NOISE IMPACT ANALYSIS
TECHNICAL REPORT

ROUTE 27 / ROUTE 244
INTERCHANGE IMPROVEMENTS

ARLINGTON, VIRGINIA

Project: 0027-000-V01, C-501
UPC: 13528
From: 0.03 mi N of I-395
To: 0.29 mi N of Route 244

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I. Summary

Potential traffic noise impacts associated with the proposed Route 27/Route 244 interchange modifications in the County of Arlington, Virginia, were assessed in accordance with the procedures and criteria approved by the Federal Highway Administration (FHWA) and the Virginia Department of Transportation (VDOT). The proposed project replaces the existing Route 27 bridge over Route 244, adds an auxiliary lane in the northbound direction, eliminates one interchange loop, and modifies two interchange ramps and local access roads. The study corridor for this project is from 0.03 miles north of the interchange with I-395, to 0.29 miles north of Route 244. A project location map is shown in Figure 1.

Noise impacts were identified along the project study corridor under the design year (2031) build condition. Noise sensitive sites studied include residential properties and commercial sites. Ninety six (96) sites were studied in five Noise Sensitive Areas (NSAs). A total of sixty four (64) sites are predicted to be impacted under design year (2031) build conditions. Noise impact will be due to approaching or exceeding the Noise Abatement Criteria for all impacted sites. Fifty six (56) sites experience noise impact under the existing case, and seventy one (71) sites are predicted to experience noise impact in the no-build case. For all sites studied, the existing year noise levels range from 62 to 72 dBA, and the design year (2031) no-build levels range from 63 to 75 dBA. The design year (2031) build levels also range from 63 to 75 dBA.

Noise abatement measures were investigated and noise barriers appear to be feasible. One of the three barriers is considered reasonable, as the others exceed the cost effectiveness criteria. The three proposed noise barriers are discussed in detail in this report. However, no final decisions will be made regarding construction of the barriers until after the public hearing, when a detailed feasible and reasonable determination can be made.

Construction activity may cause intermittent fluctuations in noise levels. During the construction phase of the project, all reasonable measures will be taken to minimize noise impact from these activities.

II. Introduction

The objective of this analysis is to assess the potential traffic noise impact associated with the proposed Route 27 and Route 244 interchange modification project in Arlington, and to evaluate potential noise abatement measures wherever impact is expected to occur.

Noise impact assessment has been performed for all noise sensitive properties within the project corridor, including residential properties in five Noise Sensitive Areas. Noise impacts are predicted to occur at 64 study sites, representing 62 residential properties and two recreational sites, under the design year (2031) condition. Noise impact is a result of approaching or exceeding the Noise Abatement Criteria. Existing noise levels at the noise sensitive properties in the study corridor range from 62 to 72 dBA. For the no-build (2031) condition, noise levels range from 63 to 75 dBA, and for the build (2031) condition, noise levels also range from 63 to 75 dBA.

This report presents a description of noise terminology, the applicable standards and criteria, a description of the computations of existing and future noise levels, a projection of future noise levels, and a discussion of construction noise.

III. Guidelines and Criteria

The potential noise impact of the proposed Route 27 interchange modification project has been assessed in accordance with Federal Highway Administration (FHWA) guidelines published in Volume 7, Chapter 7, Section 2 of the Federal Aid Policy Guide (FAPG 7-7-2) and with the State Noise Abatement Policy. In order to determine the degree of impact of highway traffic noise on human activity, the Noise Abatement Criteria (NAC), Table 1, established by FAPG 7-7-2 is used. The NAC, listed in Table 1 for various activities, represent the upper limit of acceptable traffic noise conditions and also a balancing of that which may be desirable with that which may be achievable. The NAC applies to areas having regular human use and where lowered noise levels are desired. They do not apply to the entire tract of land on which the activity is based, but

only to that portion where the activity takes place.

The NAC is given in terms of the hourly, A-weighted, equivalent sound level in decibels (dBA). The A-weighted sound level is a single number measure of sound intensity with weighted frequency characteristics that correspond to human subjective response to noise. However, since most environmental noise fluctuates from moment to moment, it is common practice to condense all of this information into a single number called the equivalent sound level (Leq). The Leq is the value of a steady sound level that would represent the same sound energy as the actual time-varying sound evaluated over the same time period. For highway traffic noise assessment, Leq is typically evaluated over a one-hour time period, and is denoted as Leq(h).

The noise impact assessment is made using the guidelines listed in Table 1. The noise sensitive residential properties and recreational sites potentially affected by this project are in Category B. If, for a given activity, the design year noise levels "approach or exceed" the NAC, then the activity is impacted and a series of abatement measures must be considered. The VDOT State Noise Abatement Policy defines "approach" as 1 dBA less than the NAC.

There is another criterion for assessing noise impact provided in the Federal guidelines. A receiver can be noise impacted if the design year build noise levels are substantially higher than existing levels. The VDOT State Noise Abatement Policy defines a substantial increase as 10 decibels or more, even though the levels may not reach the NAC.

The final decision on whether or not to provide noise abatement along a project corridor will take into account the feasibility of the design and overall cost weighted against the environmental benefit.

Table 1: FHWA Noise Abatement Criteria

Activity Category	Leq(h)	Description Of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed land, properties or activities not included in Categories A or B above.
D	---	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

IV. Methods

Noise impact assessment has been performed for all noise sensitive properties within the project corridor. Noise levels in the study area have been determined for the existing condition, the no-build condition, and the design year (2031) build condition. Noise levels have been predicted for that hour of the day when the vehicle volume, operating speed, and number of trucks (vehicles with 3 or more axles) combine to produce the worst noise conditions. The worst noise hour used in this study was 8 to 9 AM.

A review of the project corridor has established highway traffic as the dominant source of noise for the build alternative. Since highway noise can be determined accurately through computer modeling techniques for areas that are dominated by road traffic, both existing and design year traffic noise calculations have been performed using the Federal Highway Administration's Traffic Noise Model (FHWA TNM®) Version 2.5. FHWA TNM ® was developed and

sponsored by the U. S. Department of Transportation and John A. Volpe National Transportation Systems Center, Acoustics facility. The TNM computer model accounts for such factors as ground absorption, roadway geometry, receiver distance, shielding from local terrain and structures, vehicle volume, operating speed, and volumes of medium trucks (vehicles with 2 axles and 6 tires) and heavy trucks.

Assessment of traffic noise impact requires three comparisons:

(1) The noise levels under existing conditions must be compared to those under design year build conditions. This comparison shows the change in noise levels that will occur between the existing year and the design year if the project is constructed, to determine if the substantial increase impact criteria has been met.

(2) The noise levels under design year no-build conditions must be compared to those under design year build conditions. This comparison shows how much of the change in noise levels can actually be attributed to the proposed project.

(3) The noise levels under design year build conditions must be compared to the applicable NAC. This comparison determines if the impact criteria has been met under future build conditions and can be used to assist in noise compatible land use planning.

The noise prediction results are summarized in Table 2. Included for each study point are the highest hourly equivalent sound levels for the existing, no-build, and build conditions.

V. Impact Assessment

The results of the impact assessment indicate that the project will increase noise levels slightly at noise sensitive properties within the project corridor. Of the 96 sites studied, there are predicted to be 64 noise impacted sites under the build condition. The studied sites currently experience an existing noise level ranging from 62 to 72 dBA. The studied sites are predicted to experience design year no-build and build noise levels ranging from 63 to 75 dBA.

See Table 2 for a complete listing of existing, no-build and build noise levels for all study sites.

A. Residential Impacts

The study area includes single family and townhouse style dwellings in communities along the project study area. Sites were selected at ground story outdoor activities. Where residential developments, neighborhoods, or groupings of noise-sensitive land uses exist, noise modeling sites are grouped into Noise Sensitive Areas (NSAs). NSAs are groupings of receptor sites that, by location, form distinct communities within the project area. These areas are used to evaluate potential noise impacts to noise sensitive receptors as a whole, as well as considered the feasibility and reasonableness of noise abatement measures for specific areas. Each of these NSAs is discussed below.

NSA 1, Westhampton Mews Condominiums, Sites 1-3 through 1-36

The Westhampton Mews Condominium Complex consists of townhouse style residential properties backing up to Ramp G, the ramp from Southbound Route 27 to Route 244. This area is represented by Sites 1-3 through 1-36. Sites 1-29 through 1-36 are protected by an 8 foot brick privacy wall, which will remain in the build case. The existing noise level for this area ranges from 63 to 72 dBA. The no-build (2031) noise levels are predicted to range from 64 to 73 dBA. The build (2031) noise levels are predicted to range from 65 to 73 dBA. Thirty two sites, 1-3 through 1-34, are predicted to be noise impacted as a result of approaching or exceeding the NAC under the build condition. Twenty nine sites are predicted to be impacted under the no build condition, and twenty four sites are predicted to be impacted under the existing condition.

NSA 2, Columbia Square Condominiums, Sites 2-1 through 2-8

The Columbia Square Condominium complex consists of townhouse style residential properties along the westbound lanes of Route 244. NSA 2 represents sites in Columbia Square, west of Rolfe Street. This area is represented by Sites 2-1 through 2-8. The existing noise level for this area is predicted to be 67 dBA. The no-build (2031) noise levels are predicted to be 68 dBA. The build (2031) noise levels are also predicted to be 68 dBA. All eight sites, 2-1 through 2-8,

are predicted to be noise impacted as a result of approaching or exceeding the NAC under the build, no-build, and existing conditions.

NSA 3, Arlington View Subdivision, Sites 3-1 through 3-11

NSA 3 represents single family residential properties in Arlington View, along Route 244 Eastbound, on Rolfe, Quinn, and Queen Streets. This area is represented by Sites 3-1 through 3-11. The existing noise level for this area ranges from 64 to 69 dBA. The no-build (2031) noise levels are predicted to range from 65 to 71 dBA. The build (2031) noise levels are also predicted to range from 65 to 71 dBA. Ten sites, 3-1 through 3-7 and 3-9 through 3-11, are predicted to be noise impacted as a result of approaching or exceeding the NAC under the build condition. These 10 sites are also predicted to be noise impacted under the no-build condition, and eight of these sites are also predicted to be noise impacted under the existing condition.

NSA 4, Carrington Village, Sites 4-1 through 4-31

NSA 4 represents townhouse style residential properties in Carrington Village, along 10th Street, backing up to Ramp E, from Route 244 Eastbound to Route 27 Southbound. This area is represented by Sites 4-1 through 4-31. The existing noise level for this area ranges from 62 to 65 dBA. The no-build (2031) noise levels are predicted to range from 63 to 66 dBA. The build (2031) noise levels are predicted to range from 63 to 65 dBA. No sites are predicted to be noise impacted as a result of approaching or exceeding the NAC under the build condition. Seven sites, 4-9, 4-10 and 4-20 through 4-24, are predicted to be noise impacted under the no-build condition. The difference can be attributed to the elevation change in the design condition.

NSA 5, Arlington View Subdivision, Sites 5-1 through 5-10

NSA 5 represents single family residential properties in Arlington View, along 11th Street, backing up to the ramp from Route 27 Southbound to I-395. This area is represented by Sites 5-1 through 5-10. The existing noise level for this area ranges from 65 to 72 dBA. The no-build (2031) noise levels are predicted to range from 67 to 75 dBA. The build (2031) noise levels are also predicted to range from 67 to 75 dBA. All ten sites, 5-1 through 5-10, are predicted to be noise impacted as a result of approaching or exceeding the NAC under the build, and no build

conditions, and nine of the sites are predicted to be noise impacted under the existing condition. Noise impact is due primarily to the proximity to I-395, rather than the project roadways.

B. Schools, Churches, Recreational Facilities

There are no schools or churches within the project corridor. There is a recreational facility in the project corridor, the Towers Park with tennis courts, north of the Westhampton Mews community. The facility is represented by sites 1-1 and 1-2. The existing noise level is predicted to range from 66 to 69 dBA. The no-build (2031) noise is predicted to range from 67 to 70 dBA. The build (2031) noise level is predicted to range from 68 to 70 dBA. Noise impact is predicted to occur at this recreational facility under design year (2031) build conditions, as well as under no build and existing conditions.

C. Commercial Facilities

Commercial development in the area is on the east side of the interchange, which will not be affected by the roadway project.

VI. Noise Abatement

Design year noise levels have been predicted to approach or exceed the VDOT NAC in a number of areas throughout the project corridor. Therefore, per VDOT's State Noise Abatement Policy, noise abatement considerations are warranted for these areas. Noise abatement alternatives were considered to reduce noise levels in the areas identified with design year noise impacts, and potential mitigation measures were evaluated for feasibility and reasonableness.

VDOT guidelines recommend a variety of mitigation measures that should be considered in response to transportation-related noise impacts. While noise barriers and/or earth berms are generally the most effective form of noise mitigation, additional mitigation measures exist which have the potential to provide considerable noise reductions, under certain circumstances. Mitigation measures considered for this project include:

- Construction of noise barriers;
- Construction of earth berms;
- Acoustical insulation of public use and non-profit facilities;
- Alignment modifications; and
- Traffic Management

A. Alignment Modification and Traffic Management

The alteration of the horizontal and vertical alignment has been considered to reduce or eliminate the impacts created by the proposed project. The Route 27 vertical elevation will be raised with the project. Shifting the horizontal alignment away from impacts is not feasible because the proposed roadway widening occurs within the existing configuration.

Traffic management measures that have been considered in conjunction with this project include reduced speeds and truck restrictions. Truck restrictions to the project roadways would not be practical as the truck traffic is considered local traffic.

Reducing speeds will not be an effective noise mitigation measure since a substantial decrease in speed is necessary to provide adequate noise reduction. Typically, a 10 mph reduction in speed will result in only a 2 dBA decrease in noise level, which would not eliminate all impacts.

B. Sound Barriers

Noise walls and earth berms are often implemented into the highway design in response to the identified noise impacts. The effectiveness of a freestanding (post and panel) noise barrier and an earth berm of equivalent height are relatively consistent; however an earth berm is perceived as a more aesthetically pleasing option. The use of earth berms is not always an option due to the excessive space they require adjacent to the roadway corridor. At a standard slope of 2:1, every one-foot in height would require four feet of horizontal width. This requirement becomes more complex in urban settings where residential properties often abut the proposed roadway corridor. In these situations, implementation of earth berms can require significant property acquisitions to accommodate noise mitigation. The cost associated with the acquisition of property to construct

a berm can significantly increase the total costs to implement this form of noise mitigation.

Availability of fill material to construct the berm also needs to be considered. On proposed projects where proposed grading yields excess waste material, earth berms are often cost effective mitigation options. On balance or borrow projects the implementation of earth berms is often an expensive solution due to the need to identify, acquire, and transport the material to the project site.

Due to the limited space between the roadway and the impacted properties, earth berms were not considered a viable mitigation option throughout the project area.

As a general practice, noise barriers are most effective when placed at a relatively high point between the roadway and the impacted noise sensitive land use. To achieve the greatest benefit from a potential noise barrier, the goal of the barrier should focus on breaking the line-of-sight (to the greatest degree possible) from the roadway to the receiver. In roadway fill conditions, where the highway is above the natural grade, noise barriers are typically most effective when placed on the edge of the roadway shoulder or on top of the fill slope. In roadway cut conditions, where the roadway is located below the natural grade, barriers are typically most effective when placed at the top of the cut slope. Engineering and safety issues have the potential to alter these typical barrier locations.

The effectiveness of a noise barrier is measured by examining the barrier's capability to reduce future noise levels. Noise reduction is measured by comparing design year pre- and post-barrier noise levels. This difference between unabated and abated noise levels is known as insertion loss (IL). The following discussion presents potential mitigation measures for each of the impacted noise sensitive land uses.

According to VDOT guidelines, potential mitigation measures must also be assessed for feasibility and reasonableness. Noise barrier feasibility deals specifically with acoustical and engineering considerations such as:

- Noise barriers must reduce design year noise levels by 5 dBA for impacted sites;
- The barrier cannot deny access to local vehicular and/or pedestrian travel; and
- There cannot be significant engineering and/or safety problems associated with the barrier which preclude construction of the barrier (engineering, safety, and utility conflicts)

Noise barrier reasonableness is determined by assessing multiple issues including:

- The number of units protected;
- The desires of those citizens affected by the barrier;
- A comparison of existing and future noise levels;
- Total barrier cost and cost per protected and benefited property;
- Barrier constructability and maintainability; and
- Barrier impacts to utilities and drainage

Typically, the limiting factor related to barrier reasonableness is cost per protected dwelling unit, where a protected and/or benefited receptor receives at least a 5 dBA reduction in noise level. VDOT's current approved cost is $30,000 per protected and/or benefited residence.

When a barrier exceeds the State Noise Abatement Policy's cost-effectiveness criteria, third party funding is required for the barrier to continue towards construction. FHWA and VDOT contribute the first $30,000 for each protected or benefited property. The remainder must come from any source other than FHWA or VDOT. Final approval of all barriers will take into account the views of the impacted property owners. The final determination of a barrier's cost effectiveness will be based on the following:

- For residential properties, a barrier is cost effective when the cost does not exceed $30,000 per protected or benefited residential unit.
- An impacted property is considered protected when it receives a noise reduction of at least 5 decibels.
- Should a non-impacted property receive 5 dBA or more of noise reduction then the property will be considered benefited and included in the cost per protected site equation.

For non-residential properties such as parks, schools, and churches, the $30,000 cost criterion does not apply. The determination is based on cost, severity of impact (both in terms of noise levels and the size of the impacted area and the activity it contains), and amount of noise reduction.

Any sound walls identified in this document must satisfy final feasibility and cost-effectiveness criteria to be constructed. Therefore, the sound wall design parameters and cost identified in this document are preliminary and should not be considered final. Final design parameters, feasibility, and cost-effectiveness cannot be determined as the sound wall cost estimate must be based upon an approved road design alignment and include all required materials & installation costs. If the sound walls are determined to be feasible, the affected public will be given an opportunity to decide whether they are in favor of construction of the sound barrier.

Three sound barriers were considered on this project and found to be feasible. All barriers were designed using the Federal Highway Administration's Traffic Noise Model (FHWA TNM®) Version 2.5. Figures 2 through 4 show the location of the study sites and feasible barriers in relation to the project roadway. Table 4 is a summary of the sound barriers designed for this project. Each barrier is described in detail below. The preliminary cost estimate for barrier materials and installation is $45 per square foot.

A final determination as to the construction of the barriers will be made after the public hearing process. Before final decisions and approvals can be made to construct a sound barrier, a detailed evaluation will be performed, and input from the impacted property owners must be obtained. All feasible sound barriers will be reviewed by the Joint VDOT/FHWA Noise Abatement Committee, which will make recommendations to the Chief Engineer for approval. Approved barriers will be incorporated into the road project plans.

Barrier 1 – Westhampton Mews, NSA 1

Barrier 1 is designed to protect noise-impacted residential properties in the Westhampton Mews Subdivision. The barrier would protect 22 of the impacted residential sites. Barrier 1 would be located along the relocated Ramp G, and around to meet the existing brick wall along Route 244 Westbound. It would extend from Ramp G station 1200+00 to Route 244 station 1349+00. Barrier 1 would be 804 feet in length with a height ranging from 12 to 20 feet. Barrier 1 would reduce the noise level by 5 to 13 dBA. Impacted sites 1-3 through 1-22, 1-29 and 1-30 would be protected. Based on preliminary road design plans and sound wall materials & installation costs

for Barrier 1, the estimated total cost is currently $641,970 or $29,180 per protected property.

Barrier System 2/3- Arlington View, NSA 3

Barriers 2 and 3 are designed to protect noise-impacted single family residential properties in the Arlington View subdivision. The barrier system would protect three of the impacted sites and benefit one additional site. Barrier 2 would be located along the eastbound lanes of the Route 244, between Quinn Street and Queen Street. Barrier 2 would extend from Ramp E station 1001+75 to station 1003+75, a total of 203 feet in length. Barrier 2 would range in height from 12 to 15 feet. Barrier 3 would be located along Ramp E, south of Queen Street, from station 1004+15 to station 1007+00. Barrier 3 would be 346 feet in length with a height range of 14 to 18 feet. The barrier system would reduce the noise level by 5 to 7 dBA. Impacted sites 3-5 through 3-7 would be protected, and site 3-8 would be benefited. Based on preliminary road design plans and sound wall materials & installation costs for Barriers 2 and 3, the estimated total cost is currently $348,480 or $87,120 per protected property. This barrier system would require third party funding.

A sound barrier is not feasible to protect impacted sites in NSA 3 along Columbia Pike due to the access required for these properties.

A sound barrier is not feasible to protect impacted sites in NSA 2. Due to limited Right of Way, utility conflicts, and a sight distance conflict at S Rolfe Street, it is not feasible to construct a noise barrier to protect these properties.

A sound barrier was not investigated to protect impacted sites in NSA 5. The impact is due to I-395, and not the project roadway. It is beyond the scope of this project to design a barrier for this area.

VII. Noise Contours

Noise contours are lines of equal noise exposure that parallel the roadway noise source, and diminish in intensity with distance. For the design year (2031) build case, the location of the 66

dBA noise contour line was determined for areas along the project corridor for the purpose of characterizing the noise environment in the study area. The approximate distance between the roadway centerline and the 66 dBA noise contour is 150 feet from Route 27, and 60 feet from Route 244, as shown on Figures 2 through 4. Any noise sensitive properties within the 66 dBA contour should be considered noise impacted if no sound barrier is present to reduce noise levels.

VIII. Noise Sensitivity Analysis

To ensure the noise analysis remains current for the life of the project, noise levels have been predicted beyond the design year. Assessments have been made for 1, 5, and 10 years of traffic growth. Assuming a 2% increase in traffic volumes each year, these cases would represent design years 2032, 2036, and 2041. Noise levels are anticipated to change up to 1 dBA over 10 years. Under the design year 2032 scenario, one new impact is anticipated in NSA 1. Under the design year 2036 scenario, two new impacts are anticipated in NSA 1 and 4. Under the design year 2041 scenario, 4 additional impacts are anticipated, in NSAs 1 and 4. The proposed barrier designs remain effective for all cases. See Table 3 for a listing of the noise levels for each receptor under these cases.

IX. Construction Noise

Land uses that will be sensitive to traffic noise will also be sensitive to construction noise. A method of controlling construction noise is to establish the maximum level of noise that construction operations can generate. In view of this, VDOT has developed and FHWA has approved a specification that establishes construction noise limits. This specification can be found in VDOT's January 2002 *Road and Bridge Specifications,* Section 107.14(b.3), ″Noise″. The contractor will be required to conform to this specification to reduce the impact of construction noise on the surrounding community.

Table 2: Computed Existing and Future Noise Levels

Site	Location	Dwelling Units	Existing Leq (dBA)	2031 No- Build Leq (dBA)	2031 No Barrier Leq (dBA)	2031 With Barrier Leq (dBA)	Insertion Loss (dBA)	NAC Impact	Sub. Inc. Impact
NSA 1, Westhampton Mews									
1-1	Towers Park	Rec	66	67	68	67	1	**Yes**	No
1-2	Towers Park	Rec	69	70	70	69	1	**Yes**	No
1-3	Rolfe St	1	67	68	69	63	**6**	**Yes**	No
1-4	Rolfe St	1	68	69	70	63	**7**	**Yes**	No
1-5	Rolfe St	1	70	71	71	63	**8**	**Yes**	No
1-6	Rolfe St	1	71	72	72	62	**10**	**Yes**	No
1-7	Rolfe St	1	72	73	73	63	**10**	**Yes**	No
1-8	Rolfe St	1	71	72	72	62	**10**	**Yes**	No
1-9	Rolfe St	1	69	70	71	63	**8**	**Yes**	No
1-10	Rolfe St	1	68	69	70	62	**8**	**Yes**	No
1-11	Rolfe St	1	67	68	69	62	**7**	**Yes**	No
1-12	Rolfe St	1	71	72	73	60	**13**	**Yes**	No
1-13	Rolfe St	1	70	71	72	59	**13**	**Yes**	No
1-14	Rolfe St	1	70	71	71	59	**12**	**Yes**	No
1-15	Rolfe St	1	69	70	71	60	**11**	**Yes**	No
1-16	Rolfe St	1	68	69	70	60	**10**	**Yes**	No
1-17	Rolfe St	1	68	69	70	61	**9**	**Yes**	No
1-18	Rolfe St	1	67	69	69	61	**8**	**Yes**	No
1-19	Rolfe St	1	67	68	69	62	**7**	**Yes**	No
1-20	Rolfe St	1	67	68	69	62	**7**	**Yes**	No
1-21	Rolfe St	1	66	67	67	62	**5**	**Yes**	No
1-22	Rolfe St	1	66	67	67	62	**5**	**Yes**	No
1-23	Rolfe St	1	65	66	66	62	4	**Yes**	No
1-24	Rolfe St	1	64	66	66	62	3	**Yes**	No
1-25	Rolfe St	1	64	65	66	64	2	**Yes**	No
1-26	Rolfe St	1	65	66	66	64	2	**Yes**	No
1-27	Rolfe St	1	65	66	67	64	2	**Yes**	No
1-28	Rolfe St	1	66	67	67	64	3	**Yes**	No
1-29	Rolfe St	1	68	69	69	64	**5**	**Yes**	No
1-30	Rolfe St	1	67	68	69	64	**5**	**Yes**	No
1-31	Rolfe St	1	66	67	68	64	4	**Yes**	No
1-32	Rolfe St	1	65	66	67	64	3	**Yes**	No
1-33	Rolfe St	1	64	65	66	64	3	**Yes**	No
1-34	Rolfe St	1	63	65	66	63	2	**Yes**	No
1-35	Rolfe St	1	63	64	65	63	2	No	No
1-36	Rolfe St	1	63	64	65	64	2	No	No
NSA 2, Columbia Square									
2-1	Columbia Pike	1	67	68	68	N/A	N/A	**Yes**	No
2-2	Columbia Pike	1	67	68	68	N/A	N/A	**Yes**	No
2-3	Columbia Pike	1	67	68	68	N/A	N/A	**Yes**	No
2-4	Columbia Pike	1	67	68	68	N/A	N/A	**Yes**	No
2-5	Columbia Pike	1	67	68	68	N/A	N/A	**Yes**	No

Site	Location	Dwelling Units	Existing Leq (dBA)	2031 No- Build Leq (dBA)	2031 No Barrier Leq (dBA)	2031 With Barrier Leq (dBA)	Insertion Loss (dBA)	NAC Impact	Sub. Inc. Impact
2-6	Columbia Pike	1	67	68	68	N/A	N/A	**Yes**	No
2-7	Columbia Pike	1	67	68	68	N/A	N/A	**Yes**	No
2-8	Columbia Pike	1	67	68	68	N/A	N/A	**Yes**	No
NSA 3, Arlington View									
3-1	Columbia Pike	1	69	70	70	N/A	N/A	**Yes**	No
3-2	Columbia Pike	1	68	69	70	N/A	N/A	**Yes**	No
3-3	S Rolfe St	1	68	69	69	N/A	N/A	**Yes**	No
3-4	S Quinn St	1	69	71	71	N/A	N/A	**Yes**	No
3-5	S Quinn St	1	68	70	70	65	**5**	**Yes**	No
3-6	S Queen St	1	66	68	68	61	**7**	**Yes**	No
3-7	S Queen St	1	65	66	66	59	**7**	**Yes**	No
3-8	S Queen St	1	64	65	65	60	**5**	No	No
3-9	S Quinn St	1	67	68	68	66	2	**Yes**	No
3-10	S Quinn St	1	66	68	66	65	1	**Yes**	No
3-11	S Queen St	1	64	66	66	65	1	No	No
NSA 4, Carrington Village									
4-1	10th St	1	64	65	64	61	3	No	No
4-2	10th St	1	63	64	64	61	3	No	No
4-3	10th St	1	63	64	64	61	3	No	No
4-4	10th St	1	63	64	64	61	3	No	No
4-5	10th St	1	62	64	64	61	3	No	No
4-6	10th St	1	62	64	63	61	2	No	No
4-7	10th St	1	62	63	63	61	2	No	No
4-8	10th St	1	62	63	63	61	2	No	No
4-9	10th St	1	65	66	65	62	3	No	No
4-10	10th St	1	64	66	65	62	3	No	No
4-11	10th St	1	64	65	65	62	3	No	No
4-12	10th St	1	63	65	64	62	2	No	No
4-13	10th St	1	63	65	64	62	2	No	No
4-14	10th St	1	63	64	64	62	2	No	No
4-15	10th St	1	63	64	64	62	2	No	No
4-16	10th St	1	64	65	64	62	2	No	No
4-17	10th St	1	64	65	64	63	1	No	No
4-18	10th St	1	64	65	64	63	1	No	No
4-19	10th St	1	64	65	64	63	1	No	No
4-20	10th St	1	64	66	64	63	1	No	No
4-21	10th St	1	64	66	64	63	1	No	No
4-22	10th St	1	64	66	64	64	0	No	No
4-23	10th St	1	64	66	65	65	0	No	No
4-24	10th St	1	64	66	65	65	0	No	No
4-25	10th St	1	64	65	65	65	0	No	No
4-26	10th St	1	62	64	64	64	0	No	No
4-27	10th St	1	63	65	64	64	0	No	No
4-28	10th St	1	63	65	65	65	0	No	No
4-29	10th St	1	63	65	65	65	0	No	No
4-30	10th St	1	63	65	65	65	0	No	No
4-31	10th St	1	63	65	65	65	0	No	No

Site	Location	Dwelling Units	Existing Leq (dBA)	2031 No- Build Leq (dBA)	2031 No Barrier Leq (dBA)	2031 With Barrier Leq (dBA)	Insertion Loss (dBA)	NAC Impact	Sub. Inc. Impact
NSA 5, Arlington View									
5-1	11th St	1	65	67	67	N/A	N/A	**Yes**	No
5-2	11th St	1	67	69	68	N/A	N/A	**Yes**	No
5-3	11th St	1	67	69	69	N/A	N/A	**Yes**	No
5-4	11th St	1	68	70	70	N/A	N/A	**Yes**	No
5-5	11th St	1	68	71	70	N/A	N/A	**Yes**	No
5-6	11th St	1	69	72	72	N/A	N/A	**Yes**	No
5-7	11th St	1	70	72	72	N/A	N/A	**Yes**	No
5-8	11th St	1	71	74	74	N/A	N/A	**Yes**	No
5-9	11th St	1	72	74	74	N/A	N/A	**Yes**	No
5-10	11th St	1	72	75	75	N/A	N/A	**Yes**	No

Table 3: Computed Existing and Future Noise Levels (Sensitivity Analysis)

Site	Location	Dwelling Units	2031 Build Leq (dBA)	2032 Build Leq (dBA)	2036 Build Leq (dBA)	2041 Build Leq (dBA)	Increase over 10 years (dBA)
NSA 1, Westhampton Mews							
1-1	Rolfe St	Rec	68	68	68	68	1
1-2	Rolfe St	Rec	70	71	71	71	1
1-3	Rolfe St	1	69	69	69	70	1
1-4	Rolfe St	1	70	70	70	71	1
1-5	Rolfe St	1	71	71	72	72	1
1-6	Rolfe St	1	72	72	73	73	1
1-7	Rolfe St	1	73	73	73	74	1
1-8	Rolfe St	1	72	72	72	73	1
1-9	Rolfe St	1	71	71	71	72	1
1-10	Rolfe St	1	70	70	70	71	1
1-11	Rolfe St	1	69	69	69	70	1
1-12	Rolfe St	1	73	73	73	73	1
1-13	Rolfe St	1	72	72	72	73	1
1-14	Rolfe St	1	71	71	72	72	1
1-15	Rolfe St	1	71	71	71	72	1
1-16	Rolfe St	1	70	70	70	71	1
1-17	Rolfe St	1	70	70	70	71	1
1-18	Rolfe St	1	69	69	70	70	1
1-19	Rolfe St	1	69	69	69	70	1
1-20	Rolfe St	1	69	69	69	70	1
1-21	Rolfe St	1	68	68	68	69	1
1-22	Rolfe St	1	67	67	68	68	1
1-23	Rolfe St	1	67	67	67	68	1
1-24	Rolfe St	1	66	66	67	67	1
1-25	Rolfe St	1	66	66	66	67	1
1-26	Rolfe St	1	66	66	67	67	1
1-27	Rolfe St	1	67	67	67	67	1
1-28	Rolfe St	1	67	67	68	68	1
1-29	Rolfe St	1	69	69	70	70	1
1-30	Rolfe St	1	68	68	69	69	1
1-31	Rolfe St	1	68	68	68	68	1
1-32	Rolfe St	1	67	67	67	68	1
1-33	Rolfe St	1	66	66	67	67	1
1-34	Rolfe St	1	66	66	66	67	1
1-35	Rolfe St	1	65	66	66	66	1
1-36	Rolfe St	1	65	65	66	66	1
NSA 2, Columbia Square							
2-1	Columbia Pike	1	68	68	69	69	1
2-2	Columbia Pike	1	68	68	69	69	1
2-3	Columbia Pike	1	68	68	69	69	1
2-4	Columbia Pike	1	68	68	69	69	1
2-5	Columbia Pike	1	68	68	69	69	1

Site	Location	Dwelling Units	2031 Build Leq (dBA)	2032 Build Leq (dBA)	2036 Build Leq (dBA)	2041 Build Leq (dBA)	Increase over 10 years (dBA)
2-6	Columbia Pike	1	68	68	69	69	1
2-7	Columbia Pike	1	68	68	69	69	1
2-8	Columbia Pike	1	68	68	69	69	1
NSA 3, Arlington View							
3-1	Columbia Pike	1	70	70	71	71	1
3-2	Columbia Pike	1	70	70	70	70	1
3-3	S Rolfe St	1	69	70	70	70	1
3-4	S Quinn St	1	71	71	72	72	1
3-5	S Quinn St	1	70	70	71	71	1
3-6	S Queen St	1	68	68	68	69	1
3-7	S Queen St	1	66	66	67	67	1
3-8	S Queen St	1	65	65	65	66	1
3-9	S Quinn St	1	68	68	69	69	1
3-10	S Quinn St	1	66	66	67	67	1
3-11	S Queen St	1	66	66	66	67	1
NSA 4, Carrington Village							
4-1	10th St	1	64	65	65	65	1
4-2	10th St	1	64	64	65	65	1
4-3	10th St	1	64	64	64	65	1
4-4	10th St	1	64	64	64	65	1
4-5	10th St	1	64	64	64	65	1
4-6	10th St	1	63	64	64	64	1
4-7	10th St	1	63	63	64	64	1
4-8	10th St	1	63	63	64	64	1
4-9	10th St	1	65	65	65	66	1
4-10	10th St	1	65	65	65	65	1
4-11	10th St	1	65	65	65	65	1
4-12	10th St	1	64	64	65	65	1
4-13	10th St	1	64	64	65	65	1
4-14	10th St	1	64	64	65	65	1
4-15	10th St	1	64	64	64	65	1
4-16	10th St	1	64	64	65	65	1
4-17	10th St	1	64	64	65	65	1
4-18	10th St	1	64	64	65	65	1
4-19	10th St	1	64	64	65	65	1
4-20	10th St	1	64	64	65	65	1
4-21	10th St	1	64	65	65	65	1
4-22	10th St	1	65	65	65	65	1
4-23	10th St	1	65	65	65	66	1
4-24	10th St	1	65	65	65	66	1
4-25	10th St	1	65	65	65	66	1
4-26	10th St	1	64	64	65	65	1
4-27	10th St	1	64	65	65	65	1
4-28	10th St	1	65	65	65	66	1
4-29	10th St	1	65	65	65	66	1
4-30	10th St	1	65	65	65	66	1
4-31	10th St	1	65	65	66	66	1

Site	Location	Dwelling Units	2031 Build Leq (dBA)	2032 Build Leq (dBA)	2036 Build Leq (dBA)	2041 Build Leq (dBA)	Increase over 10 years (dBA)
NSA 5, Arlington View							
5-1	11th St	1	67	67	67	68	1
5-2	11th St	1	68	68	69	69	1
5-3	11th St	1	69	69	70	70	1
5-4	11th St	1	70	70	70	71	1
5-5	11th St	1	70	70	71	71	1
5-6	11th St	1	72	72	72	72	1
5-7	11th St	1	72	72	73	73	1
5-8	11th St	1	74	74	74	74	1
5-9	11th St	1	74	74	74	75	1
5-10	11th St	1	75	75	75	75	1

Table 4: Sound Barrier Summary

Barrier	Noise Sensitive Area	Barrier Location	Height (ft)		Length (ft)	Surface Area (sq ft)	Insertion Loss (dBA)	Total Number Impacts	Protected and Benefited	Total Cost * ($45/sqft)	Cost per Receptor
Barrier 1	1, Westhampton Mews	Ramp G	12 to 20		804	14,266	5 to 13	34	22	$641,970	$29,180
Barrier 2/3	3, Arlington View	Route 244 EB, Ramp E	2	12 to 15	203	2,840	5 to 7	5	4	$348,480	$87,120
			3	14 to 18	346	4,904					
			Total	12 to 18	549	7,744					

* Total cost represents the cost for barrier materials and installation only. Any Right of Way and Utility relocation costs incurred solely for barrier construction may be added before the final barrier determination.

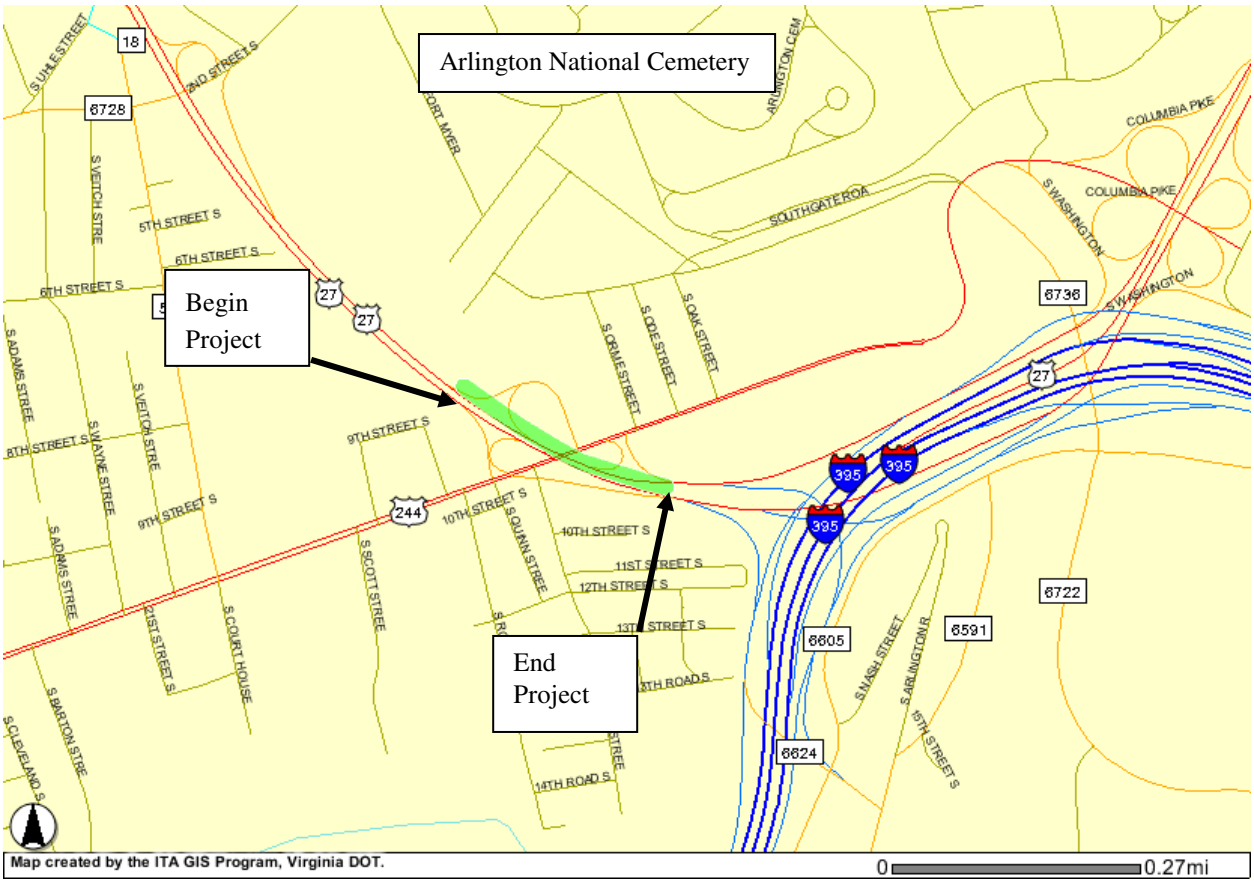

Figure 1: Route 27/Route 244 Project Location Overview

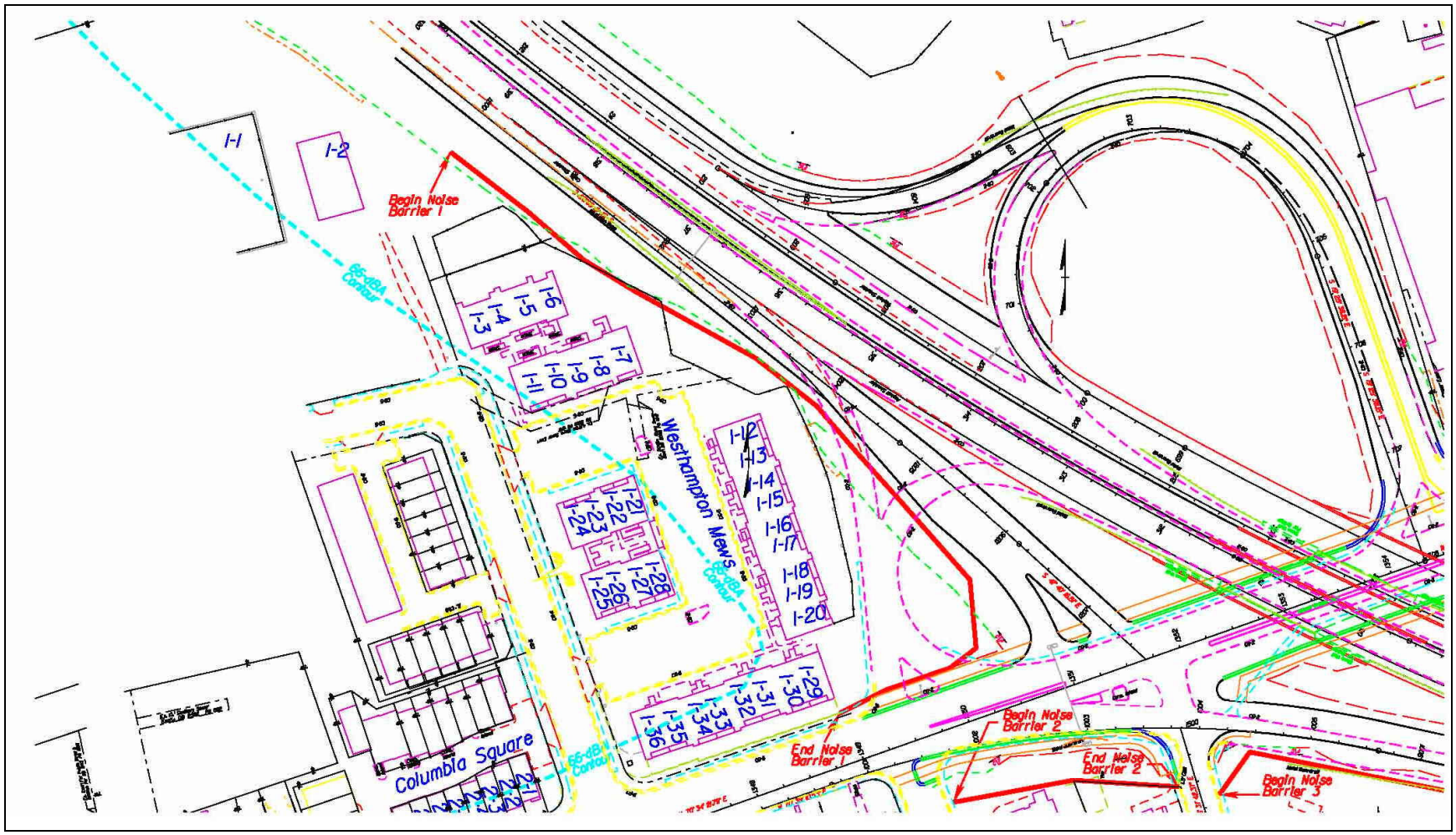

Figure 2: Study Sites and Noise Barriers Under Consideration 1

Figure 3: Study Sites and Noise Barriers Under Consideration 2

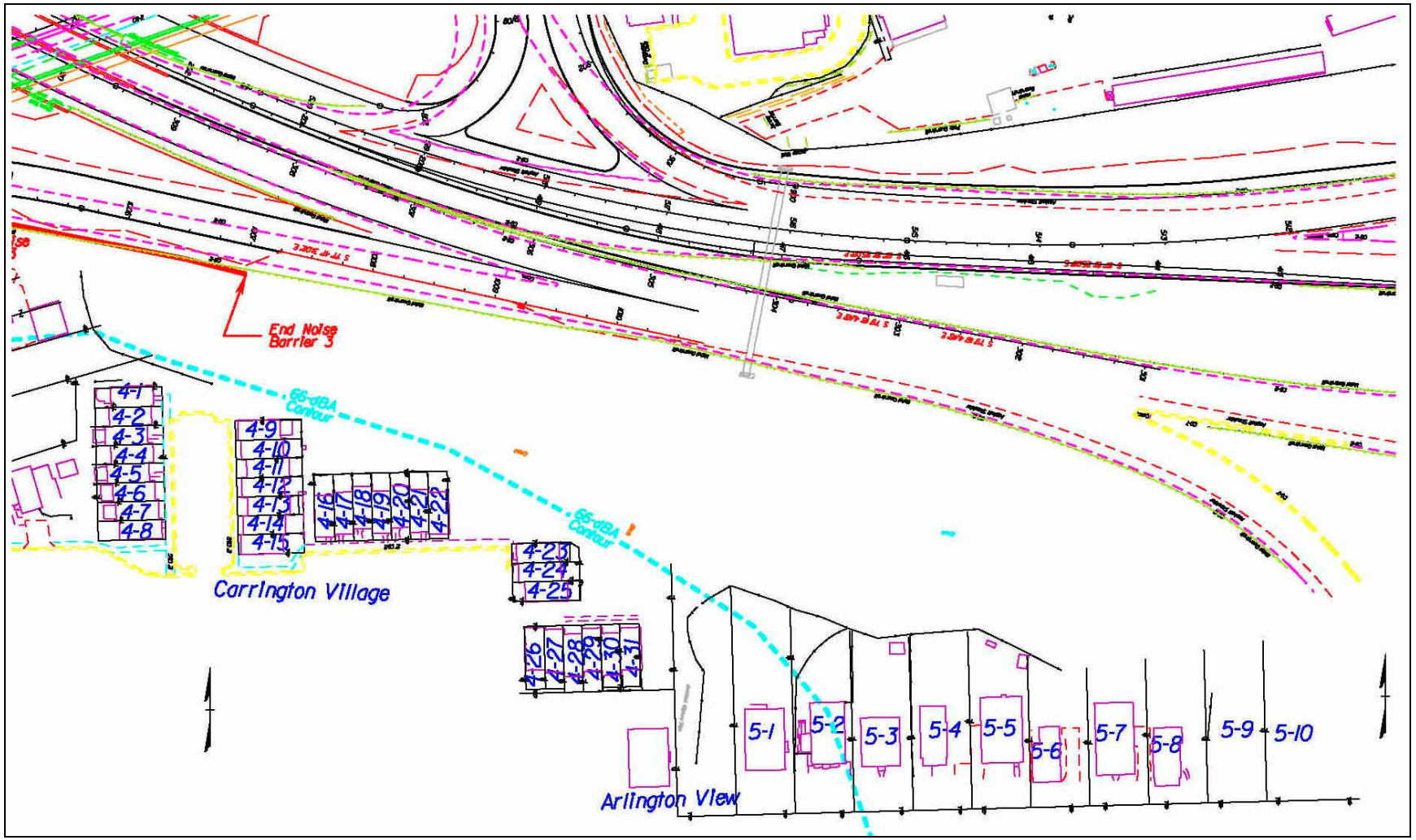

Figure 4: Study Sites and Noise Barriers Under Consideration 3