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Appendix C
Noise Technical Memorandum

Transportation
Land Development
Environmental
Services

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Memorandum

To: File

Date: October 7, 2005

Project No.: 3169800

From: VHB

Re: I-81 Corridor Study Noise Technical Memorandum

Highway Noise Modeling and Assumptions

FHWA's Traffic Noise Model Version 2.5 (TNM 2.5) was used to calculate future highway traffic-related noise levels for each of the concepts, including the No-Build. TNM 2.5 uses traffic volume data, speeds, vehicle type (automobile, medium-duty truck, heavy-duty truck, bus, and motorcycle), highway geometry, receiver distance from highway (source), ground absorption, and shielding from local terrain and structures to generate noise level predictions in dBA (Leq) at a given distance from the centerline of a highway. TNM 2.5 was used to establish the location of noise contours, or lines of equal noise exposure, that parallel the highway and diminish in intensity with distance.

The Minimum Width template and the Maximum Width template were modeled based upon changes in highway cross-section, traffic volume, and traffic speed. Receiver distance was constant. A level highway geometry and receiver relationship, and a median width of 64 feet (the average median width of I-81 in Virginia) were assumed for the entire I-81 study area for modeling purposes.

The Minimum Width template and the Maximum Width template configurations were modeled in TNM 2.5 using averaged No-Build and "Build" concept traffic volumes. The Minimum Width template with low tolls results in the lowest increase in noise because this concept has the lowest vehicle miles traveled (VMT), the lowest proportions of medium and heavy trucks in the vehicle mix, and the lowest vehicle speeds. The Maximum Width template with exclusive truck lanes to the outside and exclusive car lanes to the inside, no tolls, and with Rail results in the highest increase in noise because this concept has the highest VMT, the highest proportions of medium and heavy trucks in the vehicle mix, the highest vehicle speeds, and an additional rail noise component.

Averaged traffic volumes for the No-Build and the range of "Build" concepts were determined by dividing the entire study area into six highway volume categories (A to F) based on peak traffic volumes and number of lanes. The percentage of medium-duty trucks and heavy-duty trucks was determined from existing classified count information and, for this analysis, was assumed to be the same for the

No-Build and the range of "Build" concepts. Noise levels were calculated for each concept, and the distance from the highway centerline to the 66 dBA contour was determined.

Rail Noise Modeling and Assumptions

Based on FTA procedures, an inventory of sensitive noise receptors in the rail study area was determined by using an unobstructed screening distance of 750 feet on either side of the rail centerline. The unobstructed screening distance provides a more conservative screening distance than that for intervening buildings. Furthermore, an unobstructed distance better characterizes the rural land use typical in the rail study area.

Since Federal Railroad Administration criteria are available for high-speed trains only (*i.e.*, trains faster than 125 miles per hour), FTA criteria were used in this assessment because they are more reflective of train speed typical in the rail study area. The General Noise Assessment method outlined in the Federal Transit Administration Transit Noise and Vibration Impact Assessment Guidance Manual (FTA Manual) was followed to calculate rail traffic noise levels for the rail line sections in the study area. The transit noise sources in the calculations were replaced with freight rail sources for use in this assessment. The freight noise source information was obtained from rail noise measurement data for Norfolk Southern freight trains used by the U.S. Surface Transportation Board in its environmental review of the Conrail Acquisition, as presented in the Final Environmental Impact Statement Proposed Conrail Acquisition (May 1998).

For this analysis, it was assumed that the track alignments would be the same for the No-Build and the range of "Build" concepts, and rail volume and speed would change as a result of the rail improvements in the Maximum Width template. The rail data for traffic volume and speed used in this analysis were provided by Norfolk Southern and are presented in Table 5.11-1.

The analysis was based on the reference Sound Exposure Level (SEL), speed, number of cars, number of locomotives, and train length for No-Build and future ("Build") conditions. A reference SEL of 99 dBA for locomotives and 79 dBA for rail cars, and a day-night traffic split of 50/50 was assumed. The locomotive Ldn and the rail car Ldn were combined to determine the total Ldn at 100 feet from the rail line section. The Ldn at other distances from the railway was determined using the noise attenuation with distance rate of 4.5 dBA for each doubling of distance.

Table 5.11-1 Rail Traffic Data

Rail Line	Termini	Trains	Loco/Train	Cars	Speed (mph)	Length (feet)
No-Build						
Shenandoah	Bristol to Walton	7	3	100	40	5,000
Shenandoah	Walton to Roanoke	13	3	100	40	5,000
Piedmont	Danville to Lynchburg	25-30	3	120	50/60	6,000
Piedmont	Roanoke to Lynchburg	17-22	3	120	60/50	6,000
Piedmont	Lynchburg to Manassas	20-25	3	120	50/60	6,000
Piedmont	Manassas to Riverton	12-15	3	100	30	5,000
Piedmont	Front Royal to Hagerstown	16	3	100	40	5,000
"Build"						
Shenandoah	Bristol to Walton	9	3	150	33	7,500
Shenandoah	Walton to Roanoke	28	3	150	33	7,500
Piedmont	Danville to Lynchburg	33-38	3	150	33	7,500
Piedmont	Roanoke to Lynchburg	21-26	3	150	33	7,500
Piedmont	Lynchburg to Manassas	32-37	3	150	33	7,500
Piedmont	Manassas to Riverton	24-27	3	150	33	7,500
Piedmont	Front Royal to Hagerstown	28	3	150	33	7,500

Source: Norfolk Southern

Table 5.11-2 Detailed Summary of Impacted Noise-Sensitive Receptors by Receptor Type: 66 dBA L_{eq} Noise Contour for I-81

					Build	
FHWA Activity Category	Name	Locality	Location	No-Build	Minimum	Maximum
Residences						
B	Residences	City of Bristol	TN Line to Exit 7	98	84	84
B	Residences	Washington County	Exits 10 to 32	362	648	725
B	Residences	Smyth County	Exits 35 to 54	189	499	499
B	Residences	Wythe County	Exits 60 to 86	345	678	707
B	Residences	Pulaski County	Exits 89 to 101	213	366	490
B	Residences	City of Radford	Exit 105	1	2	2
B	Residences	Montgomery County	Exits 105 to 128	411	921	1038
B	Residences	Roanoke County	Exits 132 to 146	564	1102	1277
B	Residences	City of Salem	Exits 137 to 141	55	130	182
B	Residences	Botetourt County	Exits 150 to 168	195	397	428
B	Residences	Rockbridge County	Exits 175 to 205	124	287	318
B	Residences	Augusta County	Exits 213 to Exit 235	158	335	360
B	Residences	City of Staunton	Exits 222 to 225	0	10	11
B	Residences	Rockingham County	Exits 240 to 257	82	167	183
B	Residences	City of Harrisonburg	Exits 243 to 247	74	321	376
B	Residences	Shenandoah County	Exits 264 to 298	150	474	569
B	Residences	Warren County	Exits 298 to 300	1	2	5
B	Residences	Frederick County	Exits 300 to 323	282	760	963
B	Residences	City of Winchester	Exits 313 to 315	200	329	367
Parks						
B	Mendota Trail (Proposed Park)	City of Bristol/Washington County	Exit 3	1	1	1
B	Suncrest Park	City of Bristol	Exits 5 to 7	1	1	1
B	Virginia Creeper Trail	Washington County	Exits 17 to 19	1	1	1
B	Chilhowie Town Park	Smyth County	Exit 35	1	1	1
B	Appalachian National Scenic Trail	Smyth County	Crosses at Exit 54	1	1	1
B	George Washington and Jefferson National Forest	Smyth County	Exit 54	1	1	1
B	New River Trail State Park	Pulaski County	Exits 94 to 98	1	1	1
B	Pedlar Hills Glade	Montgomery County	Exits 118 to 128	0	1	1
B	Beverly Heights Park	Roanoke County	Exits 132 to 137	1	1	1
B	Hanging Rock Battlefield Trail	City of Salem	Exits 140 to 141	1	1	1
B	Appalachian National Scenic Trail	Botetourt County	Exits 150 to 156	1	1	1
B	Purcell Park	City of Harrisonburg	Exits 243 to 245	1	1	1
B	Ramblewood Fields Softball Park	City of Harrisonburg	Exits 243 to 245	1	1	1
B	New Market Community Park	Shenandoah County	Exits 257 to 264	1	1	1
B	New Market Battlefield Park	Shenandoah County	Exits 264 to 269	1	1	1
B	Mount Jackson Park	Shenandoah County	Exits 269 to 273	1	1	1
B	Fairview Park	Shenandoah County	Exits 283 to 291	1	1	1
B	Jim Barnett Park	City of Winchester	Exits 313 to 315	1	1	1
B	Dry Branch Park	City of Salem	Exits 137 to 140	0	0	1
B	Smithland Road Soccer Fields	City of Harrisonburg	Exit 247	0	1	1

Table 5.11-2 Detailed Summary of Impacted Noise-Sensitive Receptors by Receptor Type: 66 dBA Leq Noise Contour for I-81 (Continued)

Schools/Colleges						
B	Middletown Elementary School	Frederick County	Exits 302 to 307	0	1	1
B	Newbern Elementary School	Pulaski County	Exits 98 to 101	0	1	1
B	Robert E. Aylor Middle School	Frederick County	Exits 307 to 310	0	1	1
B	Shenandoah University	City of Winchester	Exits 313 to 315	1	1	1
B	Dominion Business School	City of Harrisonburg	Exits 245 to 247	1	1	1
B	James Madison University (DHR ID# 115-0103)	City of Harrisonburg	Exits 245 to 247	1	1	1
B	Stonewall Elementary School	Frederick County	Exit 321	0	0	1
B	Pleasant Valley Elementary School	Rockingham County	Exit 243	0	1	1
B	Glenvar Elementary School	Roanoke County	Exit 132 to 137	0	0	1
Historic Properties						
B	Marion Battlefield (DHR ID# none)	Smyth County	Exit 47 to 50	1	1	1
B	McGavock Family Cemetery (DHR ID# 098-0022)	Wythe County	Exit 80	1	1	1
B	Fort Chiswell Site (DHR ID# 098-0026)	Wythe County	Exit 81	1	1	1
B	Buchanan Historic District (DHR ID# 180-0028)	Botetourt County	Exit 162 to 167	1	1	1
B	New Market Historic District (DHR ID# 269-0005)	Shenandoah County	Exit 264	0	1	1
B	Fisher's Hill Battlefield (DHR ID# 085-0001)	Shenandoah County	Exits 291 to 296	1	1	1
B	Fort Bowman (DHR ID# 085-0004)	Shenandoah County	Exits 298	1	1	1
B	New Market Battlefield Park (DHR ID# 085-0027)	Shenandoah County	Exits 264 to 269	1	1	1
B	New Market Battlefield (DHR ID# 269-5001)	Shenandoah, Rockingham Counties	Exit 264 to 269	1	1	1
B	Tom's Brook Battlefield (DHR ID# 085-5045)	Shenandoah County	Exits 291	1	1	1
	Cedar Creek Battlefield (DHR ID# 034-0303/0002)	Frederick, Shenandoah, Warren Counties	Exits 291 to 307	1	1	1
B	Zig-Zag Trenches (DHR ID# 034-0314)	Frederick County	Exits 307 to 310	1	1	1
B	Camp Russell Historic District (DHR ID# 034-5036)	Frederick County	Exit 310	1	1	1
B	Opequon Battlefield (DHR ID# 034-0456)	Frederick County	Exits 310 to 321	1	1	1
	Kernstown 1 Battlefield (DHR ID#034-007)/ Kernstown 2 Battlefied (DHR ID# none)	Frederick County	Exits 310 to 313	1	1	1
B	Winchester 1 Battlefield (DHR ID# 138-5005)	Winchester, Frederick County	Exit 313 to 315	1	1	1
B	Newtown/Stephens City Historic District (DHR ID# 304-0001)	Frederick County	Exit 313 to 315	1	1	1
Total Number of Sensitive Receptors				3,540	7,555	8,630
(Additional Impacts to Receptors Over No-Build)				N/A	4,015	5,090

Rail Noise

Table 5.11-3 provides the determination of noise impacts associated with varying distances from the rail line sections according to FTA's guidance. Noise levels from rail sources were identified as No Impact (N), Impact (I), or Severe Impact (S), depending on the relationship between existing (No Build) noise levels and predicted noise level increases with rail improvements and Land Use Category. The FTA criteria are based on the principle that, as existing noise levels increase, the amount of allowable increase in overall noise levels contributed by potential improvements decrease.

Table 5.11-3 Rail Noise Impacts Based on FTA Criteria

	Distance (Feet)														
Rail Termini	750	700	650	600	550	500	450	400	350	300	250	200	150	100	50
Category 1 or 2 Sites															
Bristol to Walton	I	I	I	I	I	I	I	I	I	I	I	I	I	I	S
Walton to Roanoke	I	I	I	I	I	I	I	I	I	I	I	I	I	S	S
Danville to Lynchburg	I	I	I	I	I	I	I	I	I	I	I	I	I	I	S
Roanoke to Lynchburg	I	I	I	I	I	I	I	I	I	I	I	I	I	I	S
Lynchburg to Manassas	I	I	I	I	I	I	I	I	I	I	I	I	I	I	S
Manassas to Riverton	I	I	I	I	I	I	I	I	I	S	S	S	S	S	S
Front Royal to Hagerstown	I	I	I	I	I	I	I	I	I	I	I	S	S	S	S
Category 3 Sites															
Bristol to Walton	N	N	N	N	N	N	N	N	N	N	N	N	N	I	I
Walton to Roanoke	N	N	N	N	N	N	N	N	N	N	N	I	I	I	I
Danville to Lynchburg	N	N	N	N	N	N	N	N	N	N	N	N	I	I	I
Roanoke to Lynchburg	N	N	N	N	N	N	N	N	N	N	N	N	I	I	I
Lynchburg to Manassas	N	N	N	N	N	N	N	N	N	N	N	N	I	I	I
Manassas to Riverton	N	N	N	N	N	N	N	I	I	I	I	I	I	I	I
Front Royal to Hagerstown	N	N	N	N	N	N	N	N	I	I	I	I	I	I	I

Modeled rail noise levels for No-Build and future "Build" conditions for the Maximum Width template are presented in Table 5.11-4. As indicated in the table, in most instances, the decibel level for the Maximum Width Concept decreases or maintains the same decibel level as No Build conditions along much of the rail alignment. The predicted decrease is attributed to the forecast reduction in train speed. However, model results indicate an increase of one to three dBA L_{dn} along the Manassas to Riverton and Front Royal to Hagerstown rail sections.

Table 5.11-4 Additional Impacted Noise-Sensitive Receptors – "Build" Over No-Build

	Distance (Feet)														
Rail Termini	750	700	650	600	550	500	450	400	350	300	250	200	150	100	50
No-Build Noise Levels (L_{dn})															
Bristol to Walton	54	54	55	55	56	57	57	58	59	60	61	63	65	67	72
Walton to Roanoke	57	57	58	58	59	59	60	61	62	63	64	65	67	70	74
Danville to Lynchburg	63	64	64	65	65	66	67	67	68	69	70	72	74	76	81
Roanoke to Lynchburg	62	62	63	63	64	64	65	66	67	68	69	70	72	75	80
Lynchburg to Manassas	62	63	63	64	64	65	66	66	67	68	70	71	73	76	80
Manassas to Riverton	56	56	57	57	58	59	59	60	61	62	63	64	66	69	74
Front Royal to Hagerstown	57	58	58	59	59	60	61	61	62	63	65	66	68	70	75
"Build" Noise Levels (L_{dn})															
Bristol to Walton	54	54	55	55	56	57	57	58	59	60	61	63	64	67	72
Walton to Roanoke	57	57	57	58	59	59	60	61	61	62	64	65	67	70	74
Danville to Lynchburg	60	61	61	62	62	63	64	64	65	66	67	69	71	73	78
Roanoke to Lynchburg	59	59	60	60	61	61	62	63	64	65	66	67	69	72	76
Lynchburg to Manassas	60	61	61	62	62	63	63	64	65	66	67	69	71	73	78
Manassas to Riverton	59	59	60	60	61	61	62	63	64	65	66	67	69	72	76
Front Royal to Hagerstown	59	59	60	60	61	62	62	63	64	65	66	68	69	72	77

Table 5.11-5 Detailed Summary of Impacted Noise-Sensitive Receptors by Receptor Type: 65 dBA Ldn Contour for Rail

FTA Land Use Category	Name	Locality	Rail Line	Noise Receptors in 65 dBA Contour for No- Build	Noise Receptors in 65 dBA Contour for Maximum Width Concept	Additional Number of Receptors Impacted by Noise as Result of the Maximum Width Concept
1	Appalachian National Scenic Trail	Smyth and Fauquier counties	Shenandoah	1	1	1
1	Blue Ridge Parkway	Botetourt County	Shenandoah	1	1	1
1	Jefferson National Forest	Smyth, Wythe, and Pulaski counties	Shenandoah	1	1	1
1	SP Comfort Stations & New River Trail SP Acq	Pulaski County	Shenandoah	1	1	1
1	Gatewood Reservoir Campground	Pulaski County	Shenandoah	1	1	1
1	Blue Ridge Park	Botetourt County	Shenandoah	1	1	1
1	Bisset Park	City of Radford/	Shenandoah	1	1	1

FTA Land Use Category	Name	Locality	Rail Line	Noise Receptors in 65 dBA Contour for No- Build	Noise Receptors in 65 dBA Contour for Maximum Width Concept	Additional Number of Receptors Impacted by Noise as Result of the Maximum Width Concept
		Pulaski County				
1	Radford Park Improvements	City of Radford/Pulaski County	Shenandoah	1	1	1
1	Roanoke Sports Complex Phase II	City of Roanoke	Shenandoah	1	1	1
1	Blackwater Creek	City of Lynchburg	Piedmont	1	1	1
1	Riverside Park	Amherst County/City of Lynchburg	Piedmont	1	1	1
1	Municipal Park Swimming Pool	Warren County/Town of Front Royal	Piedmont	1	1	1
1	Hanging Rock Battlefield Trail	City of Salem	Shenandoah	1	1	0
1	419 Property	City of Salem	Shenandoah	1	1	0
1	James I Moyer Park and Skate Park	City of Salem	Shenandoah	1	1	0
1	Riverside Park	City of Salem	Shenandoah	1	1	0
1	Golf Course	Prince William County	Piedmont	1	0	0
1	Golf Course	Wythe County	Shenandoah	1	0	0
1	Golf Course	Smyth County	Shenandoah	1	1	0
1	Golf Course	Warren County	Piedmont	1	1	0
1	Golf Course	Albemarle County	Piedmont	1	1	0
1	Golf Course	City of Danville	Piedmont	1	1	0
1	Park	City of Charlottesville	Piedmont	1	1	0
1	Tennis Courts	Campbell County	Piedmont	1	1	0
1	Tennis Courts	Campbell County	Piedmont	1	0	0
1	Ballfield	City of Danville	Piedmont	1	1	0
1	Tennis Courts	City of Danville	Piedmont	1	0	0
1	Tennis Courts	City of Danville	Piedmont	1	0	0
1	Ballfield	City of Lynchburg	Piedmont	1	0	0
1	Tennis Courts	City of Lynchburg	Piedmont	1	1	0
1	Tennis Courts	City of Lynchburg	Piedmont	1	1	0
1	Tennis Courts	City of Lynchburg	Piedmont	1	0	0
1	Tennis Courts	City of Roanoke	Shenandoah	1	1	0
1	Ballfield	City of Salem	Shenandoah	1	1	0
1	Ballfield	City of Salem	Shenandoah	1	1	0
1	Front Royal Battlefield	Warren County	Piedmont	1	1	0
1	Hanging Rock Battlefield	Roanoke County	Shenandoah	1	1	0
1	Fairfield	Clarke County	Piedmont	1	1	0
1	Berryville Historic District	Clarke County	Piedmont	1	1	0
1	Annefield	Clarke County	Piedmont	1	1	0
1	Meadow, The (Huntingdon)	Clarke County	Piedmont	1	1	0
1	Old Chapel	Clarke County		1	1	0
1	Saratoga National Historic Landmark	Clarke County	Piedmont	1	1	0
1	Tuleyries, The	Clarke County	Piedmont	1	1	0
2	Residences	City of Bristol	Shenandoah	34	34	0
2	Residences	Washington County	Shenandoah	171	171	0
2	Residences	Smyth County	Shenandoah	182	182	0

FTA Land Use Category	Name	Locality	Rail Line	Noise Receptors in 65 dBA Contour for No- Build	Noise Receptors in 65 dBA Contour for Maximum Width Concept	Additional Number of Receptors Impacted by Noise as Result of the Maximum Width Concept
2	Residences	Wythe County	Shenandoah	56	57	1
2	Residences	Pulaski County	Shenandoah	43	43	0
2	Residences	City of Radford	Shenandoah	30	30	0
2	Residences	Montgomery County	Shenandoah	97	97	0
2	Residences	Roanoke County	Shenandoah	118	93	0
2	Residences	City of Salem	Shenandoah	79	79	0
2	Residences	City of Roanoke	Shenandoah	263	158	0
2	Residences	Botetourt County	Shenandoah	61	37	0
2	Residences	Bedford County	Shenandoah	296	181	0
2	Residences	City of Bedford	Shenandoah	56	33	0
2	Residences	City of Lynchburg	Shenandoah	328	198	0
2	Residences	City of Lynchburg	Piedmont	23	11	0
2	Residences	City of Lynchburg	Piedmont	268	122	0
2	Residences	City of Danville	Piedmont	951	455	0
2	Residences	Pittsylvania County	Piedmont	499	259	0
2	Residences	Campbell County	Piedmont	378	181	0
2	Residences	Amherst County	Piedmont	123	55	0
2	Residences	Nelson County	Piedmont	102	63	0
2	Residences	Albemarle County	Piedmont	216	122	0
2	Residences	City of Charlottesville	Piedmont	576	333	0
2	Residences	Orange County	Piedmont	286	180	0
2	Residences	Culpeper County	Piedmont	283	195	0
2	Residences	Fauquier County	Piedmont	182	130	0
2	Residences	Prince William County	Piedmont	139	198	59
2	Residences	City of Manassas	Piedmont	7	7	0
2	Residences	Warren County	Piedmont	122	179	57
2	Residences	Clarke County	Piedmont	79	99	20
3	Central Virginia Community College	City of Lynchburg	Piedmont	1	1	0
3	Virginia Highlands Community College	Washington County	Shenandoah	1	1	0
3	Schoolfield Elementary School	City of Danville	Piedmont	1	1	0
3	Chilhowie Elementary School	Smyth County	Shenandoah	1	1	0
3	Chilhowie High School	Smyth County	Shenandoah	1	1	0
3	Blue Ridge Technical Academy	City of Roanoke	Shenandoah	1	1	0
3	Gretna Middle School	Pittsylvania County	Piedmont	1	0	0
3	Cemetery	Culpeper County	Piedmont	1	1	0
3	Staunton River Memorial Branch Library	Campbell County	Piedmont	1	1	0
3	Washington Library (Glade Spring)	Washington County	Shenandoah	1	1	0
Total Number of Sensitive Receptors				6102	4028	137 (residences)

Combined Highway and Rail Noise Analysis

Areas where combined noise effects would occur include:

- City of Bristol, between Exits 5 and 7;
- Smyth County, beween Exits 35 and 54;
- Wythe County, between Exits 72 and 77;
- Montgomery County, between Exits 118 and 128; and
- Roanoke County, between Exits 140 and 141