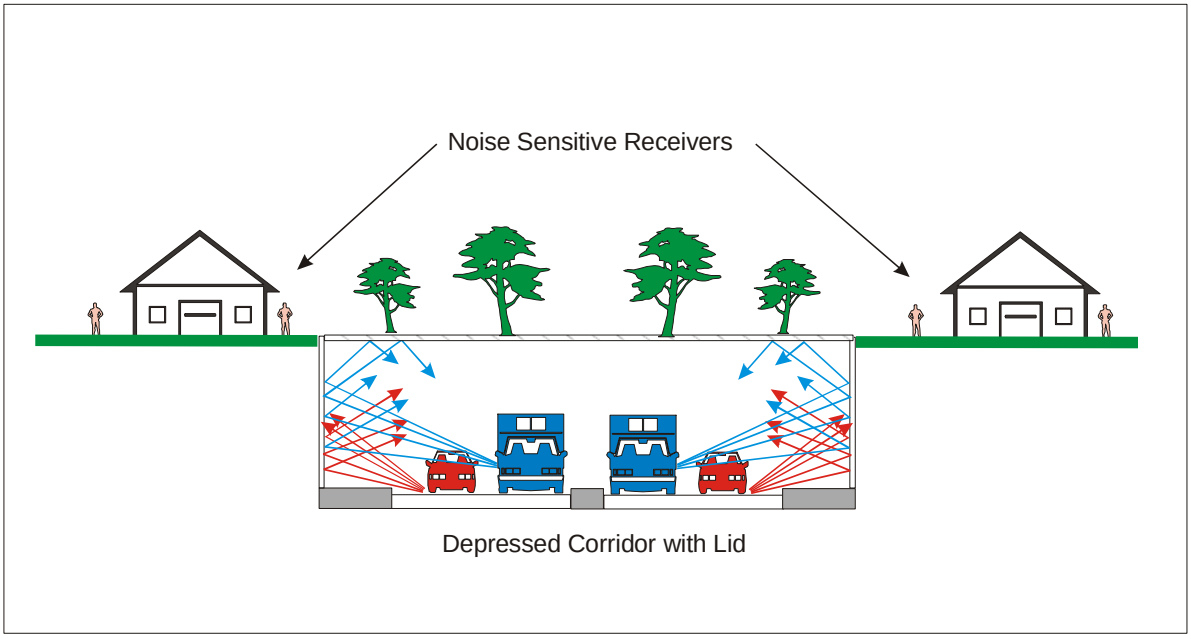


Exhibit 47. Example of a Depressed Roadway with a Lid

Acquisition of Property Rights for Construction of Noise Barriers

Under WSDOT policy, noise barriers (berms or walls) are normally evaluated and constructed within WSDOT's rights of way. In some cases, WSDOT right-of-way might not be the most prudent location for abatement, but abatement might be reasonable if constructed on adjacent property. WSDOT notes that in these cases:

- The department's mitigation cost reasonableness allowance is limited to normal cost for abatement on WSDOT right-of-way;
- The adjacent property owners allow access and easements as necessary to construct and maintain the abatement; and
- Any additional cost to acquire access, acquire property, provide alternative access, or provide additional infrastructure to accommodate access must be added to the barrier cost calculation

and compared to the normal reasonableness cost allowance of the abatement to determine whether the proposed abatement is reasonable.

For those noise barriers that have met WSDOT's feasibility and reasonableness criteria (see the "WSDOT Noise Wall Feasibility and Reasonableness [Cost] Criteria" section), the final placement and construction of recommended noise barriers might require the acquisition of additional property rights. In addition, during final design, noise abatement recommendations might change due to design changes and actual right-of-way acquisitions.

Acquisition of Real Property to Serve as a Buffer Zone

Buffer zones are undeveloped open spaces that border a highway. They are created when a highway agency purchases land or development rights, in addition to the normal right-of-way, so that future dwellings cannot be constructed close to the highway. These buffer zones prevent the possibility of constructing dwellings that would otherwise experience an excessive noise level from nearby highway traffic. FHWA limits the acquisition of real property to serve as a buffer zone to Type I projects such as this I-5 to Medina project.

In addition to the noise abatement benefit, buffer zones can improve the roadside appearance. However, creating buffer zones is often not possible because of the tremendous amount of land that would need to be purchased and because, in many cases, dwellings already border existing roads.

While federal-aid highway funds may be used on a highway project to create buffer zones, this measure has not been used very often. As with acquisition of property rights for construction of noise barriers, any additional cost to acquire access, acquire property, provide alternative access, or provide additional infrastructure to accommodate access must be added to the cost calculation and compared to the normal reasonableness cost allowance of the abatement to determine whether the proposed abatement is reasonable.

Within the study area, the majority of the undeveloped, open spaces that border the proposed alignment have been designated as park lands contained within the Washington Park Arboretum boundary. These park lands, which have been identified as a noise-sensitive land use for the I-5 to Medina project, are restricted from residential development.

No other open spaces within the study area that could be construed as possible buffers zones exist at this time.

Noise Insulation (Public Use or Nonprofit Institutional Structures)

Architectural treatment for noise mitigation may be used for public or nonprofit institutional buildings such as schools, churches, or libraries. Building retrofits, which are considered on a case-by-case basis, are determined during the final design stage. Some possible mitigation measures to reduce interior noise levels to less than the NAC include ventilation systems, storm windows, and air conditioning.

Ventilation Systems

In public buildings where windows are used for ventilation, noise effects might occur. Closing the windows is often sufficient to reduce interior noise levels to less than the NAC. To re-establish the ventilation the windows would have provided, ventilation systems would be needed. A forced-air ventilation system could re-establish proper air circulation while providing effective noise mitigation. The air intakes should be on the north side of the building or in the same proximity as the windows. Air intakes on the roof or on the south side of the building, which might take in abnormally hot air, should be avoided.

Storm Windows

Often storm windows are installed with a ventilation system to further reduce noise. Storm windows also decrease winter heat losses. The money saved in heating could offset any operation or maintenance costs associated with the ventilation system.

Air Conditioning

Air conditioning systems might be used in place of ventilation systems when they could be installed at the same or lower costs. Some air conditioners, however, generate their own noise levels, which might negate the traffic noise reductions. Ventilation systems could also be designed so the public use or nonprofit institution could add air conditioning at a later date.

Noise Barriers

To reduce noise levels, barriers that physically block the transmission of traffic-generated noise might be constructed between the roadways and the affected receivers. Barriers can be constructed as walls or earthen berms. Noise barriers should be high enough to break the line-of-sight

between the highway and the receiver. They must also be long enough to prevent significant flanking of noise around the ends of the barriers.

Earthen Berms

Earthen berms, which require more right-of-way than walls, are usually constructed with a 3-to-1 slope. Earthen berms would not be a feasible form of noise abatement because of the limited amount of right-of-way available for noise barrier construction.

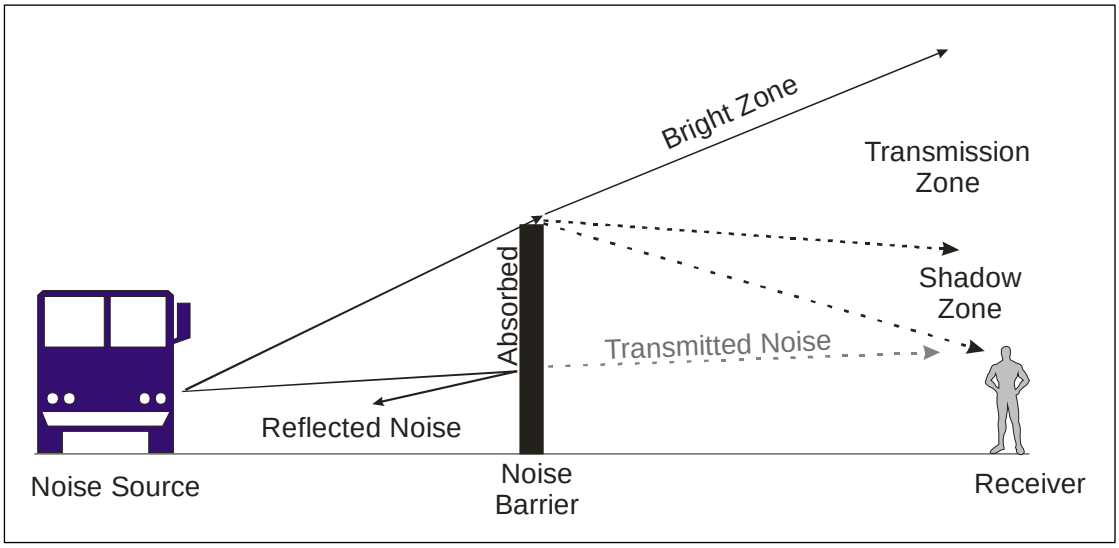
Noise Walls

Openings in noise walls (for example, at driveways, bridges, and side streets) allow noise to pass through the openings, usually limiting the achievable noise-level reduction to less than 3 dBA for receivers near the openings. Other design considerations that can affect the overall effectiveness of noise walls include horizontal placement, the general topography between the receivers and the roadway, and the elevation relationship (for example, relative height differences) between the receiver, noise wall, and roadway. In general, noise walls are most effective if they are placed as close as possible to either the noise source or the receiver locations. In addition, if sensitive receivers are located above the roadway grade, the overall effectiveness of the noise wall can be considerably reduced unless the wall is placed at the same elevation as the receiver. Noise walls have the greatest noise-reducing effect for receivers located close to the roadway.

As shown in Exhibit 48, noise walls reduce traffic noise by directly absorbing it, reflecting it back across the highway, or dispersing or diffracting it upward. Reflected noise is the noise that moves back toward the traffic after hitting the noise wall. Some noise would be diffracted over the wall, while a small amount of noise would either be transmitted through, or absorbed by, the wall.

The following three zones can reduce the effectiveness of a noise wall:

- The **bright zone** is the area above the wall with a direct line of sight to the noise source. The bright zone contains noise directly transmitted from the noise source.
- The **transmission zone** contains some noise that is directly transmitted by the noise source, along with some noise that is diffracted over the wall.
- The **shadow zone** is primarily all diffracted noise.



Source: Adapted from Noise Barrier Design Handbook (USDOT 2000a)

Exhibit 48. Noise Wall Absorption, Transmission, Reflection, and Diffraction

Factors to consider when determining the height of a noise wall include design feasibility and construction costs. There is a point of diminishing returns where the additional height of a noise wall is prohibitively more expensive to construct while providing very little additional noise reduction. Other factors for determining if a noise wall is feasible include construction considerations, safety, and potential noise wall reflections. If a noise wall is safe, feasible, and meets the WSDOT cost-effectiveness criteria (explained in the next section), it is typically recommended for construction with the project.

WSDOT Noise Wall Feasibility and Reasonableness (Cost) Criteria

WSDOT requires that every reasonable effort be made to attain a 10-dBA (or greater) noise reduction at the first row of receivers (for example, front-line receivers). For WSDOT to consider a noise wall a feasible form of mitigation, the following feasibility criteria must be met:

1. The proposed mitigation must be physically constructible,
2. A majority of the first-row ground-floor receivers must achieve a 5-dBA noise reduction as a result of mitigation, assuring that every reasonable effort would be made to assess ground-floor exterior use areas as appropriate, and
3. At least one receiver must have at least a 7-dBA noise reduction.

For most projects, noise wall construction is considered feasible if a 7-dBA noise reduction can be achieved for ground-floor residences. Mitigation from noise walls is not considered for upper floors, such as second floors of single-family residences.

WSDOT has established cost-effectiveness criteria to ensure that, if a noise wall is recommended, its cost is consistent with the level of noise reduction and is not excessive. After a noise wall has been determined feasible, WSDOT decides whether its construction would be reasonable by thoroughly considering the following factors:

1. **Cost per residence.** The noise mitigation cost per residence (or residential equivalent) cannot exceed the amounts indicated in Exhibit 49. The cost per residence is determined by counting all residences (including owner-occupied units, rental units, mobile homes, and residential equivalents as defined by WSDOT) that receive at least a 3-dBA noise reduction from the noise wall, and then dividing that number into the total cost of the noise abatement measure. Each benefited unit in a multifamily building is counted as a separate residence. In addition, areas such as parks and schools are counted based on the WSDOT residential equivalent calculations. The criteria used for the residential equivalency for this analysis were determined using the method WSDOT provided. The "What methods were used to evaluate the potential effects?" section provides more details related to residential equivalents. Exhibit 49 shows that, as the predicted future noise level increases, it is considered reasonable to implement more costly measures, as necessary, to mitigate traffic noise.

2. **Items not included in reasonableness cost calculations.** Consideration of aesthetic barrier treatments, artwork, revegetation, and any increased cost of alternative barrier construction materials with transmission losses lower than 20 dB per frequency range must not be included in the noise mitigation reasonableness cost calculations for long-term noise mitigation. Decisions on aesthetic treatments, revegetation, and barrier material choices are based on applicable WSDOT practices and funding availability.

Noise walls would be constructed only if WSDOT determines that they are feasible and reasonable. WSDOT policy also provides for local jurisdiction and community input to the process of assessing mitigation measures.

Exhibit 49. Cost Allowance for Effects Caused by Total Traffic Noise Levels

Design Year Traffic Noise Level	Noise Level Increase as a Result of the Project[a]	Allowed Cost per Qualified Residence or Residential Equivalent[b]	Allowed Wall Surface Area per Qualified Residence or Residential Equivalent
66 dBA		$37,380	700 sq ft (65.0 sq m)
67 dBA		$41,110	770 sq ft (71.5 sq m)
68 dBA		$44,640	836 sq ft (77.7 sq m)
69 dBA		$48,270	904 sq ft (84.0 sq m)
70 dBA		$51,900	972 sq ft (90.3 sq m)
71 dBA	10 dBA (substantial, Tier 1[c])	$55,530	1,040 sq ft (96.6 sq m)
72 dBA	11 dBA (substantial, Tier 1)	$59,160	1,108 sq ft (102.9 sq m)
73 dBA	12 dBA (substantial, Tier 1)	$62,790	1,176 sq ft (109.3 sq m)
74 dBA	13 dBA (substantial, Tier 1)	$66,420	1,244 sq ft (115.6 sq m)
75 dBA	14 dBA (substantial, Tier 1)	$70,060	1,312 sq ft (121.9 sq m)
76 dBA[d]	15 dBA (substantial, Tier 2)[e]	$73,690	1,380 sq ft (128.2 sq m)

[a] If the noise level increase as the result of the project is 10 dBA or more, follow the "Allowed Wall Surface Area" and "Allowed Cost" for the level of increase in lieu of the "Total Design Year Traffic Noise Level." For total design year highway-related noise levels at 76 or more dBA or for projects that result in an increase of 15 or more decibels, continue increasing the allowance at the rate provided in this exhibit unless circumstances determined on a case-by-case basis require an alternative methodology for determining the cost allowance.

[b] Costs are re-evaluated on an as-needed basis. Currently based on $53.40 per square-foot constructed cost.

[c] Tier 1 is when the noise levels are 10 to 14 dBA over existing traffic noise as a result of the transportation project.

[d] If the traffic-related noise level is 80 dBA or more or there is an increase of traffic-related noise of 30 dBA or more over existing traffic noise levels as a result of a proposed transportation project, then the effects are considered severe. Additional consideration for mitigation may be considered under these circumstances.

[e] Tier 2 is when the noise levels are 15 or more dBA over existing traffic noise as a result of the transportation project (or total highway-related noise levels are between 76 and 79 decibels). Additional consideration for mitigation may be considered under these circumstances.

sq ft = square feet

sq m = square meters

Source: WSDOT (2006a)

Determining Noise Wall Locations and Heights

The noise discipline analysts determined the height and location of the noise walls by modeling noise walls at various locations and heights. This section provides details about the recommended noise walls, including graphic illustrations of typical situations for receivers located at-grade, below-grade, and above-grade (Exhibits 50 through 52); information about how the noise walls' overall noise-reduction characteristics are affected by area topography; and detailed drawings

and aerial views of the I-5 to Medina project corridor and locations of the noise walls (Exhibits 54, 55, 58, and 61).

Residents in the I-5 to Medina project corridor are at-grade with SR 520, below the grade of SR 520, or above the grade of SR 520. The heights of noise walls would be significantly influenced by this geometry.

Noise Walls for At-Grade Receivers

Noise walls would be a very effective mitigation method for receivers located at a similar grade to the I-5 to Medina project corridor, such as near the Montlake Playfield. The noise walls would be placed close to the roadway within the I-5 to Medina project corridor. Because of the limited right-of-way, they would have little room for horizontal movement. Noise walls for locations such as these would be 10 to 14 feet high. Noise walls of this height are normal for major highways with light to moderate levels of heavy truck traffic (such as SR 520) where receivers are at approximately the same grade as the roadway.

Exhibit 50 shows a schematic of typical noise wall placement and relative effectiveness for receivers located at grade for different distances from the project roadway. The data shown in Exhibits 50, 51, and 52 are for a typical neighborhood where the front-line receivers are 40 to 60 feet from the highway, the second-line receivers are approximately 100 feet from the highway, and the third-line receivers are over 150 feet from the highway. The noise-level projections are for 5 feet above the ground in typical outdoor uses at the residence.

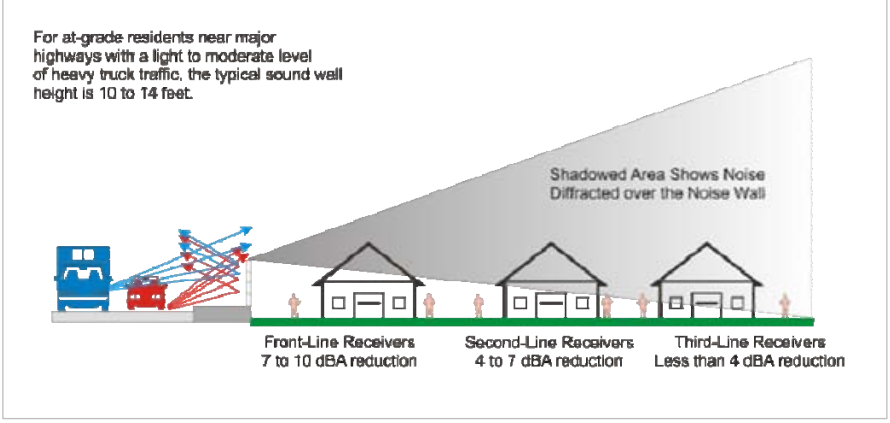


Exhibit 50. Typical Noise Wall Effectiveness with At-Grade Receiver

Noise Walls with Below-Grade Receivers

Normally, the overall effectiveness of a noise wall increases for locations where receivers are located below the highway elevation (such as the north side of SR 520 near Portage Bay). Because the

receivers are located below the elevation of the highway, less of the noise diffracted over the top of the noise wall reaches the receivers. In most cases, the noise wall height could be lower and still provide the same level of noise reduction as that shown for receivers located at the same level as the roadway (Exhibit 50). Typical noise wall heights for below-grade receivers are 2 to 4 feet less than for at-grade receivers. The actual height of the noise wall would again depend on wall placement, distance to the receiver, and the vehicle mix. Exhibit 51 provides a schematic of typical noise wall heights and relative effectiveness for receivers located below the road grade.

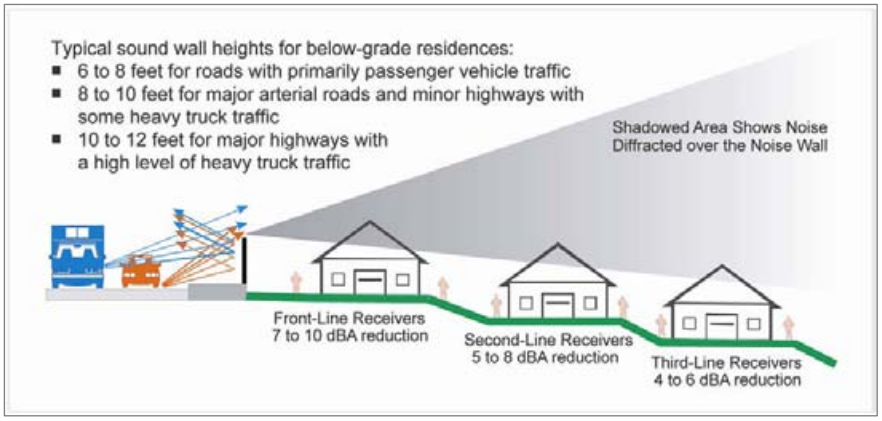


Exhibit 51. Typical Noise Wall Effectiveness with Below-Grade Receiver

Noise Walls with Above-Grade Receivers

Noise walls are normally less effective at reducing transportation noise at locations where receivers are elevated above the roadway (such as in North Capitol Hill) because the receivers are closer to noise that is diffracted over the top of the noise wall. Increasing the height of the noise wall can, in some circumstances, result in noise reductions of the same magnitude that would be achieved for at-grade receivers. The overall effectiveness would depend on the level of elevation over the roadway, the vehicle mix, noise wall placement, and other geometric considerations. Again, because of the limited right-of-way in the I-5 to Medina project corridor, changing the horizontal placement of the noise wall is not an option in most cases. Noise walls of up to 16 feet high are being considered in certain sections of the I-5 to Medina project corridor. Exhibit 52 shows a schematic of typical noise wall heights and relative effectiveness for receivers located above the road grade.

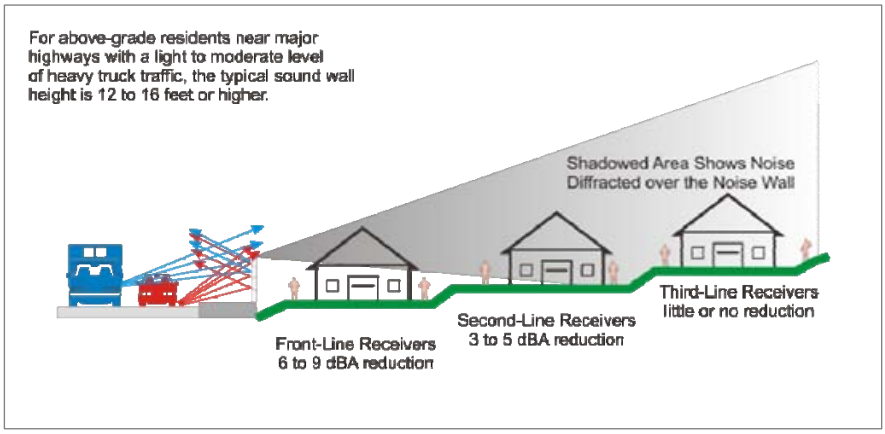


Exhibit 52. Typical Noise Wall Effectiveness with Above-Grade Receiver

Noise Walls on Roadway Bridge Structures

When noise walls are constructed on the edge of bridge structures, there are structural as well as operational limitations on how high the walls can be built. For the I-5 to Medina project, the limiting factor for noise wall heights on bridge structures was based on WSDOT's ability to conduct safety inspections under the bridge structures using an under bridge inspection truck (UBIT). In areas where noise walls would be required on bridge structures (that is, Portage Bay Bridge) their heights were limited to 10 feet. The effect this height limitation would have on the resulting noise levels with the recommended noise walls is discussed in the "What negative effects would remain after mitigation?" section.

Under bridge inspection truck (UBIT)
(Source: WSDOT)

What noise walls were evaluated for the 6-Lane Alternative?

Noise walls were evaluated for all areas within the I-5 to Medina project where traffic noise levels are expected to approach or exceed the NAC. The specific design parameters (location, length, and height) for noise walls proposed with the 6-Lane Alternative would vary depending on which design options are included in the project. The proposed parameters common among the 6-Lane Alternative options include noise walls along the north side of SR 520 from the Delmar lid to the Montlake lid and along the south side of SR 520 from the Delmar lid to just west of Montlake Boulevard. Each of the design options also includes generally the same noise wall along the south side of SR 520 along the Madison Park neighborhood. On the east end of the

Evergreen Point Bridge, the 6-Lane Alternative options include noise walls along both sides of SR 520 from just east of the floating bridge to Evergreen Point Road.

The recommended noise walls in the Montlake vicinity would vary depending on which design option would be included in the project. The recommended noise walls are described in the next section.

In areas where the evaluated noise walls would not meet the WSDOT reasonableness and/or feasibility criteria (for example, between Montlake Boulevard NE and the Arboretum), noise walls are not proposed.

What noise walls are recommended for the 6-Lane Alternative?

The 6-Lane Alternative peak-hour traffic noise levels with noise walls represent the worst-case traffic noise levels that could be expected with 2030 traffic flow conditions if the recommended noise walls were constructed.

The project peak-hour traffic noise levels were modeled for 208 receivers with Options A and K and for 207 receivers with Option L. Overall, the 6-Lane Alternative with recommended noise walls would lower the number of residences where noise levels would exceed the NAC under the No Build Alternative. Under Option A, the number of residences that would exceed the NAC would decrease to 94 compared to 327 under the No Build Alternative. The number of residences that would exceed the NAC under Options K and L would decrease to 123 and 119, respectively. The addition of the recommended noise walls and five lids and landscape features over the highway (I-5/East Roanoke Street lid, Delmar lid, Montlake lid, Pacific Street lid, and Foster Island [land bridge] [Option K only]) would assist in reducing noise levels.

I-5 to Medina Project Corridor Summary
(with Recommended Noise Walls)

Number of Residences Where Noise Levels Would Exceed NAC
(% of residences where noise levels would approach or exceed NAC based on the 862[a] total residences identified in the study area)

Current	No Build Alternative	6-Lane Alternative		
		Option A	Option K	Option L
288 (33.5%)	327 (37.9%)	94 (11.0%)	123 (14.4%)	119 (13.9%)

[a] For Options A and K, the percentages of residences are based on a total of 858 residences and, for Option L, a total of 855 residences.

Exhibits 27 through 32 show the receiver locations and modeled noise levels. For each receiver, the existing, 2030 No Build Alternative, and 2030 6-Lane Alternative peak-hour noise levels are shown. To illustrate

how effective the noise walls would be at reducing traffic noise levels under the 6-Lane Alternative, noise levels with and without the recommended noise walls are shown for each receiver location. Because the 6-Lane Alternative included construction of noise walls in the analysis, the number of residences that would experience traffic noise effects under this alternative would be reduced from No Build Alternative conditions.

The 6-Lane Alternative with the recommended noise walls would meet the following noise abatement objectives:

1) Reducing the overall noise levels in the community;

2) Where possible, reducing the noise levels at all residences to below the NAC of 67 dBA L_{eq}; and

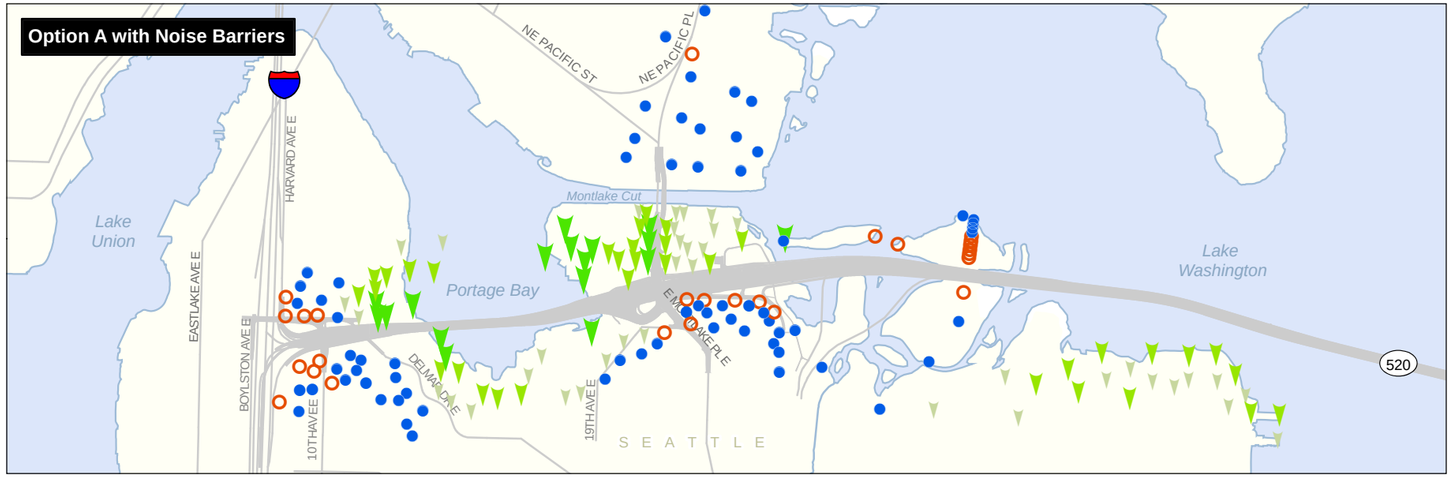
3) Where possible, providing an average 7 to 10 dBA L_{eq} noise reduction for front-line receivers adjacent to SR 520.

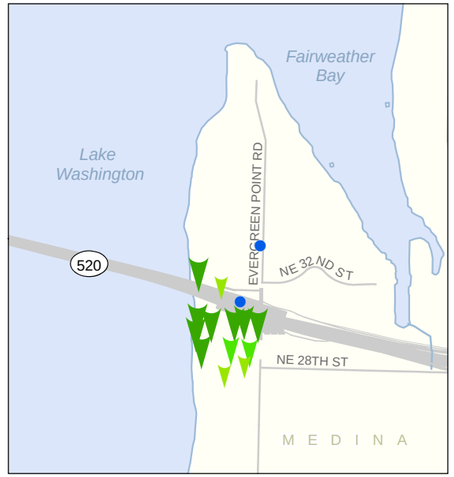
As noted previously, a 3-dBA change in noise level is normally perceived as a barely noticeable change. The 3 dBA change is a useful metric for noticeable change when comparing the 2030 No Build Alternative and the 2030 6-Lane Alternative noise levels. When considering how effective a noise wall would be at reducing noise levels, it is helpful to keep in mind that decreases of 5 dBA or more are clearly noticeable and that most people perceive reductions of 10 dBA as reducing noise to a level considered half as loud.

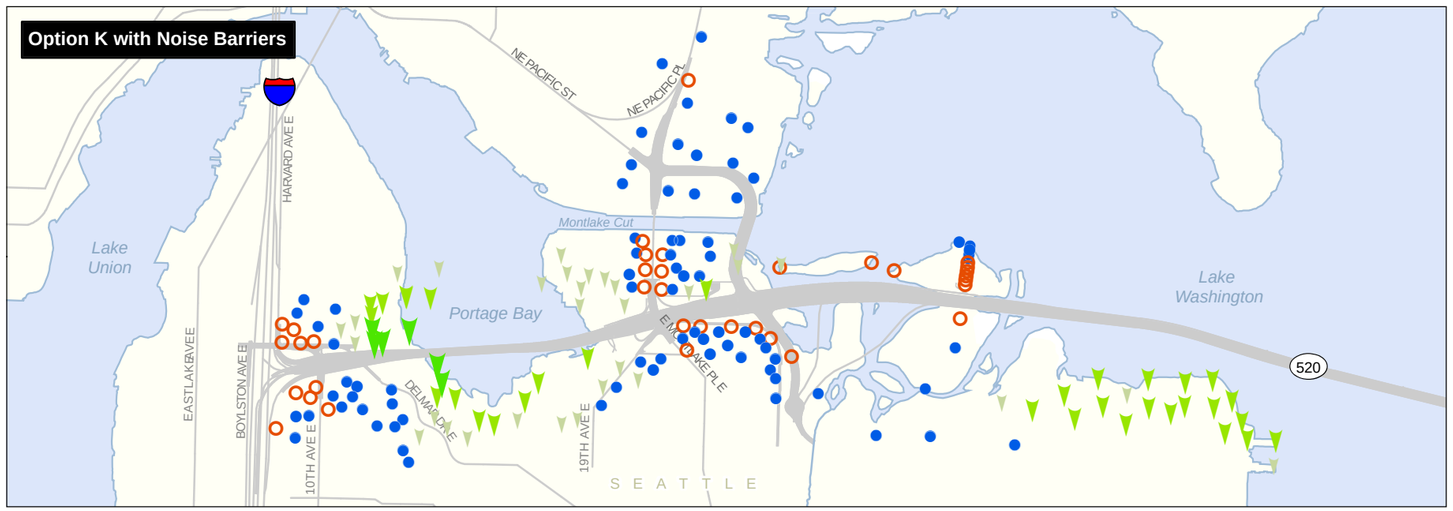
Noise walls evaluated and recommended for each neighborhood under the 6-Lane Alternative

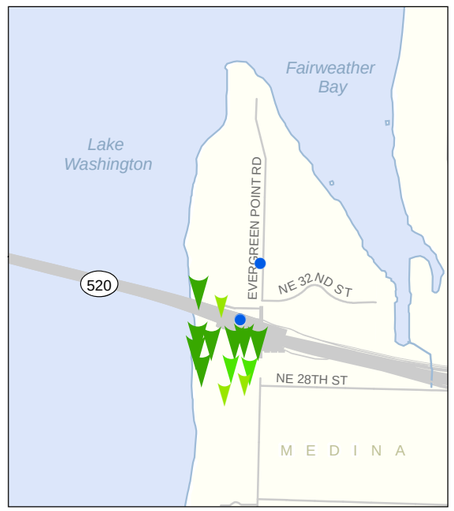
This section describes the effectiveness of the proposed traffic noise mitigation measures for each neighborhood in the study area, focusing on the number of residences or residential equivalents that would benefit from the noise walls. In addition, the audible differences in traffic noise levels between the 2030 No Build Alternative and the 2030 6-Lane Alternative are presented. The noise levels stated in this section include the noise-reduction benefit from all recommended noise walls. The noise discipline analysts do not recommend some of the noise walls evaluated for the I-5 to Medina project. Their reasons for rejecting those walls are provided in each case.

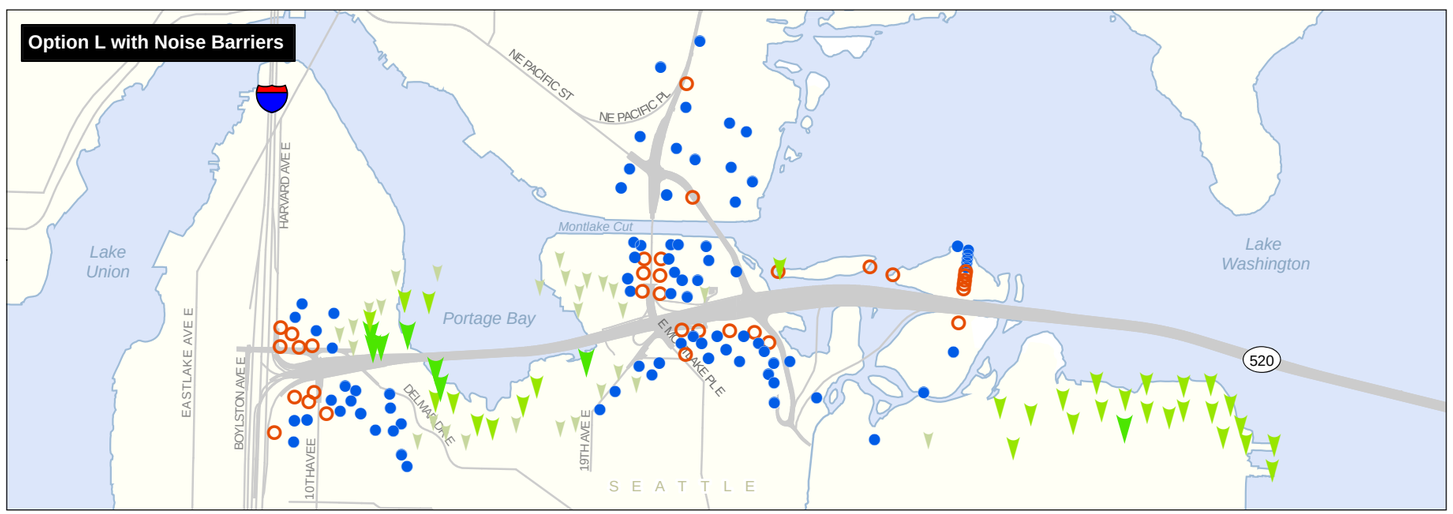
Exhibit 53 presents the results of the traffic noise and noise wall analysis in terms of relative noise-level changes that could be expected

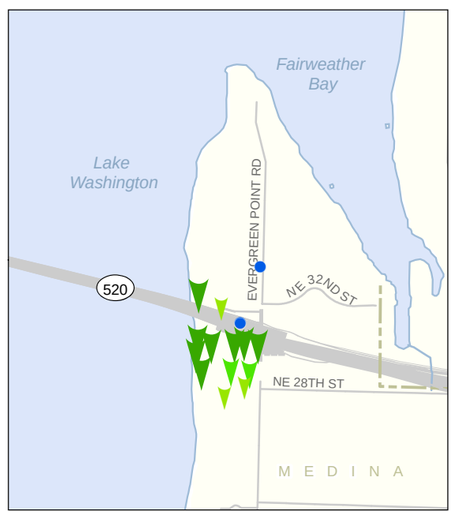


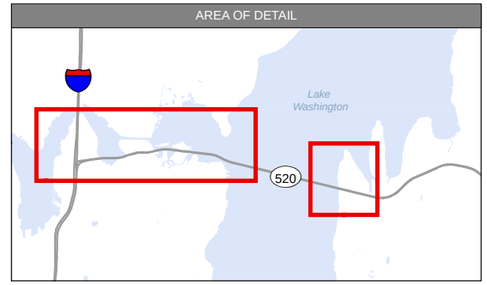












Noise Reduction with Noise Barriers (2030)

- < -13 (dBA)
- -10 to -13 (dBA)
- -7 to -9 (dBA)
- -3 to -6 (dBA)
- No noticeable change and noise level below noise abatement criteria
- No noticeable change and noise level above noise abatement criteria
- Pavement

Note: No walls were evaluated for the Laurelhurst neighborhood because noise levels from SR 520 would remain below the NAC for the 6-Lane Alternative with the design options.

N

0 500 1,000 2,000 Feet

Sources: King County (2005) GIS Data (Streets), King County (2007) GIS Data (Water Bodies). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 53. **Noise Level Reduction for all Options with Noise Barriers**

I-5 to Medina: Bridge Replacement and HOV Project

for each neighborhood in 2030. This exhibit provides a separate frame for each design option. The exhibit shows the noise modeling sites using a symbol indicating whether an average person would notice a decrease or no change in traffic noise due to the recommended noise walls. If there would be no noticeable reduction in noise levels from the recommended noise barriers, two distinct symbols indicate whether the noise level would be below or above the NAC. Noise levels would be reduced by 3 dBA L_{eq} or more at locations where there would be a noticeable decrease in noise levels. Noise levels at locations shown as having no noticeable change would not receive a noticeable reduction in noise levels from the recommended noise walls.

The following sections discuss each neighborhood study area.

Portage Bay/Roanoke

With the recommended noise walls for the 6-Lane Alternative with Option A, the 26 residences that would exceed the NAC without the noise walls would be reduced to 13 (represented by HR-1 through HR-3 and HR-15). These 13 residences would exceed the NAC due to their proximity to unmitigated traffic noise from I-5 and East Roanoke Street. A noise wall constructed along the north side of East Roanoke Street would be required to effectively reduce noise levels at HR-1 through HR-3, but this would not be feasible due to the direct driveway accesses onto East Roanoke Street. HR-15 noise levels would continue to be dominated by I-5 traffic noise. Compared to the 6-Lane Alternative without noise walls, noise-level reductions of 0 to 13 dBA L_{eq} would be achieved with the recommended noise walls under the 6-Lane Alternative with Option A.

Portage Bay/Roanoke with Recommended Noise Walls

Number of Residences Where Noise Levels Would Exceed NAC

		6-Lane Alternative		
Current	No Build Alternative	Option A	Option K	Option L
24	24	13	16	16

Under the 6-Lane Alternative with Options K and L, the same receivers as noted in Option A plus HR-14 would have noise levels that would exceed the NAC after the recommended noise walls were constructed. Under Options K and L, HR-14 would be less than 1 dBA higher than under Option A; however, due to rounding, the final noise level increases to 66 dBA L_{eq}. Similar to HR-15, HR-14 noise levels would continue to be dominated by I-5 traffic noise, with additional contributions from East Roanoke Street traffic noise. With the recommended noise walls for the 6-Lane Alternative with Options K or L, the 27 residences that would exceed the NAC without the noise walls

would be reduced to 16. Compared to the 6-Lane Alternative without noise walls, noise-level reductions of 0 to 12 dBA L_{eq} would be achieved with the recommended noise walls under the 6-Lane Alternative with Options K or L.

North Capitol Hill

With the recommended noise walls for the 6-Lane Alternative with Options A and K, noise levels at the 89 residences that would exceed the NAC without noise walls would be reduced to 35 with the recommended noise walls. With Option L, the 83 residences that would exceed the NAC without the walls would also be reduced to 35 residences with the recommended noise walls.

North Capitol Hill with Recommended Noise Walls

Number of Residences Where Noise Levels Would Exceed NAC

		6-Lane Alternative		
Current	No Build Alternative	Option A	Option K	Option L
99	109	35	35	35

With Options A, K, and L, receivers CH-1, CH-2, CH-13, CH-16, and CH-28 (representing 35 residences) would continue to exceed the NAC with the recommended noise walls. These 35 residences are a subset of those residences estimated to exceed the NAC under the No Build Alternative noise-level conditions. These residences are located between the northbound I-5 off-ramp to westbound SR 520 and 10th Avenue East. CH-1, CH-13, and CH-28 are elevated above I-5 and the SR 520 on- and off-ramps, which would make a noise wall less effective at reducing traffic noise levels. CH-2 and CH-16 would continue to receive unmitigated traffic noise from 10th Avenue East. The Delmar lid would reduce noise levels at many residences east of 10th Avenue East.

The noise walls recommended for this neighborhood would reduce traffic noise levels by 0 to 13 dBA L_{eq} with Options A, K, and L.

Montlake North of SR 520

With the recommended noise walls for the 6-Lane Alternative and Option A, noise levels at each of the 27 residences that would exceed the NAC without noise walls would be reduced to below the NAC. Noise-level reductions of 3 to 12 dBA L_{eq} are projected at residences with the recommended noise walls under the 6-Lane Alternative with Option A.

Montlake North of SR 520 with Recommended Noise Walls

Number of Residences Where Noise Levels Would Exceed NAC

		6-Lane Alternative		
Current	No Build Alternative	Option A	Option K	Option L
37	47	0	19	18

With the recommended noise walls for Option K, noise levels at the 28 residences that would exceed the NAC without the recommended noise walls would be reduced to 19. All 19 residences would continue to receive unmitigated traffic noise from Montlake Boulevard East. Unlike Option A, the existing NE Montlake Boulevard roadway would not be modified under Options K or L. Therefore, noise walls were not considered along the west and east sides of NE Montlake Boulevard, which accounts for the 19 and 18 additional affected residences under Options K and L compared to Option A. Noise-level reductions of 0 to 7 dBA L_{eq} would be achieved with the recommended noise walls under the 6-Lane Alternative with Option K.

With the recommended noise walls for Option L, noise levels at the 28 residences that would exceed the NAC without the recommended noise walls would be reduced to 18 residences. Similar to Option K, the 18 residences would continue to receive unmitigated traffic noise from Montlake Boulevard East. With Option L, traffic noise levels would decrease by 2 dBA L_{eq} at MN-34 due to traffic shifting to the SPUI (interchange with two levels) northeast of the Washington Park Arboretum. The reduction in traffic on Montlake Boulevard East near East Shelby Street would decrease noise levels at MN-34 to 65 dBA L_{eq}, which accounts for the difference between Options K and L of one residence where noise levels would exceed the NAC. Noise-level reductions of 0 to 9 dBA L_{eq} would be achieved with the recommended noise walls under the 6-Lane Alternative with Option L.

The 18 residual affected residences with Option L are primarily due to the fact that noise walls were not considered along the west and east sides of NE Montlake Boulevard. However, the suboption for Option L that would include adding capacity on northbound Montlake Boulevard NE to NE 45th Street would require a noise wall evaluation if that suboption were included with the project. This area should be re-considered during the final design stage to determine whether a noise wall should be considered once the final project is selected.

Montlake South of SR 520

With the recommended noise walls for the 6-Lane Alternative with Option A, the 57 residences that would exceed the NAC without noise walls would be reduced to 28. The 52 residences with Option K and the 45 residences with Option L that would exceed the NAC without noise walls would be reduced to 24 residences. With Option A, one additional

receiver, MS-18 (representing 4 residences), would approach the NAC with a level of 66 dBA L_{eq}.

Twenty-two of the 24 residences (represented by MS-1 through MS-5) would continue to receive unmitigated traffic noise from Lake Washington Boulevard. Noise walls on SR 520 would not lower the noise levels at these receivers. The remaining two residences (represented by MS-17) would continue to receive traffic noise levels from Montlake Place East. A noise wall was evaluated along the east side of Montlake Place East between East North Street and East Roanoke Street. However, because openings would be needed to accommodate driveway access, the noise wall would not be effective in reducing traffic noise levels at the two residences represented by MS-17. The recommended noise walls for the Montlake neighborhood south of SR 520 under Option A would reduce traffic noise levels by 0 to 10 dBA L_{eq} below unmitigated levels. Similarly, with Options K and L, the recommended noise walls would reduce noise levels by 0 to 9 dBA L_{eq} and by 0 to 10 dBA L_{eq}, respectively.

Montlake South of SR 520 with Recommended Noise Walls

Number of Residences Where Noise Levels Would Exceed NAC

		6-Lane Alternative		
Current	No Build Alternative	Option A	Option K	Option L
63	70	28	24	24

University of Washington

Under the 6-Lane Alternative with Options A, K, and L, peak-hour traffic noise levels outside the Edmundson Pavilion athletic building entrance (UW-11, representing 2 residential equivalents) would remain unchanged and continue to approach the NAC with a level of 66 dBA L_{eq}. No changes to the roadway near UW-11 are proposed for the I-5 to Medina project. With Option L, the green space near Montlake Boulevard East and the portion of the Burke-Gilman Trail represented by UW-2 would exceed the NAC. Therefore, with Option L, 4 residential equivalents would exceed the NAC. A noise wall was evaluated for UW-11 under all design options and another for UW-2 under Option L. None of the noise walls considered for these two receivers would meet the WSDOT reasonableness (cost) criteria under any of the design options.

University of Washington (No Recommended Noise Walls)

Number of Residences Where Noise Levels Would Exceed NAC

		6-Lane Alternative		
Current	No Build Alternative	Option A	Option K	Option L
2	4	2	2	4

Washington Park Arboretum

Noise walls for the Washington Park Arboretum were evaluated for the 6-Lane Alternative with Options A, K, and L, but they would not meet the WSDOT reasonableness (cost) criteria. Therefore, with Option A, the 16 residential equivalents that would exceed the NAC under the 6-Lane Alternative without noise walls would continue to be affected by SR 520 traffic noise. Similarly, the 27 residential equivalents with Option K and the 22 residential equivalents with Option L would continue to exceed the NAC under the 6-Lane Alternative.

Washington Park Arboretum (No Recommended Noise Walls)

Number of Residences Where Noise Levels would Exceed NAC

		6-Lane Alternative		
Existing	No Build Alternative	Option A	Option K	Option L
22	27	16	27	22

As described earlier, areas within the Arboretum within 100 feet of the proposed lids under all three design options would receive traffic noise-level reductions of up to 10 dBA L_{eq} compared to the existing and No Build Alternative peak-hour traffic noise levels. The lids would reduce the number of affected residential equivalents by 11 with Option A (compared to the No Build Alternative condition) and by 5 with Option L. With Option K, the number of residential equivalents that would exceed the NAC would be the same as under the No Build Alternative, but again, there would be a net benefit in those areas near the lids that were not used as residential equivalent modeling points. Beyond the area near the lids, the noise levels would remain effectively unchanged by the 6-Lane Alternative with any of the design options.

Madison Park

With the recommended noise walls for the 6-Lane Alternative with Options A, K, and L, all residences that would exceed the NAC without noise walls would receive noise-level reductions sufficient to bring the noise levels to below the NAC. The recommended noise walls for the Madison Park neighborhood under Option A would reduce traffic noise levels by 4 to 8 dBA L_{eq} compared to noise levels without noise walls. Similarly, with Options K and L, the recommended noise walls would reduce noise levels by 4 to 8 dBA L_{eq} and by 5 to 10 dBA L_{eq}, respectively.

Madison Park with Recommended Noise Walls

Number of Residences Where Noise Levels Would Exceed NAC

		6-Lane Alternative		
Current	No Build Alternative	Option A	Option K	Option L
16	16	0	0	0

Laurelhurst

Under the 6-Lane Alternative with Options A, K, and L, noise levels in Laurelhurst would increase by less than 1 dBA and all receivers would remain below the NAC. The Foster Island land bridge (Option K only) would have no discernible effect on noise levels at the Laurelhurst receivers. No noise walls were evaluated for this neighborhood because noise levels from SR 520 would remain below the NAC for the 6-Lane Alternative with the design options.

Laurelhurst (No Recommended Noise Walls)

Number of Residences Where Noise Levels Would Exceed NAC

		6-Lane Alternative		
Current	No Build Alternative	Option A	Option K	Option L
0	0	0	0	0

Medina

With the recommended noise walls for the 6-Lane Alternative with Options A, K, and L, the 21 residences that would exceed the NAC without mitigation would receive noise-level reductions sufficient to reduce future noise levels at all of the affected residences to below the NAC. Noise-level reductions of 2 to 14 dBA L_{eq} are projected for those residences north of SR 520 and reductions of 3 to 14 dBA L_{eq} are projected for those residences south of SR 520.

Medina North & South of SR 520 with Recommended Noise Walls

Number of Residences Where Noise Levels Would Exceed NAC

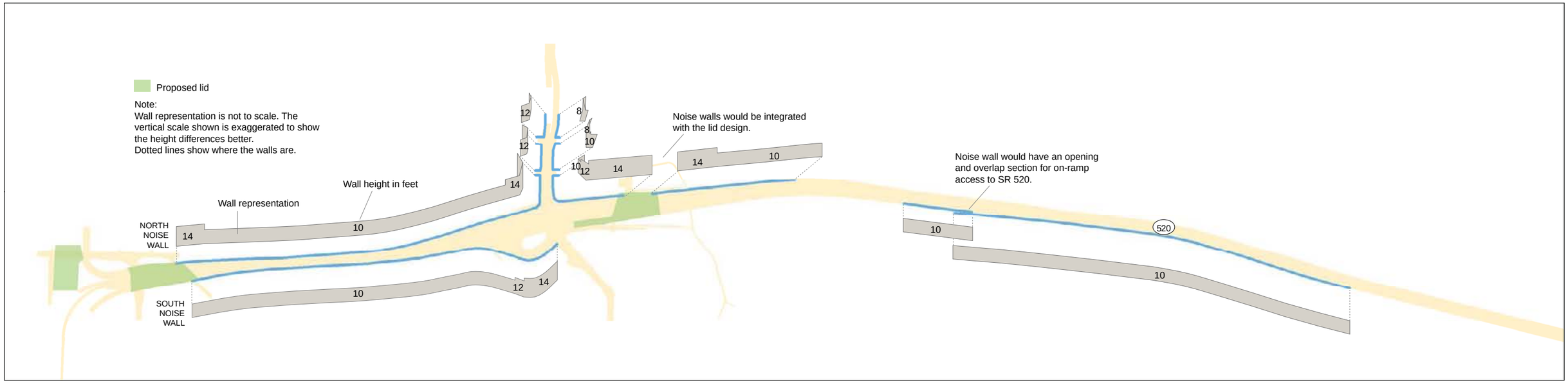
		6-Lane Alternative		
Current	No Build Alternative	Option A	Option K	Option L
26	30	0	0	0

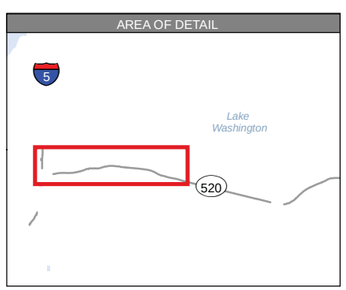
Noise Walls Recommended for each Design Option under the 6-Lane Alternative

This section describes the noise walls evaluated for the three design options of the 6-Lane Alternative. The locations, heights, performance characteristics, and cost-effectiveness analyses are provided for each evaluated noise wall.

Option A

The overall I-5 to Medina project corridor noise walls recommended for Option A would be 18,819 feet long with heights varying from 8 to 14 feet. The taller noise walls would be necessary in areas where residents are located uphill from the I-5 to Medina project corridor. Exhibit 54 shows the locations and heights of the recommended noise walls with 6-Lane Alternative Option A west of Lake Washington. Exhibit 55 shows the locations and heights of the recommended noise walls in the Medina neighborhood east of Lake Washington. The





Noise Wall
Lid
Pavement

N

0 500 1,000 2,000 Feet

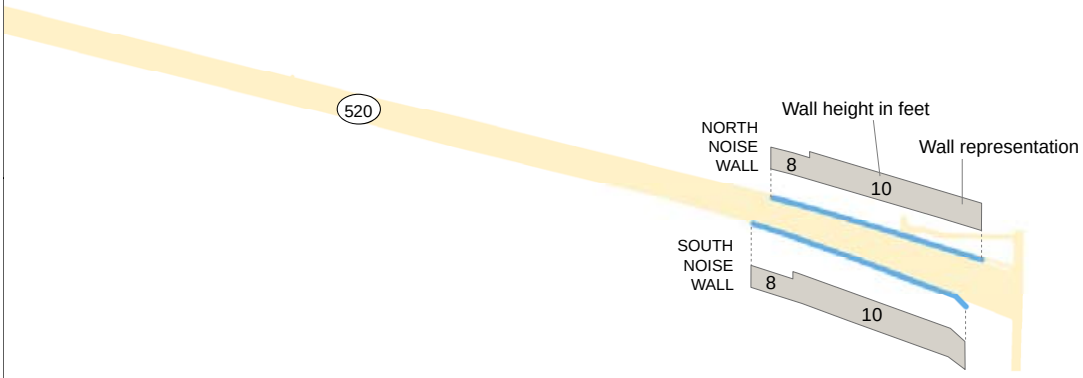
Source: King County (2006) aerial photo. Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

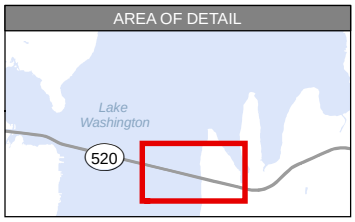
Exhibit 54. **Potential Noise Wall Locations and Heights for the 6-Lane Alternative Option A – I-5 to Madison Park**

I-5 to Medina: Bridge Replacement and HOV Project

\\SIMBA\PROJ\PARAMETRIX\180171\GRAPHICS\x_SDEIS_Westside\NOI\SDEIS_NOI_Ex54_NoiseWalls_OptionA_29dec09_FINAL.ai

Note:
Wall representation is not to scale. The vertical scale shown is exaggerated to show the height differences better.
Dotted lines show where the walls are.





Noise Wall
Pavement

N
0 250 500 1,000 Feet

Source: King County (2006) aerial photo. Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 55. **Noise Wall Locations and Heights for the 6-Lane Alternative Options A, K, and L – Medina**

I-5 to Medina: Bridge Replacement and HOV Project

recommended noise walls for the Medina neighborhood are the same under Options A, K, and L. The heights shown on Exhibits 54 and 55 are for the noise walls above any retaining walls, where applicable, or above the highest ground elevation near SR 520. Adjustments in the top-of-wall elevations could be necessary during the project's final design phase to ensure acceptable noise wall performance.

The noise walls on the north side and the south side of the study area are described below.

North Side of SR 520

On the north side of SR 520, from the Delmar lid to the Montlake Cut, the noise wall heights would be 14 feet at the Delmar lid, decrease to 10 feet where the Portage Bay Bridge structure begins, and continue at that height until the end of the Portage Bay Bridge structure. After the end of the Portage Bay Bridge structure, the wall would increase to 14 feet and remain at that height until reaching Montlake Boulevard East. The noise wall height would decrease to 12 feet as it turned north and remain at that height until ending at the Montlake Cut. Openings in the wall would be constructed at the entrance to the NOAA NWFSC, East Hamlin Street, and East Shelby Street. The noise wall would wrap around the corners at these openings approximately 50 feet.

The next noise wall would be constructed along the east side of Montlake Boulevard East from the Montlake Cut to the Montlake lid. Near the Montlake Cut, the noise wall height would be 8 feet, increasing to 12 feet at East Hamlin Street (MN-18) and remaining at that height until turning east along SR 520 to the Montlake Boulevard East on-ramp. At the on-ramp, the noise wall would increase in height to 14 feet and end at the Montlake lid.

A noise wall east of the Montlake lid would start at 14 feet high until the start of the bridge structure, decrease to 10 feet, and remain at that height until reaching a point approximately 850 feet east of MN-29.

The 264-foot-long wall varying in height from 6 to 8 feet along Montlake Boulevard was evaluated for the entrance to the Edmundson Pavilion athletic building (UW-11). As discussed later in this section, this wall would not meet the WSDOT criteria for mitigation.

A noise wall for the Arboretum north of SR 520 was evaluated and determined to meet the feasibility requirement in terms of sufficient noise-level reduction. However, the analysts do not recommend this noise wall because it would not meet the reasonableness (cost) criteria.

The Arboretum noise wall north of SR 520 that was evaluated but not recommended included a noise wall east of the Montlake lid that would have had heights ranging from 8 to 10 feet and would have extended from the Montlake lid to a point approximately 1,000 feet east of AB-4.

A noise wall on the north side of SR 520 would be constructed in Medina. This wall would be 932 feet long, would start approximately 290 feet west of PN-1, and would extend to the Evergreen Point lid. The height of the noise wall would begin at 8 feet on the highrise structure, increase to 10 feet after the first 170 feet, and remain at 10 feet until reaching the lid. The recommended noise wall design along the north side of SR 520 in Medina is the same for all three 6-Lane Alternative design options.

South Side of SR 520

On the south side of SR 520, from the Delmar lid to the east end of the Portage Bay bridge structure, the noise wall height would be a consistent 10 feet. The height would then increase to 14 feet and continue at that height until reaching Montlake Boulevard East.

A noise wall for the Arboretum south of SR 520 was evaluated and determined to meet the feasibility requirement in terms of sufficient noise-level reduction. However, the analysts do not recommend this wall because it would not meet the reasonableness (cost) criteria. The Arboretum wall south of SR 520 that was evaluated but not recommended would have included a noise wall east of the Montlake lid that started at 8 feet high, stepped up to 10 feet within the first 150 feet, and remained at that height until reaching the point where the East Lake Washington Boulevard on-ramp meets SR 520. The modeled noise wall would have continued on the southern edge of East Lake Washington Boulevard for approximately 1,000 feet at a consistent height of 10 feet.

A noise wall for the Madison Park neighborhood would be constructed in two segments. The first segment, along the north side of the Lake Washington on-ramp to eastbound SR 520, would be approximately 644 feet long. This first segment would be 10 feet high and would start where the Lake Washington on-ramp turns and begins to run parallel with SR 520. The second segment, along the south side of the Lake Washington on-ramp, would start approximately 150 feet west of the end of the first segment, creating a 150-foot overlap with the first wall segment. The second segment would be approximately 5,256 feet in length along SR 520 with a consistent height of 10 feet. This wall would

end approximately 1,770 feet east of the eastern-most Madison Park receiver (MP-19).

In Medina, a noise wall would be constructed on the south side of SR 520 parallel to the north-side noise wall. It would start approximately 980 feet west of the Evergreen Point lid (on the highrise structure) and extend to the lid. The height of the wall would begin at 8 feet, increase to 10 feet, and remain at 10 feet until reaching the lid. The recommended noise wall design along the south side of SR 520 in Medina is the same for all three 6-Lane Alternative design options.

Summary

Exhibit 56 summarizes information about the noise walls for the 6-Lane Alternative with Option A. The noise walls were evaluated using WSDOT cost criteria for each designated neighborhood, outside activity area, or park. The noise-reducing benefits of the various lid designs are included in the calculated noise levels listed under the "6-Lane Option A Noise Levels without Noise Wall" column as well as under the "6-Lane Option A Noise Levels with Noise Wall" column shown in Exhibit 56. The noise-reduction amounts listed in Exhibit 56 under the "Noise Reduction" column represent the noise-level reductions expected from the noise wall only. This approach focuses on the effectiveness of each noise wall in reducing traffic noise levels and compares this information directly to the WSDOT cost criteria.

As shown in Exhibit 56, receivers MS-1 through MS-14 and MS-31 through MS-33 (which represent residences that border East Lake Washington Boulevard/Lake Washington Boulevard East) would receive essentially no noise-reduction benefits from the recommended noise walls. A noise wall would be required along East Lake Washington Boulevard to effectively mitigate traffic noise effects at these residences. However, openings in a noise wall along East Lake Washington Boulevard required for each driveway would render that noise wall ineffective at reducing traffic noise levels.

Exhibit 57 summarizes the cost analysis conducted for the noise walls with the 6-Lane Alternative Option A. A total of 468 residential equivalents (19 with noise levels of 70 dBA or higher) would benefit from construction of the recommended noise walls.

Exhibit 56. Noise Wall Performance Summary for 6-Lane Alternative Option A

Receiver Number	6-Lane Option A Noise Levels without Noise Wall[a,b]	6-Lane Option A Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
Portage Bay/Roanoke					
HR-1	**73**	**73**	0	0	$0.00
HR-2	**72**	**72**	0	0	$0.00
HR-3	**68**	**67**	1	0	$0.00
HR-4	64	63	1	0	$0.00
HR-5	**68**	63	5	3	$133,920.00
HR-7	**70**	57	13	2	$103,800.00
HR-8	**69**	56	13	1	$48,270.00
HR-9	65	55	10	1	$37,380.00
HR-10	**67**	56	11	4	$164,440.00
HR-11	63	55	8	4	$149,520.00
HR-12	64	61	3	4	$149,520.00
HR-13	63	62	1	0	$0.00
HR-14	**66**	65	1	0	$0.00
HR-15	**67**	**67**	0	0	$0.00
HR-16	64	63	1	0	$0.00
HR-17	64	63	1	0	$0.00
HR-18	62	60	2	0	$0.00
HR-19	63	54	9	4	$149,520.00
HR-20	62	53	9	4	$149,520.00
HR-21	61	54	7	3	$112,140.00
HR-22	61	54	7	5	$186,900.00
HR-23	59	55	4	6	$224,280.00
BH-1	61	53	8	3	$112,140.00
BH-2	62	55	7	3	$112,140.00
BH-3	59	54	5	3	$112,140.00
			Total Available for Noise Mitigation		$1,945,630.00
North Capitol Hill					
CH-1	**71**	**71**	0	0	$0.00
CH-2	**71**	**71**	0	0	$0.00
CH-3	62	62	0	0	$0.00
CH-4	63	63	0	0	$0.00
CH-5	65	64	1	0	$0.00
CH-6	**69**	56	13	18	$868,860.00
CH-7	**67**	57	10	4	$164,440.00
CH-8	**66**	57	9	24	$897,120.00
CH-9	**66**	57	9	8	$299,040.00
CH-10	64	63	1	0	$0.00
CH-11	62	62	0	0	$0.00

Exhibit 56. Noise Wall Performance Summary for 6-Lane Alternative Option A

Receiver Number	6-Lane Option A Noise Levels without Noise Wall[a,b]	6-Lane Option A Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
CH-12	65	65	0	0	$0.00
CH-13	**68**	**68**	0	0	$0.00
CH-14	63	63	0	0	$0.00
CH-15	65	65	0	0	$0.00
CH-16	**67**	**67**	0	0	$0.00
CH-17	63	63	0	0	$0.00
CH-18	62	62	0	0	$0.00
CH-19	62	61	1	0	$0.00
CH-20	63	57	6	4	$149,520.00
CH-21	63	55	8	14	$523,320.00
CH-22	63	55	8	16	$598,080.00
CH-23	63	55	8	8	$299,040.00
CH-24	61	56	5	14	$523,320.00
CH-25	62	58	4	6	$224,280.00
CH-26	62	61	1	0	$0.00
CH-27	61	61	0	0	$0.00
CH-28	**71**	**71**	0	0	$0.00
CH-29	61	61	0	0	$0.00
CH-30	60	59	1	0	$0.00
CH-31	59	58	1	0	$0.00
CH-32	61	59	2	0	$0.00
			Total Available for Noise Mitigation		$4,547,020.00
Montlake North of SR 520					
MN-1	**67**	55	12	3.3[c]	$137,033.33
MN-2	64	55	9	3.3[c]	$124,600.00
MN-4	**67**	60	7	2	$82,220.00
MN-5	**66**	60	6	3	$112,140.00
MN-6	64	59	5	3	$112,140.00
MN-7	**69**	61	8	2	$96,540.00
MN-8	**70**	59	11	3	$155,700.00
MN-9	63	56	7	3	$112,140.00
MN-10	63	54	9	4	$149,520.00
MN-11	65	53	12	3.3[c]	$124,600.00
MN-12	64	53	11	3.3[c]	$124,600.00
MN-13	63	52	11	4	$149,520.00
MN-14	63	52	11	3	$112,140.00
MN-15	62	53	9	4	$149,520.00
MN-16	62	55	7	4	$149,520.00
MN-17	**71**	59	12	4	$222,120.00

Exhibit 56. Noise Wall Performance Summary for 6-Lane Alternative Option A

Receiver Number	6-Lane Option A Noise Levels without Noise Wall[a,b]	6-Lane Option A Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
MN-18	**68**	61	7	3	$133,920.00
MN-19	60	57	3	5	$186,900.00
MN-20	59	56	3	3	$112,140.00
MN-21	58	55	3	3	$112,140.00
MN-22	61	54	7	3.3[c]	$124,600.00
MN-23	**70**	59	11	4	$207,600.00
MN-24	62	50	12	3	$112,140.00
MN-25	62	55	7	2	$74,760.00
MN-26	**68**	61	7	2	$89,280.00
MN-27	62	58	4	3	$112,140.00
MN-28	58	55	3	6	$224,280.00
MN-29	64	54	10	3.3[c]	$124,600.00
MN-30	58	52	6	3.3[c]	$124,600.00
MN-31	57	53	4	4	$149,520.00
MN-32	60	57	3	2	$74,760.00
MN-33	63	59	4	1	$37,380.00
MN-34	**66**	59	7	1	$37,380.00
MN-35	62	57	5	2	$74,760.00
			Total Available for Noise Mitigation		$4,226,953.33
Montlake South of SR 520					
MS-1	**72**	**72**	0	0	$0.00
MS-2	**70**	**69**	1	0	$0.00
MS-3	**70**	**70**	0	0	$0.00
MS-4	**70**	**70**	0	0	$0.00
MS-5	**69**	**69**	0	0	$0.00
MS-6	60	60	0	0	$0.00
MS-7	61	61	0	0	$0.00
MS-8	62	62	0	0	$0.00
MS-9	63	63	0	0	$0.00
MS-10	**66**	65	1	0	$0.00
MS-11	60	60	0	0	$0.00
MS-12	57	57	0	0	$0.00
MS-13	59	59	0	0	$0.00
MS-14	61	61	0	0	$0.00
MS-15	56	56	0	0	$0.00
MS-16	61	61	0	0	$0.00
MS-17	**69**	**69**	0	0	$0.00
MS-18	**67**	**66**	1	0	$0.00
MS-19	**66**	63	3	4	$149,520.00

Exhibit 56. Noise Wall Performance Summary for 6-Lane Alternative Option A

Receiver Number	6-Lane Option A Noise Levels without Noise Wall[a,b]	6-Lane Option A Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
MS-20	**67**	64	3	3	$123,330.00
MS-21	**68**	58	10	9.2[c]	$409,200.00
MS-22	**67**	61	6	9.2[c]	$376,841.67
MS-23	65	59	6	9.2[c]	$342,650.00
MS-24	62	57	5	2	$74,760.00
MS-25	62	57	5	2	$74,760.00
MS-26	57	57	0	0	$0.00
MS-27	64	61	3	3	$112,140.00
MS-28	65	64	1	0	$0.00
MS-29	62	60	2	0	$0.00
MS-30	64	62	2	0	$0.00
MS-31	59	59	0	0	$0.00
MS-32	62	62	0	0	$0.00
MS-33	65	65	0	0	$0.00
			Total Available for Noise Mitigation		$1,663,201.67
University of Washington (Not Recommended)					
UW-1	65	65	0	0	$0.00
UW-2	57	57	0	0	$0.00
UW-3	53	53	0	0	$0.00
UW-4	52	52	0	0	$0.00
UW-5	52	52	0	0	$0.00
UW-6	55	55	0	0	$0.00
UW-7	59	59	0	0	$0.00
UW-8	51	51	0	0	$0.00
UW-9	52	52	0	0	$0.00
UW-10	62	62	0	0	$0.00
UW-11	**66**	59	7	2.2[c]	$83,437.50
UW-12	64	64	0	0	$0.00
UW-13	57	57	0	0	$0.00
UW-14	63	63	0	0	$0.00
UW-15	63	63	0	0	$0.00
UW-16	61	61	0	0	$0.00
			Total Available for Noise Mitigation		$83,437.50
Washington Park Arboretum North of SR 520 (Not Recommended)					
AB-1	65	56	9	5.4[c]	$202,475.00
AB-2	**69**	55	14	5.4[c]	$261,462.50
AB-3	**70**	56	14	5.4[c]	$281,125.00
AB-4	**71**	60	11	0	$0.00

Exhibit 56. Noise Wall Performance Summary for 6-Lane Alternative Option A

Receiver Number	6-Lane Option A Noise Levels without Noise Wall[a,b]	6-Lane Option A Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
AB-5	**70**	60	10	0	$0.00
AB-6	**69**	60	9	0	$0.00
AB-7	**68**	60	8	0	$0.00
AB-8	**67**	59	8	0	$0.00
AB-9	**66**	59	7	0	$0.00
AB-10	65	59	6	0	$0.00
AB-11	64	59	5	0	$0.00
AB-12	64	58	6	0	$0.00
AB-13	63	59	4	0	$0.00
AB-14	63	57	6	5.4[c]	$202,475.00
			Total Available for Noise Mitigation		$947,537.50
Washington Park Arboretum South of SR 520 (Not Recommended)					
AB-15	**71**	63	8	5.4[c]	$300,787.50
AB-16	65	59	6	5.4[c]	$202,475.00
AB-17	60	56	4	5.4[c]	$202,475.00
AB-18	56	53	3	5.4[c]	$0.00
AB-19	64	63	1	5.4[c]	$0.00
AB-20	62	59	3	5.4[c]	$202,475.00
			Total Available for Noise Mitigation		$908,212.50
Madison Park					
MP-1	**66**	59	7	3	$112,140.00
MP-2	**67**	59	8	2	$82,220.00
MP-3	**67**	60	7	2	$82,220.00
MP-4	**67**	60	7	3	$123,330.00
MP-5	65	58	7	3	$112,140.00
MP-6	62	56	6	2	$74,760.00
MP-7	61	55	6	3	$112,140.00
MP-8	60	54	6	3	$112,140.00
MP-9	61	54	7	4	$149,520.00
MP-10	61	55	6	16.7[c]	$623,000.00
MP-11	62	55	7	16.7[c]	$623,000.00
MP-12	60	53	7	4	$149,520.00
MP-13	60	54	6	3	$112,140.00
MP-14	61	55	6	4	$149,520.00
MP-15	61	55	6	4	$149,520.00
MP-16	62	56	6	4	$149,520.00
MP-17	63	57	6	3	$112,140.00
MP-18	64	57	7	5	$186,900.00
MP-19	65	58	7	3	$112,140.00

Exhibit 56. Noise Wall Performance Summary for 6-Lane Alternative Option A

Receiver Number	6-Lane Option A Noise Levels without Noise Wall[a,b]	6-Lane Option A Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
MP-20	63	58	5	3	$112,140.00
MP-21	61	54	7	1	$37,380.00
MP-22	59	53	6	4	$149,520.00
MP-23	57	53	4	3	$112,140.00
			Total Available for Noise Mitigation		$3,739,190.00
Medina North of SR 520					
PN-1	**70**	56	14	3	$155,700.00
PN-2	**73**	60	13	3	$188,370.00
PN-5	**66**	60	6	3	$112,140.00
PN-6	64	59	5	2	$74,760.00
PN-7	62	57	5	6	$224,280.00
PN-8	60	56	4	4	$149,520.00
PN-9	61	59	2	0	$0.00
			Total Available for Noise Mitigation		$904,770.00
Medina South of SR 520					
PS-1	**68**	56	12	3	$133,920.00
PS-2	**68**	54	14	3	$133,920.00
PS-3	**67**	55	12	2	$82,220.00
PS-4	**67**	56	11	4	$164,440.00
PS-5	61	58	3	2	$74,760.00
PS-21	61	54	7	2	$74,760.00
PS-22	60	52	8	3	$112,140.00
PS-23	65	55	10	4	$149,520.00
PS-24	63	52	11	4	$149,520.00
PS-25	60	52	8	3	$112,140.00
PS-26	56	50	6	4	$149,520.00
			Total Available for Noise Mitigation		$1,336,860.00

[a] All noise levels in the exhibit are stated as L_{eq} in dBA.

[b] Bold numbers throughout the exhibit indicate noise levels that approach within 1 dBA or exceed the NAC of 67 dBA L_{eq}.

[c] Includes residential equivalents for outside activity areas represented by this receiver. These areas include the University of Washington, Arboretum, Montlake Playfield, West Montlake Park, NOAA NWFSC outside use area, McCurdy Park, East Montlake Park, and Broadmoor Golf Club.

[d] Available mitigation capital from WSDOT criteria for cost evaluation.

Exhibit 57. Details and Cost Analysis for 6-Lane Alternative Option A Noise Walls

Noise Wall Description	Heights Along Wall (ft)[a]			Length (ft)[b]	Wall Area (sq ft)[c]	Cost[d]	Available Capital[e]	Residual Capital[f]
	Min	Avg	Max					
Portage Bay/ Roanoke Delmar lid to Portage Bay	10	11	14	1,921	20,237	$1,080,656	$1,945,630	+$864,974
North Capitol Hill Delmar lid to Montlake Playfield	10	10	10	2,488	24,884	$1,328,806	$4,547,020	+$3,218,214
Montlake North of SR 520 Portage Bay to Arboretum	10	11	14	5,236	59,114	$3,156,688	$4,226,953	+$1,070,265
Montlake South of SR 520 Montlake Playfield to Montlake Boulevard NE	10	12	14	1,362	15,752	$841,157	$1,663,202	+ $822,045
University of Washington Edmundson Pavilion near entrance	6	6.7	8	264	1,923	$102,688	$83,438	- $19,250
Washington Park Arboretum Montlake lid to west of Evergreen Point Bridge—North of SR 520	10	12	14	3,635	33,785	$1,804,119	$947,538	- $856,581
Washington Park Arboretum Montlake lid to west of Evergreen Point Bridge—South of SR 520	8	10	10	4,015	39,875	$2,129,325	$908,213	- $1,221,112
Madison Park Arboretum to west end of Evergreen Point Bridge	10	10	10	5,900	59,003	$3,150,760	$3,739,190	+ $588,430
Medina North East end of Evergreen Point Bridge to Evergreen Point Road	8	9.6	10	932	8,980	$479,532	$904,770	+ $425,238
Medina South East end of Evergreen Point Bridge to Evergreen Point Road	8	9.7	10	980	9,473	$505,858	$1,336,860	+ $831,002

[a] Minimum, average, and maximum noise wall heights in feet.

[b] Length of recommended noise walls in feet.

[c] Total noise wall surface area in square feet.

[d] Cost of noise wall based on $53.40 per square-foot from WSDOT criteria for cost evaluation. The cost has been rounded to the nearest whole dollar.

[e] Available mitigation capital from WSDOT criteria for cost evaluation.

[f] Residual mitigation capital: a positive value is within the allowable capital based on WSDOT criteria; a negative value exceeds the criteria.

avg = average ft = feet max = maximum min = minimum sq ft = square-feet

The noise walls evaluated would meet the WSDOT cost criteria with residual capital except for the Arboretum walls north and south of SR 520 and the short wall outside the Edmundson Pavilion athletic building. Each recommended noise wall would meet WSDOT cost criteria with an overall I-5 to Medina project corridor residual of $7,820,168 less than the WSDOT-prescribed capital available for mitigation.

The Arboretum wall north of SR 520 would cost $1,804,119 with available capital of $947,538, resulting in negative residual capital of $856,581. This wall would not be cost-effective and is not recommended for this project with Option A.

The Arboretum wall south of SR 520 would cost $2,129,325 with available capital of $908,213, resulting in negative residual capital of $1,221,112. This wall would not be cost-effective and is not recommended for this project with Option A.

The wall evaluated near the entrance of the Edmundson Pavilion athletic building would cost $102,688 with available capital of $83,438, resulting in negative residual capital of $19,250. This wall would not be cost-effective and is not recommended for this project with Option A.

Option K

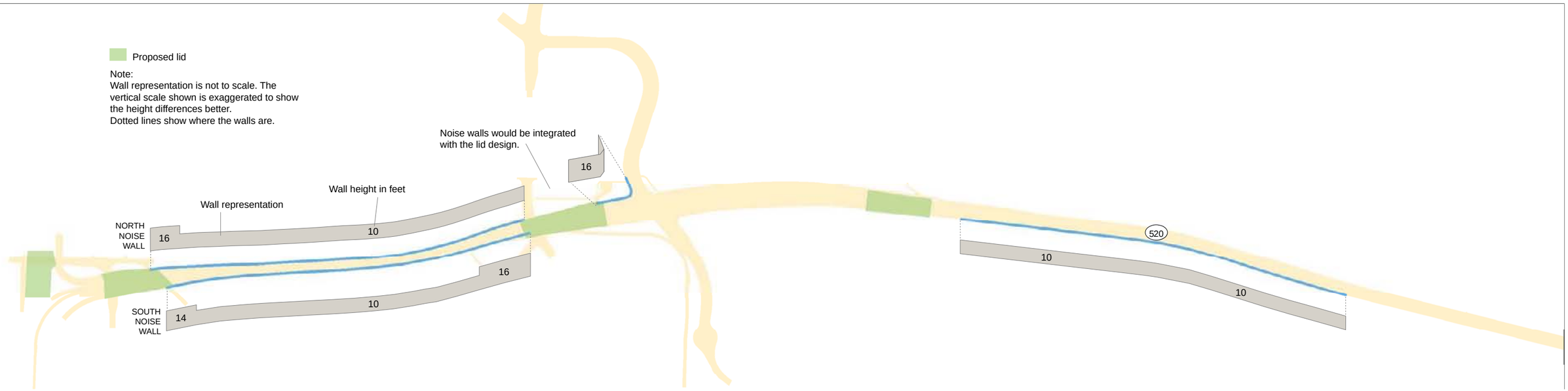
The overall I-5 to Medina project corridor noise walls would be 16,528 feet long with heights varying from 8 to 16 feet. The taller noise walls would be necessary in areas where residents are located uphill from the I-5 to Medina project corridor. Exhibit 58 shows the locations and heights of the recommended noise walls with 6-Lane Alternative Option K west of Lake Washington. Exhibit 55 (presented previously) shows the locations and heights of the recommended noise walls in the Medina neighborhood east of Lake Washington. The recommended noise walls for the Medina neighborhood are the same under Options A, K, and L. The noise wall heights shown on Exhibits 55 and 58 are for the noise walls above any retaining walls, where applicable, or above the highest ground elevation near SR 520. Adjustments in the top-of-wall elevations could be necessary during the project's final design phase to ensure acceptable noise wall performance.

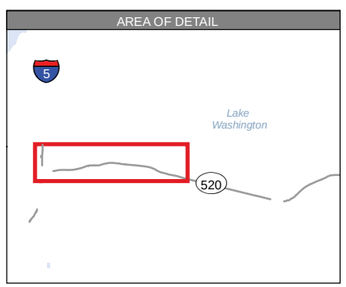
North Side of SR 520

On the north side of SR 520, the noise wall heights would be 16 feet at the Delmar lid, decrease to 10 feet at the Portage Bay Bridge structure,

Proposed lid

Note:
Wall representation is not to scale. The vertical scale shown is exaggerated to show the height differences better.
Dotted lines show where the walls are.





Noise Wall
Lid
Pavement

N
0 500 1,000 2,000 Feet

Source: King County (2006) aerial photo. Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 58. **Potential Noise Wall Locations and Heights for the 6-Lane Alternative Option K – I-5 to Madison Park**

I-5 to Medina: Bridge Replacement and HOV Project

and remain at 10 feet until reaching the Montlake lid. East of the Montlake lid, the noise wall height would be 16 feet and it would wrap north along Montlake Boulevard East approximately 100 feet.

A 264-foot-long wall varying in height from 6 to 8 feet along Montlake Boulevard was evaluated for the entrance to the Edmundson Pavilion athletic building (UW-11). As discussed later in this section, this wall would not meet the WSDOT criteria for mitigation.

A noise wall for the Arboretum north of SR 520 was evaluated and determined to meet the feasibility requirement in terms of sufficient noise-level reduction. However, the analysts do not recommend this wall because it would not meet the reasonableness (cost) criteria. The Arboretum noise wall north of SR 520 that was evaluated but not recommended included a noise wall east of the Montlake lid that, at a height of 8 feet, would have started approximately 100 feet north along Montlake Boulevard East and then would have increased to 10 feet as it wrapped east along the off-ramp. The modeled wall height would have remained at 10 feet until reaching the endpoint approximately 1,750 feet east of AB-4.

A noise wall on the north side of SR 520 would be constructed in Medina. This wall would be 932 feet long, would start approximately 290 feet west of PN-1, and would extend to the Evergreen Point lid. The height of the noise wall would begin at 8 feet on the highrise structure, increase to 10 feet after the first 170 feet, and remain at 10 feet until reaching the lid. The recommended noise wall design along the north side of SR 520 in Medina is the same for all three 6-Lane Alternative design options.

South Side of SR 520

On the south side of SR 520, the first noise wall height would be 14 feet at the Delmar lid, decrease to 10 feet at the Portage Bay Bridge structure, and remain at that height until reaching the east end of the bridge structure. The height would increase to 16 feet and continue at that height until reaching Montlake Boulevard East.

A noise wall for the Arboretum south of SR 520 was evaluated and determined to meet the feasibility requirement in terms of sufficient noise-level reduction. However, the analysts do not recommend this wall because it would not meet the reasonableness (cost) criteria. The Arboretum wall south of SR 520 that was evaluated but not recommended would have included a noise wall beginning along the

east side of the Lake Washington Boulevard on-ramp to SR 520 eastbound and would have extended east approximately 4,364 feet along the Washington Park Arboretum. The modeled wall height was 10 feet over the entire length.

A noise wall for the Madison Park neighborhood would be approximately 5,235 feet long and would be 10 feet high over the entire length. The wall would start near MP-23 and extend east along SR 520 until ending approximately 1,900 feet east of MP-19.

In Medina, on the south side of SR 520, a noise wall would be constructed parallel to the north-side wall. It would start approximately 980 feet west of the Evergreen Point lid (on the highrise structure) and extend to the lid. The height of the wall would begin at 8 feet, increase to 10 feet, and remain at 10 feet until reaching the lid. The recommended noise wall design along the south side of SR 520 in Medina is the same for all three 6-Lane Alternative design options.

Summary

Exhibit 59 summarizes information about the noise walls for the 6-Lane Alternative with Option K. The noise walls were evaluated using WSDOT cost criteria for each designated neighborhood, outside activity area, or park. For each noise wall in Option K, Exhibit 59 identifies the noise-level reduction performance from the noise wall only and the available capital for mitigation under WSDOT criteria .

As shown in Exhibit 59, receivers MS-1 through MS-14 and MS-31 through MS-33 (which represent residences that border East Lake Washington Boulevard/Lake Washington Boulevard East) would receive essentially no noise-reduction benefits from the recommended noise walls. A noise wall would be required along East Lake Washington Boulevard to effectively mitigate traffic noise effects at these residences. However, openings in a noise wall along East Lake Washington Boulevard required for each driveway would render that noise wall ineffective at reducing traffic noise levels.

Exhibit 60 summarizes the cost analysis conducted for the noise walls with the 6-Lane Alternative Option K. A total of 409 residential equivalents (8 with noise levels of 70 dBA or higher) would benefit from construction of the recommended noise walls.

Exhibit 59. Noise Wall Performance Summary for 6-Lane Alternative Option K

Receiver Number	6-Lane Option K Noise Levels without Noise Wall[a,b]	6-Lane Option K Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
Portage Bay/Roanoke					
HR-1	**73**	**73**	0	0	$0.00
HR-2	**72**	**72**	0	0	$0.00
HR-3	**68**	**68**	0	0	$0.00
HR-4	65	63	2	0	$0.00
HR-5	**69**	64	5	3	$144,810.00
HR-7	**70**	58	12	2	$103,800.00
HR-8	**69**	57	12	1	$48,270.00
HR-9	**67**	55	12	1	$41,110.00
HR-10	**67**	57	10	4	$164,440.00
HR-11	63	57	6	4	$149,520.00
HR-12	65	61	4	4	$149,520.00
HR-13	64	62	2	0	$0.00
HR-14	**66**	**66**	0	0	$0.00
HR-15	**67**	**67**	0	0	$0.00
HR-16	64	64	0	0	$0.00
HR-17	64	63	1	0	$0.00
HR-18	62	60	2	0	$0.00
HR-19	64	56	8	4	$149,520.00
HR-20	62	55	7	4	$149,520.00
HR-21	62	55	7	3	$112,140.00
HR-22	62	54	8	5	$186,900.00
HR-23	59	55	4	6	$224,280.00
BH-1	62	53	9	3	$112,140.00
BH-2	63	54	9	3	$112,140.00
BH-3	59	54	5	3	$112,140.00
			Total Available for Noise Mitigation		$1,960,250.00
North Capitol Hill					
CH-1	**71**	**71**	0	0	$0.00
CH-2	**71**	**71**	0	0	$0.00
CH-3	63	63	0	0	$0.00
CH-4	64	63	1	0	$0.00
CH-5	65	64	1	0	$0.00
CH-6	**69**	56	13	18	$868,860.00
CH-7	**67**	57	10	4	$164,440.00
CH-8	**66**	57	9	24	$897,120.00
CH-9	65	57	8	8	$299,040.00
CH-10	64	63	1	0	$0.00
CH-11	62	62	0	0	$0.00
CH-12	**66**	65	1	0	$0.00

Exhibit 59. Noise Wall Performance Summary for 6-Lane Alternative Option K

Receiver Number	6-Lane Option K Noise Levels without Noise Wall[a,b]	6-Lane Option K Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
CH-13	**68**	**68**	0	0	$0.00
CH-14	64	64	0	0	$0.00
CH-15	65	65	0	0	$0.00
CH-16	**67**	**67**	0	0	$0.00
CH-17	63	63	0	0	$0.00
CH-18	62	62	0	0	$0.00
CH-19	62	61	1	0	$0.00
CH-20	62	57	5	4	$149,520.00
CH-21	63	56	7	14	$523,320.00
CH-22	63	56	7	16	$598,080.00
CH-23	63	57	6	8	$299,040.00
CH-24	61	56	5	14	$523,320.00
CH-25	62	58	4	6	$224,280.00
CH-26	61	60	1	0	$0.00
CH-27	61	60	1	0	$0.00
CH-28	**70**	**70**	0	0	$0.00
CH-29	61	61	0	0	$0.00
CH-30	60	59	1	0	$0.00
CH-31	59	58	1	0	$0.00
CH-32	61	58	3	1	$37,380.00
			Total Available for Noise Mitigation		$4,584,400.00
Montlake North of SR 520					
MN-1	**67**	61	6	3.3[c]	$137,033.33
MN-2	**68**	64	4	3.3[c]	$148,800.00
MN-4	**66**	59	7	2	$74,760.00
MN-5	62	58	4	3	$112,140.00
MN-6	62	61	1	0	$0.00
MN-7	**67**	**66**	1	0	$0.00
MN-8	**69**	**69**	0	0	$0.00
MN-9	65	63	2	0	$0.00
MN-10	64	61	3	4	$149,520.00
MN-11	65	60	5	3.3[c]	$124,600.00
MN-12	64	58	6	3.3[c]	$124,600.00
MN-13	63	58	5	4	$149,520.00
MN-14	63	58	5	3	$112,140.00
MN-15	63	59	4	4	$149,520.00
MN-16	64	62	2	0	$0.00
MN-17	**70**	**70**	0	0	$0.00
MN-18	**69**	**68**	1	0	$0.00

Exhibit 59. Noise Wall Performance Summary for 6-Lane Alternative Option K

Receiver Number	6-Lane Option K Noise Levels without Noise Wall[a,b]	6-Lane Option K Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
MN-19	62	61	1	0	$0.00
MN-20	61	60	1	0	$0.00
MN-21	61	60	1	0	$0.00
MN-22	65	61	4	3.3[c]	$124,600.00
MN-23	**70**	**70**	0	0	$0.00
MN-24	62	57	5	3	$112,140.00
MN-25	64	63	1	0	$0.00
MN-26	**68**	**68**	0	0	$0.00
MN-27	63	63	0	0	$0.00
MN-28	60	60	0	0	$0.00
MN-29	65	62	3	3.3[c]	$124,600.00
MN-30	60	57	3	3.3[c]	$124,600.00
MN-31	59	58	1	0	$0.00
MN-32	61	60	1	0	$0.00
MN-33	62	62	0	0	$0.00
MN-34	**66**	**66**	0	0	$0.00
MN-35	63	62	1	0	$0.00
			Total Available for Noise Mitigation		$1,768,573.33
Montlake South of SR 520					
MS-1	**68**	**68**	0	0	$0.00
MS-2	**70**	**70**	0	0	$0.00
MS-3	**72**	**72**	0	0	$0.00
MS-4	**72**	**72**	0	0	$0.00
MS-5	**71**	**71**	0	0	$0.00
MS-6	60	60	0	0	$0.00
MS-7	61	61	0	0	$0.00
MS-8	63	62	1	0	$0.00
MS-9	63	62	1	0	$0.00
MS-10	65	65	0	0	$0.00
MS-11	59	59	0	0	$0.00
MS-12	56	56	0	0	$0.00
MS-13	59	59	0	0	$0.00
MS-14	62	62	0	0	$0.00
MS-15	54	54	0	0	$0.00
MS-16	58	58	0	0	$0.00
MS-17	**69**	**69**	0	0	$0.00
MS-18	63	62	1	0	$0.00
MS-19	65	63	2	0	$0.00
MS-20	**67**	64	3	3	$123,330.00
MS-21	**69**	60	9	9.2[c]	$442,475.00

Exhibit 59. Noise Wall Performance Summary for 6-Lane Alternative Option K

Receiver Number	6-Lane Option K Noise Levels without Noise Wall[a,b]	6-Lane Option K Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
MS-22	**67**	59	8	9.2[c]	$376,841.67
MS-23	65	58	7	9.2[c]	$342,650.00
MS-24	62	56	6	2	$74,760.00
MS-25	62	57	5	2	$74,760.00
MS-26	57	57	0	0	$0.00
MS-27	**66**	63	3	3	$112,140.00
MS-28	**66**	64	2	0	$0.00
MS-29	62	59	3	4	$149,520.00
MS-30	62	60	2	0	$0.00
MS-31	59	59	0	0	$0.00
MS-32	63	63	0	0	$0.00
MS-33	64	64	0	0	$0.00
			Total Available for Noise Mitigation		$1,696,476.67
University of Washington (Not Recommended)					
UW-1	63	63	0	0	$0.00
UW-2	56	56	0	0	$0.00
UW-3	54	54	0	0	$0.00
UW-4	52	52	0	0	$0.00
UW-5	52	52	0	0	$0.00
UW-6	55	55	0	0	$0.00
UW-7	59	59	0	0	$0.00
UW-8	51	51	0	0	$0.00
UW-9	52	52	0	0	$0.00
UW-10	62	62	0	0	$0.00
UW-11	**66**	59	7	2.2[c]	$83,437.50
UW-12	64	64	0	0	$0.00
UW-13	58	58	0	0	$0.00
UW-14	63	63	0	0	$0.00
UW-15	62	62	0	0	$0.00
UW-16	60	60	0	0	$0.00
			Total Available for Noise Mitigation		$83,437.50
Washington Park Arboretum (Not Recommended)					
AB-1	**66**	58	8	5.4[c]	$202,475.00
AB-2	**67**	57	10	5.4[c]	$222,679.17
AB-3	**68**	58	10	5.4[c]	$241,800.00
AB-4	**70**	65	5	0	$0.00
AB-5	**69**	64	5	0	$0.00
AB-6	**68**	62	6	0	$0.00
AB-7	**67**	61	6	0	$0.00

Exhibit 59. Noise Wall Performance Summary for 6-Lane Alternative Option K

Receiver Number	6-Lane Option K Noise Levels without Noise Wall[a,b]	6-Lane Option K Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
AB-8	**66**	60	6	0	$0.00
AB-9	**66**	60	6	0	$0.00
AB-10	65	59	6	0	$0.00
AB-11	64	59	5	0	$0.00
AB-12	64	58	6	0	$0.00
AB-13	63	58	5	0	$0.00
AB-14	63	57	6	5.4[c]	$202,475.00
			Total Available for Noise Mitigation		$869,429.17
Washington Park Arboretum (Not Recommended)					
AB-15	**71**	**67**	4	5.4[c]	$300,787.50
AB-16	65	60	5	5.4[c]	$202,475.00
AB-17	59	56	3	5.4[c]	$202,475.00
AB-18	56	54	2	0	$0.00
AB-19	60	58	2	0	$0.00
AB-20	**68**	**66**	2	0	$0.00
			Total Available for Noise Mitigation		$705,737.50
Madison Park					
MP-1	**66**	59	7	3	$112,140.00
MP-2	**67**	59	8	2	$82,220.00
MP-3	**67**	59	8	2	$82,220.00
MP-4	**68**	60	8	3	$133,920.00
MP-5	65	58	7	3	$112,140.00
MP-6	63	55	8	2	$74,760.00
MP-7	61	54	7	3	$112,140.00
MP-8	60	55	5	3	$112,140.00
MP-9	61	54	7	4	$149,520.00
MP-10	61	55	6	16.7[c]	$623,000.00
MP-11	62	55	7	16.7[c]	$623,000.00
MP-12	60	53	7	4	$149,520.00
MP-13	61	54	7	3	$112,140.00
MP-14	61	54	7	4	$149,520.00
MP-15	61	54	7	4	$149,520.00
MP-16	62	55	7	4	$149,520.00
MP-17	64	56	8	3	$112,140.00
MP-18	64	56	8	5	$186,900.00
MP-19	65	58	7	3	$112,140.00
MP-20	63	57	6	3	$112,140.00
MP-21	61	53	8	1	$37,380.00
MP-22	59	52	7	4	$149,520.00

Exhibit 59. Noise Wall Performance Summary for 6-Lane Alternative Option K

Receiver Number	6-Lane Option K Noise Levels without Noise Wall[a,b]	6-Lane Option K Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
MP-23	57	53	4	3	$112,140.00
			Total Available for Noise Mitigation		$3,749,780.00
Medina North of SR 520					
PN-1	**70**	56	14	3	$155,700.00
PN-2	**73**	60	13	3	$188,370.00
PN-5	**66**	60	6	3	$112,140.00
PN-6	64	59	5	2	$74,760.00
PN-7	62	57	5	6	$224,280.00
PN-8	60	56	4	4	$149,520.00
PN-9	61	59	2	0	$0.00
			Total Available for Noise Mitigation		$904,770.00
Medina South of SR 520					
PS-1	**68**	56	12	3	$133,920.00
PS-2	**68**	54	14	3	$133,920.00
PS-3	**67**	55	12	2	$82,220.00
PS-4	**67**	56	11	4	$164,440.00
PS-5	61	58	3	2	$74,760.00
PS-21	61	54	7	2	$74,760.00
PS-22	60	52	8	3	$112,140.00
PS-23	65	55	10	4	$149,520.00
PS-24	63	52	11	4	$149,520.00
PS-25	60	52	8	3	$112,140.00
PS-26	56	50	6	4	$149,520.00
			Total Available for Noise Mitigation		$1,336,860.00

[a] All noise levels in the exhibit are stated as L_{eq} in dBA.

[b] Bold numbers throughout the exhibit indicate noise levels that approach within 1 dBA or exceed the NAC of 67 dBA L_{eq}.

[c] Includes residential equivalents for outside activity areas represented by this receiver. These areas include the University of Washington, Arboretum, Montlake Playfield, West Montlake Park, NOAA NWFSC outside use area, McCurdy Park, East Montlake Park, and Broadmoor Golf Club.

[d] Available mitigation capital from WSDOT criteria for cost evaluation.

The noise walls evaluated would meet the WSDOT cost criteria with residual capital except for the Washington Park Arboretum walls north and south of SR 520 and the short wall outside the Edmundson Pavilion athletic building. Each recommended noise wall would meet WSDOT cost criteria with an overall I-5 to Medina project corridor residual of $6,845,307 less than the WSDOT-prescribed capital available for mitigation.

Exhibit 60. Details and Cost Analysis for 6-Lane Alternative Option K Noise Walls

Noise Wall Description	Heights Along Wall (ft)[a]			Length (ft)[b]	Wall Area (sq ft)[c]	Cost[d]	Available Capital[e]	Residual Capital[f]
	Min	Avg	Max					
Portage Bay/ Roanoke Delmar lid to Portage Bay	10	11	16	1,849	19,438	$1,037,989	$1,960,250	+ $922,261
North Capitol Hill Delmar lid to Montlake Playfield	10	10	10	2,388	23,882	$1,275,299	$4,584,400	+ $3,309,101
Montlake North of SR 520 Portage Bay to Arboretum	10	13	16	2,498	27,943	$1,492,156	$1,768,573	+ $276,417
Montlake South of SR 520 Montlake Playfield to Montlake Boulevard NE	10	11	16	2,646	29,391	$1,569,479	$1,696,477	+ $126,998
University of Washington Edmundson Pavilion near entrance	6	6.7	8	264	1,923	$102,688	$83,438	- $19,250
Washington Park Arboretum Montlake lid to west of Evergreen Point Bridge—south of SR 520	10	10	10	3,862	38,616	$2,062,094	$705,738	- $1,356,356
Madison Park Arboretum to west end of Evergreen Point Bridge	10	10	10	5,235	52,350	$2,795,490	$3,749,780	+$954,290
Medina North East end of Evergreen Point Bridge Arboretum to Evergreen Point Road	9	9.6	10	932	8,980	$479,532	$904,770	+ $425,238
Medina South East end of Evergreen Point Bridge Arboretum to Evergreen Point Road	9	9.7	10	980	9,473	$505,858	$1,336,860	+ $831,002

[a] Minimum, average, and maximum noise wall heights in feet.

[b] Length of recommended noise walls in feet.

[c] Total noise wall surface area in square feet.

[d] Cost of noise wall based on $53.40 per square-foot from WSDOT criteria for cost evaluation. The cost has been rounded to the nearest whole dollar.

[e] Available mitigation capital from WSDOT criteria for cost evaluation.

[f] Residual mitigation capital: a positive value is within the allowable capital based on WSDOT criteria; a negative value exceeds the criteria.

ft = feet

sq=square feet

The Arboretum wall north of SR 520 would cost $2,321,832 with available capital of $869,429, resulting in negative residual capital of $1,452,403. This wall would not be cost-effective and is not recommended for this project with Option K.

The Arboretum wall south of SR 520 would cost $2,062,094 with available capital of $705,738, resulting in negative residual capital of $1,356,356. This wall would not be cost-effective and is not recommended for this project with Option K.

The wall evaluated near the entrance of the Edmundson Pavilion athletic building would cost $102,688 with available capital of $83,438, resulting in negative residual capital of $19,250. This wall would not be cost-effective and is not recommended for this project with Option K.

Option L

The overall I-5 to Medina project corridor noise walls would be 16,738 feet long with heights varying from 8 to 16 feet. The taller noise walls would be necessary in areas where residents are located uphill from the I-5 to Medina project corridor. Exhibit 61 shows the locations and heights of the recommended noise walls with 6-Lane Alternative Option L west of Lake Washington. Exhibit 55 (presented previously) shows the locations and heights of the recommended noise walls in the Medina neighborhood east of Lake Washington. The recommended noise walls for the Medina neighborhood are the same under Options A, K, and L. The heights shown on Exhibits 55 and 61 are for the noise wall above any retaining walls, where applicable, or above the highest ground elevation near SR 520. Adjustments in the top-of-wall elevations could be necessary during the project's final design phase to ensure acceptable noise wall performance.

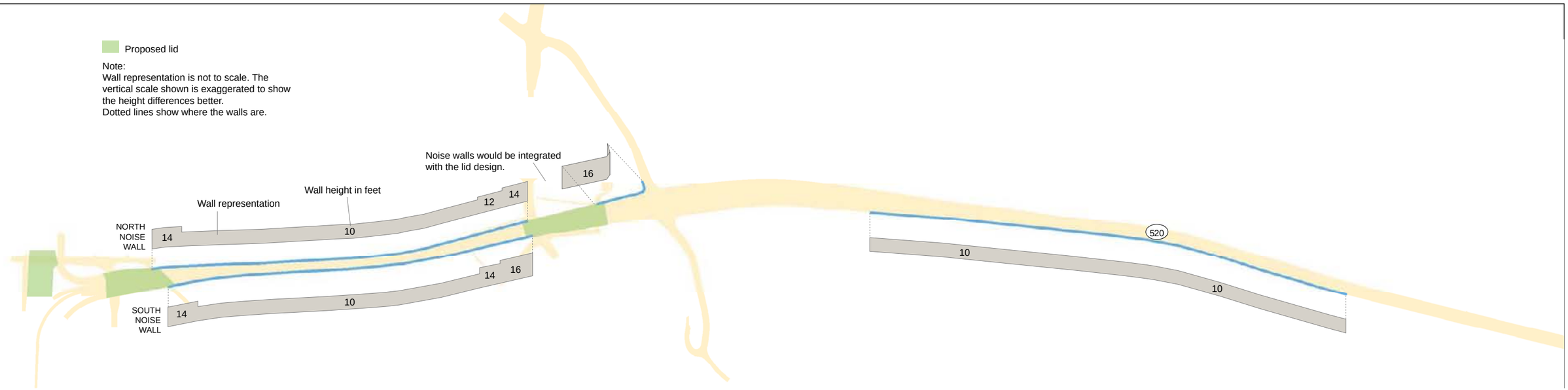
North Side of SR 520

On the north side of SR 520, the noise wall heights would be 14 feet at the Delmar lid, decrease to 10 feet at the Portage Bay Bridge structure, and then increase to 12 feet at the end of the bridge structure. A small segment of wall height between the end of the bridge structure and Montlake lid would be 14 feet as shown in Exhibit 61. East of the Montlake lid, the noise wall height would be 16 feet and it would wrap north along Montlake Boulevard East approximately 100 feet.

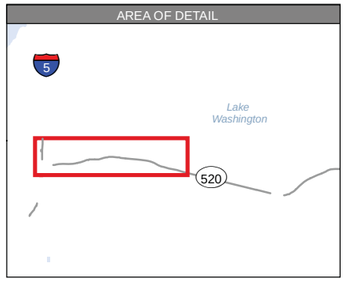
A 264-foot-long wall varying in height from 6 to 8 feet along Montlake Boulevard was evaluated for the entrance to the Edmundson Pavilion athletic building (UW-11). Another 278-foot-long wall at a height of 12 feet was evaluated for the Burke-Gilman Trail and green space near Montlake Boulevard East (UW-2). As discussed later in this section, neither of these two walls would meet the WSDOT criteria for mitigation.

Proposed lid

Note:
Wall representation is not to scale. The vertical scale shown is exaggerated to show the height differences better.
Dotted lines show where the walls are.



AREA OF DETAIL



Noise Wall
Lid
Pavement

N
0 500 1,000 2,000 Feet

Source: King County (2006) aerial photo. Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 61. **Potential Noise Wall Locations and Heights for the 6-Lane Alternative Option L – I-5 to Madison Park**

I-5 to Medina: Bridge Replacement and HOV Project

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A noise wall for the Arboretum north of SR 520 was evaluated and determined to meet the feasibility requirement in terms of sufficient noise-level reduction. However, the analysts do not recommend this wall because it would not meet the reasonableness (cost) criteria. The Arboretum noise wall north of SR 520 that was evaluated but not recommended included a noise wall along the eastern side of the SR 520 westbound off-ramp to Montlake Boulevard East. This 8-foot-high noise wall would have started approximately 100 feet north along Montlake Boulevard East, remained at 8 feet, and wrapped east along the off-ramp and along the north edge of westbound SR 520. The modeled noise wall would have extended to a point approximately 930 feet east of AB-4.

A noise wall on the north side of SR 520 would be constructed in Medina. This wall would be 932 feet long, would start approximately 290 feet west of PN-1, and would extend to the Evergreen Point lid. The height of the noise wall would begin at 8 feet on the highrise structure, increase to 10 feet after the first 170 feet, and remain at 10 feet until reaching the lid. The recommended noise wall design along the north side of SR 520 in Medina is the same for all three 6-Lane Alternative design options.

South Side of SR 520

On the south side of SR 520, similar to Option K, the noise wall height would be 14 feet at the Delmar lid, decrease to 10 feet at the Portage Bay Bridge structure, and remain at that height until reaching the east end of the bridge structure. The height would increase to 14 feet then increase to a 16-foot wall until reaching Montlake Boulevard East.

A noise wall for the Arboretum south of SR 520 was evaluated and determined to meet the feasibility requirement in terms of sufficient noise-level reduction. However, the analysts do not recommend this wall because it would not meet the reasonableness (cost) criteria. The Arboretum wall south of SR 520 that was evaluated but not recommended would have included a noise wall beginning along the east side of the Lake Washington Boulevard on-ramp to SR 520 eastbound and would have extended east approximately 4,555 feet along the Washington Park Arboretum. The modeled wall height was 10 feet over the entire length.

A noise wall for the Madison Park neighborhood would be approximately 6,078 feet long and 10 feet high over the entire length.

The wall would start near MP-23 and extend east along SR 520 until ending approximately 1,940 feet east of MP-19.

In Medina, on the south side of SR 520, a noise wall would be constructed parallel to the north-side wall. It would start approximately 980 feet west of the Evergreen Point lid (on the highrise structure) and extend to the lid. The height of the wall would begin at 8 feet, increase to 10 feet, and remain at 10 feet until reaching the lid. The recommended noise wall design along the south side of SR 520 in Medina is the same for all three 6-Lane Alternative design options.

Summary

Exhibit 62 summarizes information about the noise walls for the 6-Lane Alternative with Option L. The noise walls were evaluated using WSDOT cost criteria for each designated neighborhood, outside activity area, or park. For each noise wall in Option L, Exhibit 62 identifies the noise-level reduction performance from the noise wall only and the available capital for mitigation under WSDOT criteria.

As shown in Exhibit 62, receivers MS-1 through MS-14 and MS-31 through MS-33 (which represent residences that border East Lake Washington Boulevard/Lake Washington Boulevard East) would receive essentially no noise-reduction benefits from the recommended noise walls. A noise wall would be required along East Lake Washington Boulevard to effectively mitigate traffic noise effects at these residences. However, openings in a noise wall along East Lake

Washington Boulevard required for each driveway would render that noise wall ineffective at reducing traffic noise levels.

Exhibit 62. Noise Wall Performance Summary for 6-Lane Alternative Option L

Receiver Number	6-Lane Option L Noise Levels without Noise Wall[a,b]	6-Lane Option L Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
Portage Bay/Roanoke					
HR-1	**73**	**73**	0	0	$0.00
HR-2	**72**	**72**	0	0	$0.00
HR-3	**68**	**68**	0	0	$0.00
HR-4	65	63	2	0	$0.00
HR-5	**69**	64	5	3	$144,810.00
HR-7	**70**	58	12	2	$103,800.00
HR-8	**69**	57	12	1	$48,270.00
HR-9	**67**	55	12	1	$41,110.00
HR-10	**67**	57	10	4	$164,440.00

Exhibit 62. Noise Wall Performance Summary for 6-Lane Alternative Option L

Receiver Number	6-Lane Option L Noise Levels without Noise Wall[a,b]	6-Lane Option L Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
HR-11	63	57	6	4	$149,520.00
HR-12	65	61	4	4	$149,520.00
HR-13	64	63	1	0	$0.00
HR-14	**66**	**66**	0	0	$0.00
HR-15	**68**	**68**	0	0	$0.00
HR-16	64	64	0	0	$0.00
HR-17	64	64	0	0	$0.00
HR-18	62	60	2	0	$0.00
HR-19	63	56	7	4	$149,520.00
HR-20	61	55	6	4	$149,520.00
HR-21	62	56	6	3	$112,140.00
HR-22	62	54	8	5	$186,900.00
HR-23	59	55	4	6	$224,280.00
BH-1	62	53	9	3	$112,140.00
BH-2	62	55	7	3	$112,140.00
BH-3	59	54	5	3	$112,140.00
			Total Available for Noise Mitigation		$1,960,250.00
North Capitol Hill					
CH-1	**72**	**72**	0	0	$0.00
CH-2	**71**	**71**	0	0	$0.00
CH-3	62	62	0	0	$0.00
CH-4	64	63	1	0	$0.00
CH-5	**66**	65	1	0	$0.00
CH-6	**69**	56	13	18	$868,860.00
CH-7	**67**	57	10	4	$164,440.00
CH-8	**66**	57	9	24	$897,120.00
CH-9	65	57	8	8	$299,040.00
CH-10	64	63	1	0	$0.00
CH-11	62	62	0	0	$0.00
CH-12	65	65	0	0	$0.00
CH-13	**69**	**69**	0	0	$0.00
CH-14	64	64	0	0	$0.00
CH-15	65	65	0	0	$0.00
CH-16	**67**	**67**	0	0	$0.00
CH-17	63	63	0	0	$0.00
CH-18	62	62	0	0	$0.00
CH-19	62	61	1	0	$0.00
CH-20	62	57	5	4	$149,520.00
CH-21	63	56	7	14	$523,320.00
CH-22	63	56	7	16	$598,080.00

Exhibit 62. Noise Wall Performance Summary for 6-Lane Alternative Option L

Receiver Number	6-Lane Option L Noise Levels without Noise Wall[a,b]	6-Lane Option L Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
CH-23	63	57	6	8	$299,040.00
CH-24	61	55	6	14	$523,320.00
CH-25	62	57	5	6	$224,280.00
CH-26	62	61	1	0	$0.00
CH-27	61	61	0	0	$0.00
CH-28	**70**	**70**	0	0	$0.00
CH-29	61	61	0	0	$0.00
CH-30	60	59	1	0	$0.00
CH-31	59	58	1	0	$0.00
CH-32	61	58	3	1	$37,380.00
			Total Available for Noise Mitigation		$4,584,400
Montlake North of SR 520					
MN-1	**67**	61	6	3.3[c]	$137,033.33
MN-2	**67**	62	5	3.3[c]	$137,033.33
MN-4	65	60	5	2	$74,760.00
MN-5	61	59	2	0	$0.00
MN-6	62	61	1	0	$0.00
MN-7	**67**	**66**	1	0	$0.00
MN-8	**69**	**69**	0	0	$0.00
MN-9	64	63	1	0	$0.00
MN-10	63	60	3	4	$149,520.00
MN-11	65	60	5	3.3[c]	$124,600.00
MN-12	64	59	5	3.3[c]	$124,600.00
MN-13	63	58	5	4	$149,520.00
MN-14	63	58	5	3	$112,140.00
MN-15	63	59	4	4	$149,520.00
MN-16	63	61	2	0	$149,520.00
MN-17	**70**	**69**	1	0	$0.00
MN-18	**68**	**68**	0	0	$0.00
MN-19	61	60	1	0	$0.00
MN-20	58	57	1	0	$0.00
MN-21	58	57	1	0	$0.00
MN-22	58	57	1	0	$0.00
MN-23	**69**	**68**	1	0	$0.00
MN-24	62	57	5	3	$112,140.00
MN-25	63	62	1	0	$0.00
MN-26	**67**	**66**	1	0	$0.00
MN-27	62	62	0	0	$0.00
MN-28	59	59	0	0	$0.00

Exhibit 62. Noise Wall Performance Summary for 6-Lane Alternative Option L

Receiver Number	6-Lane Option L Noise Levels without Noise Wall[a,b]	6-Lane Option L Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
MN-29	**66**	57	9	3.3[c]	$124,600.00
MN-30	–	–	–	–	–[e]
MN-31	60	59	1	0	$0.00
MN-32	59	59	0	0	$0.00
MN-33	61	61	0	0	$0.00
MN-34	65	65	0	0	$0.00
MN-35	63	62	1	0	$0.00
		Total Available for Noise Mitigation			$1,395,466.67
Montlake South of SR 520					
MS-1	**71**	**71**	0	0	$0.00
MS-2	**70**	**70**	0	0	$0.00
MS-3	**71**	**71**	0	0	$0.00
MS-4	**71**	**71**	0	0	$0.00
MS-5	**71**	**71**	0	0	$0.00
MS-6	61	61	0	0	$0.00
MS-7	61	61	0	0	$0.00
MS-8	62	62	0	0	$0.00
MS-9	63	63	0	0	$0.00
MS-10	65	65	0	0	$0.00
MS-11	59	59	0	0	$0.00
MS-12	56	56	0	0	$0.00
MS-13	59	59	0	0	$0.00
MS-14	62	62	0	0	$0.00
MS-15	55	55	0	0	$0.00
MS-16	58	58	0	0	$0.00
MS-17	**69**	**69**	0	0	$0.00
MS-18	63	62	1	0	$0.00
MS-19	64	62	2	0	$0.00
MS-20	**67**	64	3	3	$123,330.00
MS-21	**69**	59	10	9.2[c]	$442,475.00
MS-22	**67**	59	8	9.2[c]	$376,841.67
MS-23	65	57	8	9.2[c]	$342,650.00
MS-24	62	56	6	2	$74,760.00
MS-25	62	56	6	2	$74,760.00
MS-26	56	56	0	0	$0.00
MS-27	65	60	5	3	$112,140.00
MS-28	65	64	1	0	$0.00
MS-29	62	59	3	4	$149,520.00
MS-30	62	60	2	0	$0.00
MS-31	60	60	0	0	$0.00

Exhibit 62. Noise Wall Performance Summary for 6-Lane Alternative Option L

Receiver Number	6-Lane Option L Noise Levels without Noise Wall[a,b]	6-Lane Option L Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
MS-32	63	63	0	0	$0.00
MS-33	65	65	0	0	$0.00
			Total Available for Noise Mitigation		$1,696,476.67
University of Washington (Two independent walls—neither are recommended)					
UW-1	65	65	0	0	$0.00
UW-2	**70**	63	7	2.2 [c]	$115,848.21
UW-3	59	59	0	0	$0.00
UW-4	55	55	0	0	$0.00
UW-5	54	54	0	0	$0.00
UW-6	59	59	0	0	$0.00
UW-7	61	61	0	0	$0.00
UW-8	51	51	0	0	$0.00
UW-9	52	52	0	0	$0.00
UW-10	62	62	0	0	$0.00
UW-11	**66**	59	7	2.2[c]	$83,437.50
UW-12	64	64	0	0	$0.00
UW-13	58	58	0	0	$0.00
UW-14	64	64	0	0	$0.00
UW-15	63	63	0	0	$0.00
UW-16	60	60	0	0	$0.00
			Total Available for Noise Mitigation for UW-2		$115,848.21
			Total Available for Noise Mitigation for UW-11		$83,437.50
Washington Park Arboretum North of SR 520 (Not Recommended)					
AB-1	**66**	57	9	5.4[c]	$202,475.00
AB-2	**67**	56	11	5.4[c]	$222,679.17
AB-3	**69**	57	12	5.4[c]	$261,462.50
AB-4	**71**	60	11	0	$0.00
AB-5	**69**	59	10	0	$0.00
AB-6	**68**	58	10	0	$0.00
AB-7	**67**	58	9	0	$0.00
AB-8	**67**	57	10	0	$0.00
AB-9	65	56	9	0	$0.00
AB-10	64	56	8	0	$0.00
AB-11	64	56	8	0	$0.00
AB-12	63	55	8	0	$0.00
AB-13	63	56	7	0	$0.00
AB-14	62	55	7	5.4[c]	$202,475.00
			Total Available for Noise Mitigation		$889,091.67

Exhibit 62. Noise Wall Performance Summary for 6-Lane Alternative Option L

Receiver Number	6-Lane Option L Noise Levels without Noise Wall[a,b]	6-Lane Option L Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
Washington Park Arboretum South of SR 520 (Not Recommended)					
AB-15	**70**	61	9	5.4[c]	$281,125.00
AB-16	64	55	9	5.4[c]	$202,475.00
AB-17	59	52	7	5.4[c]	$202,475.00
AB-18	55	51	4	5.4[c]	$202,475.00
AB-19	59	56	3	5.4[c]	$202,475.00
AB-20	65	60	5	5.4[c]	$202,475.00
			Total Available for Noise Mitigation		$1,293,500.00
Madison Park					
MP-1	65	57	8	3	$112,140.00
MP-2	65	58	7	2	$74,760.00
MP-3	**66**	58	8	2	$74,760.00
MP-4	**67**	58	9	3	$123,330.00
MP-5	65	57	8	3	$112,140.00
MP-6	62	54	8	2	$74,760.00
MP-7	61	53	8	3	$112,140.00
MP-8	60	53	7	3	$112,140.00
MP-9	61	53	8	4	$149,520.00
MP-10	61	53	8	16.7[c]	$623,000.00
MP-11	61	53	8	16.7[c]	$623,000.00
MP-12	61	52	9	4	$149,520.00
MP-13	62	53	9	3	$112,140.00
MP-14	62	53	9	4	$149,520.00
MP-15	62	53	9	4	$149,520.00
MP-16	63	54	9	4	$149,520.00
MP-17	63	55	8	3	$112,140.00
MP-18	64	56	8	5	$186,900.00
MP-19	65	57	8	3	$112,140.00
MP-20	63	56	7	3	$112,140.00
MP-21	62	52	10	1	$37,380.00
MP-22	59	51	8	4	$149,520.00
MP-23	57	52	5	3	$112,140.00
			Total Available for Noise Mitigation		$3,724,270.00
Medina North of SR 520					
PN-1	**70**	56	14	3	$155,700.00
PN-2	**73**	60	13	3	$188,370.00
PN-5	**66**	60	6	3	$112,140.00
PN-6	64	59	5	2	$74,760.00
PN-7	62	57	5	6	$224,280.00
PN-8	60	56	4	4	$149,520.00

Exhibit 62. Noise Wall Performance Summary for 6-Lane Alternative Option L

Receiver Number	6-Lane Option L Noise Levels without Noise Wall[a,b]	6-Lane Option L Noise Levels with Noise Wall[a,b]	Noise Reduction[a]	Benefited Homes[c]	Capital Available for Mitigation[d]
PN-9	61	59	2	0	$0.00
		Total Available for Noise Mitigation			$904,770.00
Medina South of SR 520					
PS-1	**68**	56	12	3	$133,920.00
PS-2	**68**	54	14	3	$133,920.00
PS-3	**67**	55	12	2	$82,220.00
PS-4	**67**	56	11	4	$164,440.00
PS-5	61	58	3	2	$74,760.00
PS-21	61	54	7	2	$74,760.00
PS-22	60	52	8	3	$112,140.00
PS-23	65	55	10	4	$149,520.00
PS-24	63	52	11	4	$149,520.00
PS-25	60	52	8	3	$112,140.00
PS-26	56	50	6	4	$149,520.00
		Total Available for Noise Mitigation			$1,336,860.00

[a] All noise levels in the exhibit are stated as L_{eq} in dBA.

[b] Bold numbers throughout exhibit indicate noise levels that approach within 1 dBA or exceed the NAC of 67 dBA L_{eq}.

[c] Includes residential equivalents for outside activity areas represented by this receiver. These areas include the University of Washington, Arboretum, Montlake Playfield, West Montlake Park, NOAA NWFSC outside use area, McCurdy Park, East Montlake Park, and Broadmoor Golf Club.

[d] Available mitigation capital from WSDOT criteria for cost evaluation.

[e] This receiver would be displaced by Option L.

Exhibit 63 summarizes the cost analysis conducted for the noise walls with the 6-Lane Alternative Option L. A total of 400 residential equivalents (8 with noise levels of 70 dBA or higher) would benefit from construction of the recommended noise walls.

The noise walls evaluated would meet the WSDOT cost criteria with residual capital except for the Washington Park Arboretum walls north and south of SR 520 and the short wall outside the Edmundson Pavilion athletic building. Each recommended noise wall would meet WSDOT cost criteria with an overall I-5 to Medina project corridor residual of $6,230,047 less than the WSDOT-prescribed capital available for mitigation.

Exhibit 63. Details and Cost Analysis for 6-Lane Alternative Option L Noise Walls

Noise Wall Description	Heights Along Wall (ft)[a]			Length (ft)[b]	Wall Area (sq ft)[c]	Cost[d]	Available Capital[e]	Residual Capital[f]
	Min	Avg	Max					
Portage Bay/ Roanoke Delmar lid to Portage Bay	14	14	14	1,846	19,488	$1,040,659	$1,960,250	+$919,591
North Capitol Hill Delmar lid to Montlake Playfield	10	10	14	2,388	24,953	$1,332,490	$4,584,400	+$3,251,910
Montlake North of SR 520 Portage Bay to Arboretum	10	13	16	2,268	25,997	$1,388,240	$1,395,467	+$7227
Montlake South of SR 520 Montlake Playfield to Montlake Boulevard NE	10	11	16	2,246	25,041	$1,337,189	$1,696,477	+$359,288
University of Washington Portion of the Burke-Gilman Trail and green space	12	12	12	278	3,333	$177,982	$115,848	- $62,134
University of Washington Edmundson Pavilion near entrance	6	6.7	8	264	1,923	$102,688	$83,438	- $19,250
Washington Park Arboretum Montlake lid to west of Evergreen Point Bridge—North of SR 520	6	8	8	3,153	25,006	$1,335,320	$889,092	-$446,228
Washington Park Arboretum Montlake lid to west of Evergreen Point Bridge—South of SR 520	10	10	10	4,555	45,553	$2,432,530	$1,293,500	-$1,139,030
Madison Park Arboretum to west end of Evergreen Point Bridge	10	10	10	6,078	61,582	$3,288,479	$3,724,270	+$435,791
Medina North East end of Evergreen Point Bridge Arboretum to Evergreen Point Road	8	9.6	10	932	8,980	$479,532	$904,770	+ $425,238

Exhibit 63. Details and Cost Analysis for 6-Lane Alternative Option L Noise Walls

Noise Wall Description	Heights Along Wall (ft)[a]			Length (ft)[b]	Wall Area (sq ft)[c]	Cost[d]	Available Capital[e]	Residual Capital[f]
	Min	Avg	Max					
Medina South East end of Evergreen Point Bridge Arboretum to Evergreen Point Road	8	9.7	10	980	9,473	$505,858	$1,336,860	+ $831,002

[a] Minimum, average, and maximum noise wall heights in feet.

[b] Length of recommended noise walls in feet.

[c] Total noise wall surface area in square feet.

[d] Cost of noise wall based on $53.40 per square-foot from WSDOT criteria for cost evaluation. The cost has been rounded to the nearest whole dollar.

[e] Available mitigation capital from WSDOT criteria for cost evaluation.

[f] Residual mitigation capital: positive value is within the allowable capital based on WSDOT criteria; negative value exceeds the criteria.

ft = feet

sq ft = square-feet

The Arboretum wall north of SR 520 would cost $1,335,320 with available capital of $889,092, resulting in negative residual capital of $446,228. This wall would not be cost-effective and is not recommended for this project with Option L.

The Arboretum wall south of SR 520 would cost $2,432,530 with available capital of $1,293,500, resulting in negative residual capital of $1,139,030. This wall would not be cost-effective and is not recommended for this project with Option L.

As with Options A and K, the wall evaluated near the entrance of the Edmundson Pavilion athletic building would cost $102,688 with available capital of $83,438, resulting in negative residual capital of $19,250. This wall would not be cost-effective and is not recommended for this project with Option L. Similarly, the wall evaluated for the UW-2 receiver (which represents a portion of the Burke-Gilman Trail and green space near Montlake Boulevard East) would cost $177,982 with available capital of $115,848, resulting in negative residual capital of $62,134. This wall would not be cost-effective and is not recommended for this project with Option L.

What other types of traffic noise mitigation is WSDOT currently considering?

Several types of noise mitigation have been used in other areas with some success. Examples include acoustical absorptive noise walls, wall treatments, and special pavements.

Mitigation for Potential Noise Reflection

Given that the I-5 to Medina project corridor could have parallel noise walls along much of the alignment, an additional analysis of barrier reflections might be required once a final alternative has been selected. For highways flanked by parallel noise walls, retaining walls, or a combination of the two, traffic noise can reflect back and forth across the highway before ultimately progressing outwards towards nearby residences. These reflections have the potential to increase the sound levels at nearby residences. Under these circumstances, it is possible that a noise wall would provide less attenuation than predicted. Potential mitigation for this phenomenon could include widening the distance between barriers to ensure the distance between the barriers was at least 10 times the average height of the barriers. Other mitigation for this parallel barrier effect could include placing absorptive treatment on the roadway side or canting the barriers. Further analysis will be performed once the final alternative has been selected.

Quieter Pavement

Currently, WSDOT is evaluating multiple 5-year studies on quieter pavement test sections and various types of pavement to determine if quieter pavement is an effective and feasible method for reducing highway noise for future projects. Given the unique driving and climate conditions in the study area, it is important to study the noise-reduction performance and durability of quieter pavement over time, as well as to consider the smoothness and safety of the product.

The different pavement types that WSDOT is looking at are:

- Dense-graded hot mix asphalt (HMA) pavement
- Portland cement concrete (PCC) pavement
- Open-graded friction course (OGFC) pavement

OGFC pavement is primarily used in the southern states, where temperatures are hotter. In Washington, with colder temperatures,

studded tires are allowed in the winter. In past asphalt-mix designs in the 1990s, such use led to rapid deterioration of the pavement, creating ruts and unsafe driving conditions. WSDOT is evaluating updated asphalt mixes consistent with California and Arizona test locations.

WSDOT is also studying quieter concrete. Means such as the following are used to change the texture of the surface, making the concrete quieter:

- Longitudinal tining
- Diamond and whisper grinding, where crews use diamond saw blades to remove a thin layer of hardened concrete that creates a texture pattern similar to corduroy
- Dragging over the concrete to change the texture

To date, the HMA, PCC, and OGFC pavements have not proven to be a reliable form of noise reduction. Roadside measurements along the test sections have shown reductions of less than 3 dBA after only 2 years in service. Furthermore, WSDOT's Quieter Pavements: Options and Challenges for Washington State (WSDOT 2005) concludes that, on high-traffic urban highways in Washington, quieter pavements performed poorly, with pavement lives ranging from 4 to 10 years. The average lifespan of standard western Washington pavements in similar locations is 16 years. Large reductions in pavement lifespan significantly increase life-cycle costs, a major factor in managing the Washington State Highway Preservation Program.

Noise Expert Review Panel Recommendations

To further study potential traffic noise-reducing measures, WSDOT convened a Noise Expert Review Panel (ERP). This panel consisted of 11 acoustical experts from all over the world, including a university professor, an economist, pavement experts, and several transportation noise specialists.

The ERP developed recommendations that focused on noise-reduction strategies that WSDOT could consider for the SR 520 Program. During this process, the ERP identified and discussed dozens of strategies and their components. At first, the ERP did not limit their thinking based on traditional barriers—engineering, institutional, or societal. Strategies discussed included both conventional and innovative means to reduce noise. Without caveats, the analysts were able to think of creative solutions that would otherwise not have been explored.

As the process continued, to prioritize strategies, the analysts considered those strategies that would most likely be reasonable and feasible. Some of the key components of these strategies included:

- **Roadway design**—using alternatives that sought to reduce and shield noise.
- **Noise barriers**—using alternatives that balanced the need for noise abatement with potentially competing demands for aesthetics.
- **Modeling**—that recognized the complexity of this issue and, thus, the need for a more sophisticated assessment to quantify the costs and benefits of the various strategies.
- **Perception**—to look at how the public would perceive the noise generated along the I-5 to Medina project corridor and discuss means that could be used to improve this perception.
- **Operation and finance**—using economic incentives and disincentives as a means to improve noise via traffic control.
- **Studded tires affecting acoustical durability of pavements**—discussing specific issues related to a paramount factor in the overall noise issue—the prevalence of studded tire use.
- **Vehicle sources**—identifying means to reduce vehicle noise beyond tire-pavement noise sources.
- **Structures**—exploring issues specific to the structures along the I-5 to Medina project.
- **Arterials**—discussing issues specific to the arterial streets that are part of or immediately adjacent to the project.
- **Lids and tunnels**—exploring issues specific to the proposed lids and tunnels found in various alternatives for the I-5 to Medina project.

Many of the recommendations have been included in the I-5 to Medina project (such as lids and noise walls). Other components are beyond the project's scope (such as studded tires). However, many of the other recommendations (including quieter pavement) will be reviewed and considered on a case-by-case basis. It should also be noted that WSDOT only allows the use of feasible and reasonable noise mitigation measures in the analysis within this noise discipline report. Some

prospective measures have not yet been proven to meet these criteria, including the quieter pavement.

What construction noise and vibration mitigation is normally considered?

Several construction noise and vibration abatement methods (including operational methods, equipment choice, or acoustical treatments) could be implemented to limit the effects of construction noise. The methods used might vary in the I-5 to Medina project corridor, depending on construction criteria. The following sections contain some of the more common construction noise and vibration mitigation methods.

Construction Noise Mitigation

WSDOT could use various means to abate construction noise, including the following:

- Prohibiting operation of construction equipment within 500 feet of any occupied dwelling unit in evening or nighttime hours (7:00 p.m. to 7:00 a.m.) or on Sundays or legal holidays, when noise and vibration would have the most severe effect.
- Requiring mufflers on all engine-powered equipment, to be installed according to the manufacturer's specifications.
- Requiring that all equipment comply with U.S. Environmental Protection Agency (EPA) equipment noise standards.
- Limiting activities that produce the highest noise levels (such as hauling, loading spoils, jack hammering, and using other demolition equipment) to 7:00 a.m. to 7:00 p.m.
- Mitigating the noise associated with pile driving (where maximum noise levels associated with pile driving could reach 105 dBA at distances of 50 feet) by such things as:
  - Augering rather than driving piles (however, using an auger is not likely to be feasible for this project).
  - Limiting the time the activity could take place.

  Other less effective methods of reducing noise from pile driving include coating the piles, using pile pads, or using piston mufflers. In the event that pile driving exceeds the maximum noise levels set

forth in Exhibit 20, a noise variance would be requested from the local jurisdiction.

- Keeping a construction log for each of the construction staging areas. The log could contain general construction information such as the time an activity took place, the type of equipment used, and any other information that might help with potential noise effects.
- Establishing a complaint hotline to investigate noise complaints and compare them to the construction logs.
- Developing a construction monitoring and complaint program to help ensure that all equipment met state, local, and any manufacturer's specifications for noise emissions. Equipment not meeting the standards could be removed from service until proper repairs were made, and the equipment re-tested for compliance. This procedure is recommended for all haul trucks, loaders, excavators, and other equipment that would be used extensively at the construction sites and that would contribute to potential noise effects.

Recommended noise mitigation measures that could be contained in the contract specifications might include the following:

- Requiring all engine-powered equipment to have mufflers that were installed according to the manufacturer's specifications.
- Requiring all equipment to comply with pertinent EPA equipment noise standards.
- Limiting jackhammers, concrete breakers, saws, and other forms of demolition to daytime hours of 8:00 a.m. to 5:00 p.m. on weekdays, with more stringent restrictions on weekends.
- Minimizing noise by regular inspection and replacement of defective mufflers and parts that do not meet the manufacturers' specifications.
- Installing temporary or portable acoustic barriers around stationary construction noise sources and along the sides of the temporary bridge structures, where feasible.
- Where possible, scheduling construction of the residential noise barriers early in the project. In some jurisdictions, this might be a requirement in order to get any noise variances.

- Locating stationary construction equipment as far from nearby noise-sensitive properties as possible.
- Shutting off idling equipment.
- Rescheduling construction operations to avoid periods of noise annoyance identified in complaints.
- Notifying nearby residents whenever extremely noisy work would be occurring.
- Using broadband back-up alarms as required for any night work in the Seattle portions of the project. In areas outside Seattle, restrict the use of back-up beepers during evening and nighttime hours and use spotters. In all areas, Occupational Safety and Health Administration (OSHA) will require back-up warning devices and spotters for haul vehicles.
- Using a pile-driving noise shroud and/or employing augering techniques, where possible, to limit the effects of pile driving.
- Following the recommendations set forth in the Ecosystems Discipline Report (WSDOT 2009a) regarding protection of aquatic habitat from the effects of pile driving.
- Implementing additional noise mitigation measures as more details on the actual construction processes are identified.

Construction Vibration Mitigation

WSDOT could require vibration monitoring of all activities that might produce vibration levels at or above 0.5 inch per second whenever structures are located near the construction activity. This would include pile driving, vibratory sheet installation, soil compacting, and other construction activities that had the potential to cause high levels of vibration. There is virtually no effective method to reduce vibration effects from construction. However, by restricting and monitoring vibration-producing activities, vibration effects from construction can be kept to a minimum.

What negative effects would remain after mitigation?

Although the 6-Lane Alternative would include noise walls, noise levels at some residences would continue to exceed the NAC. In accordance

with FHWA and WSDOT requirements, noise mitigation measures are considered at locations along alignments where traffic noise levels are predicted to exceed the NAC as a result of a project. There are several locations where the NAC exceedances would not be due entirely to the project, and there are no reasonable or feasible methods of reducing that noise. The following sections summarize those locations expected to exceed the NAC even with the proposed noise abatement measures, and provide information on why no additional noise abatement measures are recommended.

Portage Bay/Roanoke

In the Portage Bay/Roanoke neighborhood, noise levels at several residential locations would continue to exceed the NAC even with the proposed noise-reducing design options and noise abatement measures. Receivers HR-1 through HR-3 and HR-15 would exceed the NAC under all three design options. All of these receiver locations are close to I-5 and adjacent to Harvard Avenue East or East Roanoke Street, or both. The combined noise from I-5 and these local major arterials is the main reason for noise levels above the NAC. The analysts are not recommending any additional noise abatement because the I-5 to Medina project is not modifying any of these roadways. Furthermore, no reasonable or feasible methods of providing additional noise abatement in the area would be within the scope of this project.

North Capitol Hill

Several receiver locations in the North Capitol Hill neighborhood are projected to exceed the NAC under the 6-Lane Alternative. Five receivers (CH-1, CH-2, CH-13, CH-16, and CH-28) would exceed the NAC under all three design options. The Delmar lid would effectively reduce noise levels at approximately 10 residences that would otherwise exceed the NAC. Major noise sources for all receivers in this area include I-5 and 10th Avenue East. As with the Portage Bay/ Roanoke neighborhood, the analysts are not recommending any additional noise abatement on North Capitol Hill because the I-5 to Medina project is not modifying either of these roadways.

Montlake

In the Montlake neighborhood, several receiver locations would continue to exceed the NAC with Options K and L because of traffic on Montlake Boulevard and Lake Washington Boulevard (MN-7, MN-8, MN-17, MN-18, MN-23, and MN-26 on the north side of SR 520, and

MS-1 through MS-5, and MS-17 on the south side of SR 520). One additional receiver location (MN-34) would also exceed the NAC under Option K. Under Option A, the same receivers on the south side of SR 520 would exceed the NAC with the addition of MS-18; however, no receivers on the north side would exceed the NAC. The analysts are not recommending any additional noise abatement because the I-5 to Medina project is not modifying either of these roadways.

University of Washington

Under all three design options, one receiver (UW-11) within the University of Washington Campus would continue to exceed the NAC. The analysts are not recommending abatement because the evaluated noise wall would not meet the WSDOT criteria for reasonableness (cost). In addition, the I-5 to Medina project is not modifying the roadway in this area and the receiver is projected to have the same noise level under existing, 2030 No Build Alternative, and 2030 6-Lane Alternative conditions. With Option L, noise levels at UW-2 (which represents a portion of the Burke-Gilman Trail and green space near Montlake Boulevard East) would increase by 12 dBA. UW-2 would exceed the NAC substantial increase criterion. The analysts are not recommending abatement because the evaluated noise wall would not meet the WSDOT criteria for reasonableness (cost).

Washington Park Arboretum

With Option A, 16 residential equivalents would exceed the NAC under the 6-Lane Alternative in the Washington Park Arboretum. Similarly, the 27 residential equivalents with Option K and the 22 residential equivalents with Option L would continue to exceed the NAC under the 6-Lane Alternative. The analysts evaluated noise walls for the Washington Park Arboretum for the 6-Lane Alternative with Options A, K, and L, but these noise walls would not meet the WSDOT reasonableness (cost) criteria. Areas within the Arboretum that are within 100 feet of the proposed lids under all three design options would receive traffic noise-level reductions of up to 10 dBA L_{eq} compared to the existing and 2030 No Build Alternative peak-hour traffic noise levels. The lids would reduce the number of affected residential equivalents by 11 with Option A (compared to the No Build Alternative condition) and by 5 with Option L. With Option K, even though the number of residential equivalents that would exceed the NAC would be the same as under the No Build Alternative, there would be a net benefit in those areas near the lids that were not used as

residential equivalent modeling points. Outside the area near the lids, the noise levels would remain effectively unchanged by the 6-Lane Alternative with any of the design options.

Noise Wall Heights

Although the noise wall heights were limited to 10 feet on the bridge structures to allow for bridge structure inspections, higher wall heights were modeled to determine if the number of affected residences could be reduced. That is, the upper limit of the wall heights were based solely on WSDOT's reasonableness (cost) criteria without consideration of the 10-foot noise wall height limit on bridge structures. The modeling results showed that, although the overall noise levels under the 6-Lane Alternative with the design options could be reduced with higher walls on the bridge structures, no more affected residences would be mitigated than with the noise walls as currently recommended in this report.

Summary

The construction noise and vibration mitigation that would be required to comply with all regulatory requirements will help keep the negative effects of construction to a minimum. Nonetheless, it is likely that people would complain about noise during construction, and these complaints would be handled on a case-by-case basis.

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Attachment 1

Noise Model Validation Summary for the Project Study Area

1A: Portage Bay/Roanoke Neighborhood

Exhibit 1A-1. Noise Model Validation Summary for the Portage Bay/Roanoke Neighborhood

TNM Modeling #	Monitoring #	Measured[a]	Modeled[a]	Difference (modeled - measured)
HR-1	M3	76	75	-1
HR-4	M6	63	63	0
HR-7	M7	61	63	2
HR-17	M1	59	61	2
HR-18	M2	59	59	0
HR-20	M4	57	59	2
HR-23	M5	59	59	0

[a] Measured and modeled equivalent sound level (L_{eq}) in A-weighted decibels (dBA).

1B: North Capitol Hill Neighborhood

Exhibit 1B-1. Noise Model Validation Summary for North Capitol Hill Neighborhood

TNM Modeling #	Monitoring #	Measured[a]	Modeled[a]	Difference (modeled - measured)
CH-1	M10	72	71	-1
CH-3	M11	63	64	1
CH-9	M15	66	65	-1
CH-17	M12	60	61	1
CH-19	M13	60	61	1
CH-28	M8	67	67	0
CH-29	M9	57	59	2
CH-31	M14	56	58	2

[a] Measured and modeled equivalent sound level (L_{eq}) in A-weighted decibels (dBA).

1C: Montlake Neighborhood North of SR 520

Exhibit 1C-1. Noise Model Validation Summary for Montlake Neighborhood North of SR 520

TNM Modeling #	Monitoring #	Measured[a]	Modeled[a]	Difference (modeled - measured)
MN-1	M19	67	67	0
MN-4	M25	65	66	1
MN-5	M24	68	66	-2
MN-7	M23	65	67	2
MN-11	M18	67	65	-2
MN-13	M17	63	63	0
MN-15	M20	63	62	-1
MN-18	M21	71	72	1
MN-20	M22	59	59	0

[a] Measured and modeled equivalent sound level (L_{eq}) in A-weighted decibels (dBA).

1D: Montlake Neighborhood South of SR 520

Exhibit 1D-1. Noise Model Validation Summary for Montlake Neighborhood South of SR 520

TNM Modeling #	Monitoring #	Measured[a]	Modeled[a]	Difference (modeled - measured)
MS-1	M27	71	73	2
MS-3	M30	73	73	0
MS-11	M28	61	59	-2
MS-12	M31	57	56	-1
MS-13	M32	58	57	-1
MS-17	M29	69	70	1
MS-20	M26	63	65	2
MS-23	M16	64	65	1

[a] Measured and modeled equivalent sound level (L_{eq}) in A-weighted decibels (dBA).

1E: Arboretum

Exhibit 1E-1. Noise Model Validation Summary for the Arboretum

TNM Modeling #	Monitoring #	Measured[a]	Modeled[a]	Difference (modeled - measured)
AB-15	M33	69	70	1

[a] Measured and modeled equivalent sound level (L_{eq}) in A-weighted decibels (dBA).

1F: Madison Park Neighborhood

Exhibit 1F-1. Noise Model Validation Summary for Madison Park Neighborhood

TNM Modeling #	Monitoring #	Measured[a]	Modeled[a]	Difference (modeled - measured)
MP-2	M35	65	66	1
MP-3	M36	66	67	1
MP-9	M34	58	60	2
MP-17	M37	61	62	1

[a] Measured and modeled equivalent sound level (L_{eq}) in A-weighted decibels (dBA).

1G: Laurelhurst Neighborhood

Exhibit 1G-1. Noise Model Validation Summary for Laurelhurst Neighborhood

TNM Modeling #	Monitoring #	Measured[a]	Modeled[a]	Difference (modeled - measured)
LH-1	M39	58	59	1
LH-7	M38	48	49	1

[a] Measured and modeled equivalent sound level (L_{eq}) in A-weighted decibels (dBA).

1H: Medina Neighborhood

Exhibit 1H-1. Noise Model Validation Summary for Medina

TNM Modeling #	Monitoring #	Measured[a]	Modeled[a]	Difference (modeled - measured)
PN-1	M40	60	61	1
PN-3	M43	70	68	-2
PN-5	M45	61	61	0
PN-9	M46	63	–	N/A[b]
PS-2	M42	62	61	-1
PS-3	M44	64	65	1
PS-5	M47	72	67	**-5**[c]
PS-23	M41	59	59	0
PS-25	M48	53	55	2

[a] Measured and modeled equivalent sound level (L_{eq}) in A-weighted decibels (dBA).

[b] Located too far (more than 1,000 feet) from SR 520 for an accurate validation.

[c] Non-traffic-related noise sources distorted readings during measurement.

– = Receiver location in new highway right-of-way; therefore, no noise levels were calculated.

N/A = not applicable

Attachment 2

Residential-Equivalent Calculations for the Project Study Area

Exhibit 2A. Residential-Equivalent Calculations based on WSDOT Directive D22-22 (see table footnote)

Receiver	Area Represented	Summer Users	Hours/ Day	Months/ Year	Winter Users	Hours/ Day	Months/ Year	Residential Equivalents
Montlake North								
MN-1	NOAA NWFSC – outside use area	10	12	6	5	8	6	3.3
MN-2	NOAA NWFSC – outside use area	10	12	6	5	8	6	3.3
MN-11	NOAA NWFSC – outside use area	10	12	6	5	8	6	3.3
MN-12	Boat docks – Portage Bay	10	12	6	5	8	6	3.3
MN-22	Park	10	12	6	5	8	6	3.3
MN-29	Park	10	12	6	5	8	6	3.3
MN-30	Park	10	12	6	5	8	6	3.3
Montlake South								
MS-21	School – track/field	30	12	6	10	8	6	9.2
MS-22	School – track/field	30	12	6	10	8	6	9.2
MS-23	School – building	30	12	6	10	8	6	9.2
Arboretum								
AB-1	Park	15	12	6	10	8	6	5.4
AB-2	Park	15	12	6	10	8	6	5.4
AB-3	Park	15	12	6	10	8	6	5.4
AB-4 through AB-13 are model locations used only to determine areas within the Arboretum where the NAC is approached or exceeded—no residential equivalents are represented by these receivers.								
AB-14	Park	15	12	6	10	8	6	5.4
AB-15	Park	15	12	6	10	8	6	5.4
AB-16	Park	15	12	6	10	8	6	5.4
AB-17	Park	15	12	6	10	8	6	5.4
AB-18	Park	15	12	6	10	8	6	5.4
AB-19	Park	15	12	6	10	8	6	5.4
AB-20	Park	15	12	6	10	8	6	5.4
University of Washington[a]								
UW-1	Open Space	10	–	–	10	5	9	2.2
UW-2	Open Space	10	–	–	10	5	9	2.2
UW-3	Open Space	10	–	–	10	5	9	2.2

Exhibit 2A. Residential-Equivalent Calculations based on WSDOT Directive D22-22 (see table footnote)

Receiver	Area Represented	Summer Users	Hours/ Day	Months/ Year	Winter Users	Hours/ Day	Months/ Year	Residential Equivalents
UW-4	Open Space	10	–	–	10	5	9	2.2
UW-5	Stadium area	50	–	–	10	5	9	11.2
UW-6	Stadium area	15	–	–	10	5	9	3.3
UW-7	Stadium area	25	–	–	10	5	9	5.6
UW-8	Stadium area	25	–	–	10	5	9	5.6
UW-9	Stadium area	100	–	–	10	5	9	22.3
UW-10	Stadium area	25	–	–	10	5	9	5.6
UW-11	Gym entrance	10	–	–	10	5	9	2.2
UW-12	Gym entrance	10	–	–	10	5	9	2.2
UW-13	Near Hospital	50	–	–	6	3	12	5.4
UW-14	Near Hospital	25	–	–	6	3	12	2.7
UW-15	Open space	10	–	–	10	5	9	2.2
UW-16	Classrooms	25	–	–	10	5	9	5.6
Madison Park								
MP-10	Park	50	12	6	25	8	6	16.7
MP-11	Park	50	12	6	25	8	6	16.7

[a] Use D22-22 Usage factors for schools (0.22) and hospitals (1.0). (WSDOT 1987)

Note: Less than 12 months per year are typically assumed for parks and trails; however, because of the high density of residential structures around these areas, and conferences with local residences, the analysts assumed a full year of use.