APPENDIX C
SR 515 IMPROVEMENT PROJECT NOISE ANALYSIS

DATE: September 27, 2007

TO: Karen Comings, I-405 Project Team

FROM: Patrick Romero, I-405 Project Team

RE: Interstate 405, Tukwila to Renton Improvement Project (1-5 to SR 169 – Phase 2), SR 515 Improvement Project – Supplemental Noise Analysis

CC: File

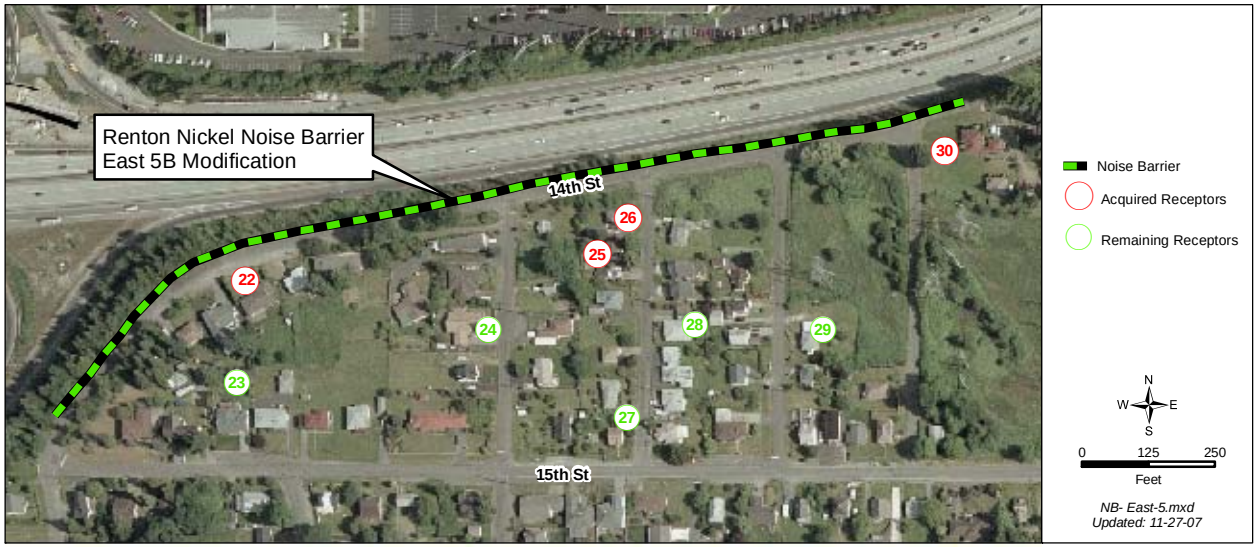
This technical memorandum presents the findings for the noise analysis of communities located near design modifications for the SR 515/I-405 half-diamond interchange. The noise levels experienced by residences located behind Noise Barrier East 5B (located southeast of the I-405/SR 167 interchange), Noise Barrier 8 (located near the Berkshire Apartments, east of the SR 515/I-405 interchange), and Noise Barrier 9 (located near the Defoor Property, east of I-405 along Renton Hill) are evaluated in these areas.

Findings presented in this technical memorandum detail the modification to Noise Barrier East 5 resulting from the SR 515/I-405 half-diamond interchange. Findings also include the evaluation of Noise Barrier 8, which satisfies WSDOT criteria for a feasible and reasonable noise barrier, and Noise Barrier 9, which is feasible but does not satisfy WSDOT criteria for a reasonable noise barrier.

Renton Nickel Noise Barrier East 5B Modification

Noise Barrier East 5 is planned for construction as part of the Renton Nickel Improvement Project. The SR 515/I-405 interchange improvements make modifications to Noise Barrier East 5 necessary. The modified Noise Barrier East 5 is renamed Noise Barrier East 5B. Noise Barrier East 5B is located along the southern right-of-way of I-405 along S 14th Street beginning approximately 250 feet west of SR 515 to the east and ending west of the S 14th Street/S 15th Street intersection atop Talbot Hill (see Exhibit C-1 below). Noise levels in the vicinity of Noise Barrier East 5B were predicted to range between 66 and 72 dBA without a noise barrier.

Exhibit C-1: Renton Nickel Noise Barrier East 5B Modification



In accordance with WSDOT perpetuity standards, Noise Barrier East 5B must be relocated to a position that provides residences in the Talbot Hill area with shielding effects that are comparable to those of Noise Barrier East 5 in its original position. Noise Barrier East 5B will have the same 18-foot height as was originally designed. However, it will be approximately 300 feet shorter because two potentially noise-sensitive residences in the area to the east of the old Smithers Avenue S will be acquired for an interim construction stage. The length of Noise Barrier East 5B will be approximately 1,860 feet and it will remain at a height of 18 feet.

Shortening the length by 300 feet off the eastern end of Noise Barrier 5B does not change noise reductions initially provided by Noise Barrier 5 at the remaining residences located behind Noise Barrier 5B.

Increasing the height of Noise Barrier 5B from 18 feet to 24 feet provided a maximum reduction of 2 dBA for the 21 residences represented by Modeled Sites 24, 28, and 29. This modification to Noise Barrier East 5B will not provide a 7-dBA reduction in I-405 traffic noise levels for any of the residences represented by Modeled Sites 23, 24, 27, 28, and 29 (see Appendix B). For this reason, an upgrade to Noise Barrier East 5B is not feasible.

The modification of Renton Nickel Noise Barrier East 5B was not considered feasible because increasing its height from 18 feet to 24 feet will not provide a 7-dBA reduction in I-405 traffic noise levels for any of the residences represented by Modeled Sites 23, 24, 27, 28, and 29, as shown in Exhibit C-2.

Exhibit C-2: Noise Barrier East 5B – 24 feet tall

Modeled Site	Residences Represented	Leq (dBA)	Allowed Barrier Area (ft^2)	Noise Level with Barrier Modification	Reduction (dBA)
23	5	63	0	61	2
24	6	63	0	62	1
27	6	63	0	62	1
28	8	64	0	63	1
29	7	63	0	61	2
Total Barrier Area (ft^2)			0	43,526	
Planning-Level Cost ($)			$0	$2,324,288	

Noise Barrier 8 (Feasible, Reasonable)

The area just east of Benson Road S and continuing atop the hillside adjacent to the Berkshire Apartments was evaluated for a noise barrier (see Exhibit C-3). This noise barrier was evaluated along the new WSDOT right-of-way line from Benson Road S, continuing north to approximately 200 feet beyond the Berkshire Apartment property. Noise levels in the area of Noise Barrier 8 range from 54 dBA to 71 dBA.

It is important to note that acquisitions are anticipated for the design of the SR 515/I-405 half-diamond interchange. Planned acquisitions include two apartment buildings within the Berkshire Apartment complex and full or partial acquisitions of several single-family residential parcels, including some residential structures along I-405 and Benson Road S.

Exhibit C-3: Location of Noise Barrier 8

At a height of 20 feet, Noise Barrier 8 provides a maximum noise reduction of 12 dBA for four second-floor residences represented by Modeled Site 33A(2). Modeled Sites 32A, 33A, and 33D represent all nine first-row residences, which experience a reduction of 5 dBA or more.

Receptors 33A(2), 33D(2), 33F, 33F(2), 33G, and 33G(2)—representing 21 ground-floor and second-floor residences—are predicted to achieve reductions that range from 3 dBA to 12 dBA.

Noise Barrier 8 meets WSDOT feasibility criteria at a height of 20 feet, because a 7-dBA reduction is achieved and a reduction of 5 dBA or greater is provided at most first-row residences. An area of approximately 21,911 square feet and a length of 1,096 feet are required for Noise Barrier 8 at this height. Noise Barrier 8 would force utility line relocation in the area north of the Berkshire Apartments. Utility relocation costs of $40,000 are included in the evaluation of reasonableness shown in Exhibit C-4. Based on the WSDOT mitigation allowance, the allowable area that the residences in the vicinity of Noise Barrier 8 can receive is 24,406 square feet, as shown in Exhibit C-4. The optimal barrier height for Noise Barrier 8 is 20 feet.

Exhibit C-4: Allowed Barrier Area for Noise Barrier 8 – 20 feet tall

Modeled Site	Residences Represented	L_{eq} (dBA)	Allowed Barrier Area (ft^2)	Noise Level with Barrier (dBA)	Reduction (dBA)
32A	2	71	2,080	66	5
32B	3	69	0	67	2
33A	4	66	2,800	57	9
33A(2)	4	71	4,160	59	12
33B	4	54	0	52	2
33B(2)	4	54	0	53	1
33C	3	56	0	55	1
33C(2)	3	58	0	56	2
33D	3	65	2,100	56	9
33D(2)	3	69	2,712	61	8
33E	3	55	0	54	1
33E(2)	3	57	0	55	2
33F	3	64	2,100	59	5
33F(2)	3	67	2,304	62	5
33G	4	66	2,800	63	3
33G(2)	4	68	3,344	65	3
TOTAL Barrier Area (ft^2)			24,400	21,911	
Utility Relocation Cost ($)			--	40,000	
Planning-Level Cost ($)			$1,302,960	$1,170,047 + $40,000 = $1,210,047	

Additional barrier heights were evaluated to determine the optimal barrier height and potential noise reduction. At a height of 12 feet, Noise Barrier 8 provides a maximum noise reduction of 8 dBA for four ground-floor residences represented by Modeled Site 33A. Modeled Sites 32A and 33D represent the remaining five first-row residences, which all experience a reduction of

5 dBA or more. Receptors 33A(2), 33D(2), 33F, and 33F(2)—representing 13 ground-floor and second-floor residences—are predicted to achieve reductions that range from 3 dBA to 7 dBA.

Noise Barrier 8 meets WSDOT feasibility criteria at a height of 12 feet, because a 7-dBA reduction is achieved and a reduction of 5 dBA or greater is provided at most first-row residences. An area of approximately 13,147 square feet and a length of 1,096 feet are required for Noise Barrier 8 at this height. Utility relocation costs of $40,000 are included in the evaluation of reasonableness shown in Exhibit C-5. Based on the WSDOT mitigation allowance, the allowable area that the residences in the vicinity of Noise Barrier 8 can receive is 18,256 square feet, as shown in Exhibit C-5. The large amount of allowable wall area that remains available at the height of 12 feet indicates that additional noise reduction may be available by increasing the height of the barrier.

Exhibit C-5: Allowed Barrier Area for Noise Barrier 8 – 12 feet tall

Modeled Site	Residences Represented	L_{eq} (dBA)	Allowed Barrier Area (ft^2)	Noise Level with Barrier (dBA)	Reduction (dBA)
32A	2	71	2,080	68	3
32B	3	69	0	68	1
33A	4	66	2,800	58	8
33A(2)	4	71	4,160	64	7
33B	4	54	0	53	1
33B(2)	4	54	0	53	1
33C	3	56	0	55	1
33C(2)	3	58	0	58	0
33D	3	65	2,100	60	5
33D(2)	3	69	2,712	64	5
33E	3	55	0	54	1
33E(2)	3	57	0	57	0
33F	3	64	2,100	61	3
33F(2)	3	67	2,304	64	3
33G	4	66	0	64	2
33G(2)	4	68	0	66	2
TOTAL Barrier Area (ft^2)			18,256	13,147	
Utility Relocation Cost ($)			--	40,000	
Planning-Level Cost ($)			$974,870	$702,050 + $40,000 = $742,050	

As shown in Exhibit C-6, Noise Barrier 8 was also evaluated at a height of 24 feet. As shown in Exhibit C-6, at a height of 24 feet Noise Barrier 8 meets WSDOT criteria for feasibility, because a 7 dBA noise reduction is experienced at several modeled sites and because all nine of the first-

row residences represented by Modeled Sites 32A, 33A, and 33D achieve at least a 5 dBA noise reduction.

At a height of 24 feet, an area of approximately 26,293 square feet and a length of 1,096 feet are required for Noise Barrier 8. Utility relocation costs of $40,000 are included in the evaluation of reasonableness shown in Exhibit C-6. Based on the WSDOT mitigation allowance, the allowable area that the residences in the vicinity of Noise Barrier 8 can receive is 24,406 square feet. Because the allowable area is less than the area needed for a 24-foot-tall barrier, the 24-foot height is not considered reasonable for Noise Barrier 8. A 0-to-1-dBA reduction is predicted per benefited receiver with the 24-foot barrier design, compared to the 20-foot barrier design. Only two additional residences experience noise levels below the NAC when comparing the 24-foot height to the 20-foot height.

Exhibit C-6: Allowed Barrier Area for Noise Barrier 8 – 24 feet tall

Modeled Site	Residences Represented	L_{eq} (dBA)	Allowed Barrier Area (ft^2)	Noise Level with Barrier (dBA)	Reduction (dBA)
32A	2	71	2,080	65	6
32B	3	69	0	67	2
33A	4	66	3,072	56	10
33A(2)	4	71	4,160	58	13
33B	4	54	0	52	2
33B(2)	4	54	0	53	1
33C	3	56	0	55	1
33C(2)	3	58	0	56	2
33D	3	65	2,100	55	10
33D(2)	3	69	2,712	58	9
33E	3	55	0	54	1
33E(2)	3	57	0	55	2
33F	3	64	2,100	57	7
33F(2)	3	67	2,304	61	6
33G	4	66	2,800	62	4
33G(2)	4	68	3,344	64	4
TOTAL Barrier Area (ft^2)			24,400	26,293	
Utility Relocation Cost ($)			--	40,000	
Planning-Level Cost ($)			$1,302,960	$1,404,046 + $40,000 = $1,444,046	

Noise Barrier 9 (Feasible, Not Reasonable)

A pocket of single-family residences located on Renton Avenue S, southeast of the southern limit of Mill Avenue S, were evaluated for a noise barrier. This noise barrier was evaluated

along the WSDOT right-of-way line east of I-405. The residences in this area are located at a much higher elevation than the I-405 lanes. Noise levels predicted at the sensitive receptor sites in this area range from 65 to 71 dBA without a barrier.

The maximum reduction provided by Noise Barrier 9 was 8 dBA for the three residences represented by Modeled Site 35D. As shown in Exhibit C-7, at a height of 16 feet Noise Barrier 9 meets WSDOT feasibility criteria, because a 7 dBA noise reduction is experienced at Modeled Sites 35B and 35D and 9 of the 12 first-row residences represented by Modeled Sites 35B, 35C, and 35D achieve at least a 5 dBA noise reduction. At a height of 16 feet, an area of approximately 11,584 square feet and a length of 724 feet is required for Noise Barrier 9. Based on the WSDOT mitigation allowance, the allowable area that residences in the vicinity of Noise Barrier 9 can receive is 10,236 square feet. Because the allowable area is less than the area needed for the shortest barrier in both height (16 feet) and length (724 feet), Noise Barrier 9 is not considered to be reasonable.

Exhibit C-7: Noise Barrier 9 – 16 feet tall

Modeled Site	Residences Represented	Leq (dBA)	Allowed Barrier Area (ft^2)	Noise Level with Barrier	Reduction (dBA)
35A	3	65	2,100	62	3
35B	3	66	2,100	59	7
35C	3	71	3,120	66	5
35D	3	70	2,916	62	8
Total Barrier Area (ft^2)			10,236	11,584	
Planning-Level Cost ($)			$546,602	$618,586	

*Planning-level cost based on typical construction techniques and engineering for noise barriers with a maximum height of 24 feet.