Appendix 4

Noise Impact Analysis
Technical Memorandum

Noise Technical Memorandum
for the
Metro Transit Police Department
District II and Training Facility

Fairfax County, Virginia

Prepared for:

Washington, DC

Prepared by:

AECOM
42101 Wilson Boulevard
Arlington, VA 22201

March 2011

Table of Contents

List of Tables

List of Figures

1.0 Introduction

A noise assessment was conducted to identify the potential for impacts from the Metro Police Training Facility proposed in Fairfax County, Virginia. The noise assessment was prepared in accordance with the Federal Transit Administration's (FTA) *Transit Noise and Vibration Impact Assessment*[1]. The results of the noise assessment are described in the following sections.

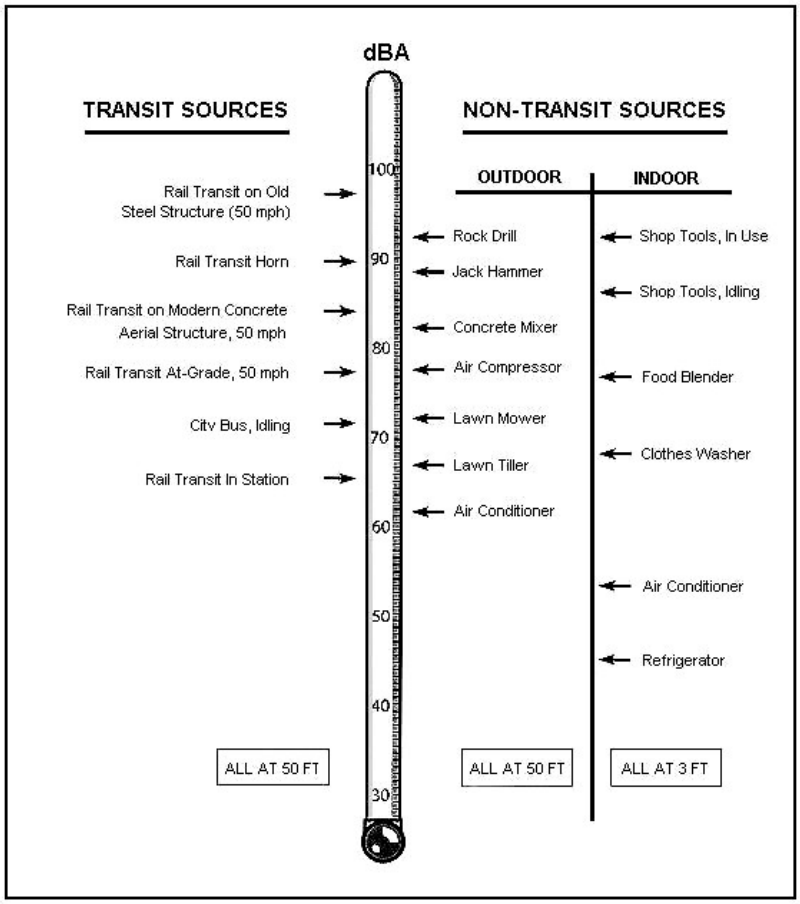
1.1.1 Human Perception of Noise

Noise is "unwanted sound" and, by this definition, the perception of noise is a subjective process. Several factors affect the actual level and quality of sound (or noise) as perceived by the human ear and can generally be described in terms of loudness, pitch (or frequency), and time variation. The loudness, or magnitude, of noise determines its intensity and is measured in decibels (dB) that can range from below 40 dB (the rustling of leaves) to over 100 dB (a rock concert). Pitch describes the character and frequency content of noise, such as the very low "rumbling" noise of stereo subwoofers or the very high-pitched noise of a piercing whistle. Finally, the time variation of noise sources can be characterized as continuous, such as with a building ventilation fan; intermittent, such as for trains passing by; or impulsive, such as pile-driving activities during construction.

Various sound levels are used to quantify noise from transit sources, including a sound's loudness, duration, and tonal character. For example, the A-weighted decibel (dBA) is commonly used to describe the overall noise level because it more closely matches the human ear's response to audible frequencies. Because the A-weighted decibel scale is logarithmic, a 10 dBA increase in a noise level is generally perceived as a doubling of loudness, while a 3 dBA increase in a noise level is just barely perceptible to the human ear. Typical A-weighted sound levels from transit and other common sources are shown in **Figure 1**.

Several A-weighted noise descriptors are used to determine impacts from stationary and transit related sources including the L_{max}, which represents the maximum noise level that occurs during an event such as a bus or train passby; the L_{eq}, which represents a level of constant noise with the same acoustical energy as the fluctuating noise levels observed during a given interval, such as one hour; the L_{90}, which represents the noise level exceeded 90 percent of the time and is used to establish the background ambient level; and the L_{dn}, or the 24-hour day-night noise level, which includes a 10-decibel penalty for all nighttime activity between 10:00 p.m. and 7:00 a.m.

[1] *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, U.S. Department of Transportation, Federal Transit Administration, Office of Planning and Environment, Washington, DC, May 2006.



Source: Transit Noise and Vibration Impact Assessment, Federal Transit Administration, Washington, DC, May 2006.

Figure 1. Typical A-Weighted Noise Levels

1.1.2 Regulatory Setting

1.1.2.1 FTA Noise Standards

The Federal Noise Control Act of 1972 (Public Law 92-574) requires that all federal agencies administer their programs in a manner that promotes an environment free from noises that could jeopardize public health or welfare. Therefore, the noise assessment was prepared in accordance with the guidelines in FTA's *Transit Noise and Vibration Impact Assessment* [2] (FTA 2006). These guidelines form the basis for determining the potential noise impacts associated with stationary sources such as railyards, bus terminals and other ancillary sources.

Although the FTA guidelines are typically used to assess noise impacts from transit vehicles and facilities (such as buses, trains, and stationary sources such as grade crossings bells and maintenance facilities), they may also be applied to stationary facilities such as is proposed for the Metro Police Training Facility. For the proposed Metro Police Training

[2] *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, U.S. Department of Transportation, Federal Transit Administration, Office of Planning and Environment, Washington, DC, May 2006.

Facility, the FTA stationary source methodologies were utilized including source noise measurements at a similar facility. FTA assesses impacts at sensitive receivers such as residences, schools, and libraries. Commercial and industrial properties are typically not considered sensitive to transit noise and vibration except perhaps laboratories and other facilities that utilize sensitive photographic or imaging equipment. For example, the 24-hour day-night noise level (or L_{dn}) is used to assess impacts particularly at night when sensitivity to noise is more enhanced. A detailed description of the FTA evaluation criteria and the modeling methodologies is included in the following section.

1.1.2.2 Fairfax County Noise Criteria

Regional noise criteria from the Fairfax County Code (Chapter 108, Article 4) specify maximum allowable noise limits for various zoning district classifications. Although the Fairfax County noise code includes limits on nuisance events such as loudspeakers and nighttime events, it also includes both broadband and 1/1-octave band noise limits at different land-use categories. The Fairfax County noise code also limits construction activities to the daytime hours between 7:00 a.m. and 9:00 p.m.

1.1.2.3 WMATA Noise Criteria

During the construction and development of the initial Metrorail rapid transit system in the 1970's, design criteria were developed specifically for the WMATA system. The most current version of these design criteria is described in the *WMATA Manual of Design Criteria for Maintaining and Continued Operation of Facilities and Systems*[3]. Although these design criteria were primarily intended for rail transit facilities, the WMATA criteria for Ancillary Facilities were used to evaluate impacts from interior firearms training proposed at the Metro Police Training Facility.

1.1.3 Evaluation Criteria

1.1.3.1 FTA Criteria

FTA's *Transit Noise and Vibration Impact Assessment* guidance manual presents the basic concepts, methods, and procedures for evaluating the extent and severity of noise and vibration impacts from transit-related projects. Noise impacts due to transit and other ancillary sources are assessed based on land-use categories and these uses' sensitivity to noise from transit sources as described in the FTA guidelines.

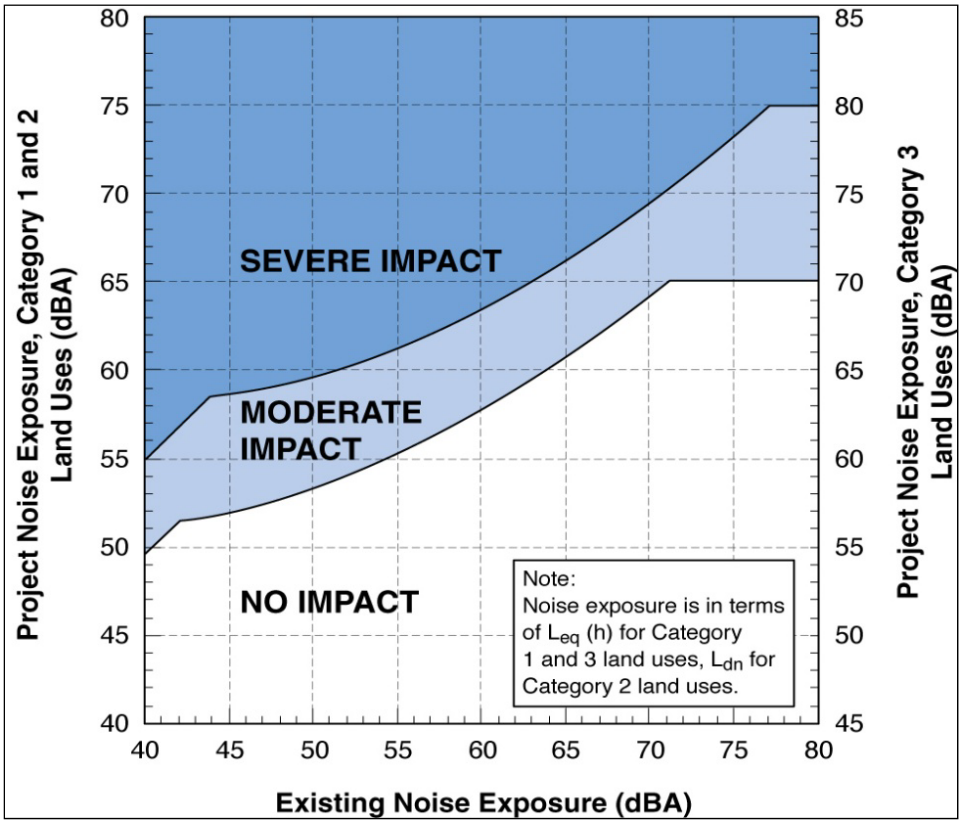
As shown in **Figure 3**, the FTA noise impact criteria are defined by two curves that allow increasing project noise levels as existing noise increases up to a point, beyond which the impact is determined based on project noise alone. The FTA land-use categories and required noise metrics are described in **Table 1** below.

[3] *WMATA Manual of Design Criteria for Maintaining and Continued Operation of Facilities and Systems*, Washington Metropolitan Area Transit Authority, Department of Operations Services, Office of Engineering Support Services, May 2008.

Table 1: FTA Land-Use Categories and Noise Metrics

Land-Use Category	Noise Metric	Description
1	$L_{eq}(h)$	Tracts of land set aside for serenity and quiet, such as outdoor amphitheaters, concert pavilions, and historic landmarks.
2	L_{dn}	Buildings used for sleeping such as residences, hospitals, hotels, and other areas where nighttime sensitivity to noise is of utmost importance.
3	$L_{eq}(h)$	Institutional land uses with primarily daytime and evening uses including schools, libraries, churches, museums, cemeteries, historic sites, and parks, and certain recreational facilities used for study or meditation.

Source: FTA, 2006.



Source: FTA 2006

Figure 2: FTA Project Noise Impact Criteria

As shown in **Figure 2**, the FTA transit noise impact criteria define noise impacts in terms of the existing noise levels, the expected noise levels with the proposed project, and the land uses that would be affected. Category 1 and 2 land uses are more sensitive to noise than Category 3 land uses (see **Table 1**). For example, a project noise level of 60 dBA might be considered a moderate impact at a Category 1 or 2 land use but no impact at a Category 3 land use.

The FTA noise criteria separate noise impacts into two categories: *moderate impact* and *severe impact*. The *moderate impact* category indicates that the change in noise is noticeable but might not be great enough to cause a strong, adverse community reaction. The *severe impact* category indicates that a significant percentage of the population would be highly affected by the new noise. The degree of impact at any specific location can be determined by comparing the predicted project noise level at the site to the existing noise level.

The average day-night noise level over a 24-hour period, or L_{dn}, was used to characterize noise exposure for residential areas (FTA Category 2). For other noise-sensitive land uses identified along the project corridor, such as schools and libraries (FTA Category 3), the peak hourly noise level, or $L_{eq}(h)$, was used.

1.1.3.2 Fairfax County Noise Criteria

The maximum allowable noise levels as per the Fairfax County noise code range from 55 dBA at residential land-uses to 60 dBA at commercial properties to 72 dBA at industrial land-uses. Since only residential noise-sensitive receptors were identified in the immediate vicinity of the proposed police training facility, the onset of impact from single noise events at the proposed police facility (such as firearms training or rooftop mechanical equipment) were assessed at nearby residences using a threshold of 55 dBA.

1.1.3.3 WMATA Ancillary Facilities Noise Criteria

The WMATA noise limits for stationary or ancillary facilities are summarized in **Table 2**. The WMATA criteria include limits for both transient and continuous noise sources. For the closest residences identified in the vicinity of the proposed training facility, the WMATA limits for high-density residential land-uses were applied. These limits range from 50 dBA for continuous sources (such as HVAC fans and pumps) to 60 dBA for transient sources (such as firearms training).

Table 2: WMATA Criteria for Noise from Transit System Ancillary Facilities (dBA)[1]

Community Area Category		Maximum Noise Level	
		Transient Noises	Continuous Noises
I	Low-density Residential	50	40
II	Average Residential	55	45
III	High-density Residential	60	50
IV	Commercial	65	55
V	Industrial/Highway	75	65

1 The WMATA criteria are generally referenced to or applied at a point 50 feet or farther from the track centerline.
2 Maximum noise level (or Lmax) criteria are reported for transient and continuous sources.

1.1.4 Modeling Methodology

The noise assessment was conducted according to FTA's *Transit Noise and Vibration Impact Assessment* guidelines. Since there is no specific guideline for indoor fire ranges, the FTA stationary methodologies were utilized to estimate future noise from the training facility at the closest residences in the design year. The modeling assumptions and input parameters (such as reference noise levels) used in the noise assessment are summarized below.

- Noise from the proposed facility include the following sources:
  - Weapons training from the interior firing ranges
  - Rooftop HVAC mechanical equipment
- Since the proposed facility would be the first of its kind for WMATA, no reference information was available within the WMATA system;
- As a result, reference noise levels were measured at the US Department of Homeland Security's (DHS) Federal Law Enforcement Training Center (FLETC) in Cheltenham, MD on February 11, 2011;
- The types of noise sources measured at the DHS facility include firearms training recorded outside the walls and overhead access doors. Due to acoustical treatments applied inside the firing range, the overhead doors provided the least noise reduction and the highest exterior levels at this facility;
- Noise from the ground-level HVAC chillers was also measured to develop reference levels for a single unit;
- Noise sources included weapons that would typically be used by the WMATA Metro Police during training such as assault rifles, shotguns and semi-automatics;
- The measured levels from the firing range at the overhead doors were applied as the highest reference noise level from firearms training for future predictions at the proposed WMATA facility;
- Similarly, the measured levels from the ground-level chillers were also applied as the highest reference noise level from HVAC mechanical equipment for future predictions at the proposed WMATA facility;
- Other noise sources, such as personal vehicles that would visit the facility, are not a significant source of noise and are not expected to contribute to an exceedance of the project impact criteria;
- The police facility is expected to operate primarily during the daytime period between 7:00 a.m. and 5:00 p.m. although the HVAC system may operate longer including during the nighttime period;
- The predicted results also reflect maximum or worst-case noise conditions as follows:
  - Weapons training noise was assumed to occur every three seconds on average (e.g., 20 percent load factor);
  - This is a conservative assumption that is significantly higher than what was observed at the DHS Cheltenham facility;
  - Rooftop HVAC mechanical equipment noise is assumed to operate continuously during the daytime period (7:00 am to 10:00 pm) and only 50 percent of the time during the nighttime period (10:00 pm to 7:00 am); and,
- To maximize facility noise levels especially from the back of the building at the dust collection system near the access doors, no shielding effects were assumed except for Site M3. Noise from the dust collection systems and access door, which is assumed to be the weakest portion of the building envelope, would be shielded by the proposed training facility itself for Site M3 only.

1.1.5 Affected Environment

1.1.5.1 Baseline Noise Conditions

To determine the existing background noise levels at sensitive receptors in the vicinity of the proposed police training facility, a noise-monitoring program was conducted at three representative locations shown in **Figure 3** and described in **Table 3**. Hourly equivalent A-weighted noise levels (or Leq(h) in dBA) were measured over a 24-hour period at each of the representative sites to determine the average ambient conditions during a typical weekday. The representative sites included single-family residences, townhomes and apartment complexes closest to the proposed facility (or FTA Category 2 land-uses). The noise measurements document existing noise sources in the vicinity of the proposed training facility such as existing traffic along Franconia-Springfield Parkway (VA 7900). In accordance with FTA guidelines, 24-hour day-night noise levels (or Ldn in dBA) were developed based on the monitoring results. Baseline noise levels were conducted continuously on February 16, 2011 at Sites M1 and M2 over a 24-hour period to document the hourly variation in ambient noise levels in the area.

The intent of the noise monitoring program was not to document the background noise level at every receptor, but to strategically select monitoring sites that were representative of the project corridor's adjacent land uses and closest to the proposed alignment. Existing noise levels observed at these monitoring sites can be adjusted to estimate existing noise levels at sites farther away from the ROW, based on distance.

Source: AECOM, March 2011.

Figure 3: Representative Baseline Noise Monitoring Sites at the Proposed Police Training Facility

As shown in **Table 3**, the measured day-night noise levels along in the vicinity of the proposed facility are fairly consistent ranging from 59 dBA at Site M3 (single-family residences along Elden Avenue) to 62 dBA at Site M1 (multi-family residences along Metropolitan Center Drive) to 65 dBA at Site M2 (multi-family residences along Meteor Place). The hourly variation in noise levels is shown graphically in Appendix Figures A.1 and A.2 for Sites M1 and M2, respectively. Since the residential communities are surrounded by both highway corridors, such as Interstate 95 and Route VA 7900 (Franconia-Springfield Parkway), and the WMATA rail corridor, the background noise levels are representative of dense mixed-use highway corridors.

Table 3: Baseline Noise Levels Measured at Representative Locations in the Vicinity of the Proposed Metro Police Training Facility (in dBA)

Receptor	Description	Land Use	Date	1-Hour L_{eq}	24-Hour L_{dn}
M1	Metropolitan Center Drive	Res.	February 16, 2011	52	62
M2	6815 Meteor Place	Res.	February 16, 2011	62	65
M3	6821 Elden Avenue	Res.	February 16, 2011	57	59

Source: AECOM, March 2011.

The sound-level meters that were used to measure current noise conditions (Brüel & Kjær Model 2236 and Larson Davis Model 820) meet or exceed the American National Standards Institute (ANSI) standards for Type I accuracy and quality. The sound-level meters were calibrated using a Brüel & Kjær Model 4231 before and after each measurement. All measurements were conducted according to ANSI Standard S1.13-2005, *Measurement of Sound Pressure Levels in Air*. All noise levels are reported in dBA, which best approximates the sensitivity of human hearing.

1.1.5.2 DHS Source Noise Measurements

Noise measurements conducted at the DHS FLETC firing range in Cheltenham, Maryland on February 11, 2011, were used to develop the source levels that would be used for the prediction modeling of the WMATA training facility. Maximum noise levels from the weapons training ranged from 65 dBA for pistol training (FLETC Range No. 5) to 86 dBA for rifle training (FLETC Range No. 6). These levels represent maximum observed noise levels at the building's overhead doors (10 feet from the building façade), which provide noise reduction than the acoustically reinforced concrete walls. Although the WMATA Police Training Facility would have all building surfaces acoustically treated, including the access doors, this was a conservative assumption for worst-case modeling predictions.

1.1.6 Environmental Consequences

1.1.6.1 No Build Alternative

Future noise levels under the No Build Condition should be similar to those under the existing conditions. The area in the vicinity of the proposed Metro Police Training Facility is characterized as a mixture of both urban and suburban communities that include major highways and arterials (such as I-95 and VA 7900). The No Build Condition would not cause any new noise impacts.

1.1.6.2 Build Alternative

Since the project would introduce a new stationary source, noise from the Build Alternative was evaluated using the FTA prediction procedures. The FTA evaluation criteria were used to assess 24-hour impacts at residences (especially during the most sensitive nighttime period when people are sleeping) while the Fairfax County noise code was used to assess maximum noise from single events (such as firearms training or HVAC mechanical equipment).

Since the noise-sensitive sites for this project are residential, the L_{dn} descriptor was used to reflect the particularly heightened sensitivity to nighttime noise. Predicted noise levels are shown in **Table 4** under the Build Alternative. The table compares noise levels for representative receptor locations for existing conditions and the Build Alternative. The background levels and the future predicted noise levels are shown graphically in **Figure 4**. As shown in **Table 4**, the L_{dn} day-night noise levels at residences closest to the proposed training facility are predicted to range from 41 dBA at Site M3 (residences along Elden Avenue) to 52 dBA at Site M1 (apartments along Metropolitan Center Drive) to 55 dBA at Site M2 (townhomes along Meteor Place). Based on the result of the prediction analysis, none of the noise levels are predicted to exceed the FTA *moderate* or *severe* impact criteria at any of the representative sites.

Table 4: Existing and Predicted Noise Levels at Select Receivers

				Noise Levels (dBA)				FTA	
	Receiver	FTA	Noise		Firing Range		Project	Criteria[3]	
ID	Address	Cat.	Metric	Exist	Door[1]	HVAC[2]	Sum	MOD	SEV
1	Metropolitan Center Drive	2	Ldn	62	46	51	52	59	64
2	6815 Meteor Place	2	Ldn	65	48	54	55	61	66
3	6821 Elden Avenue	2	Ldn	59	30	40	41	57	63

1 For interior weapon fire noise, the dust collection door represents the acoustically weakest point of the proposed building's exterior envelope.
2 The HVAC equipment, including chillers and ventilation fans, is proposed on the rooftop of the firing range.
Source: AECOM, March 2011.

Similarly, cumulative maximum noise levels from the firing range and the rooftop HVAC mechanical equipment are predicted to range from 29 dBA at Site M3 to 47 dBA at Site M2. As a result, none of the predicted maximum noise levels from the firearms training or the rooftop HVAC equipment

are predicted to exceed the Fairfax County Noise Code. As shown in **Figure 5**, 1/1-octave band noise levels from the proposed training facility are also not predicted to exceed the Fairfax County frequency noise limits at Site M2, for example.

Additionally, none of the predicted maximum noise levels from the firearms training or the rooftop HVAC equipment are predicted to exceed the WMATA transient or continuous noise limits, respectively.

Table 5: Predicted Maximum Noise Levels and Fairfax County and WMATA Impact Criteria at Select Receivers

				Noise Levels (dBA)			Criteria		
	Receiver	Land	Noise	Firing Range		Project	Fairfax[1]	WMATA[2]	
ID	Address	Use	Metric	Firearms	HVAC	Sum	County	Trans.	Cont.
1	Metropolitan Center Drive	III	Lmax	42	39	44	55	60	50
2	6815 Meteor Place	III	Lmax	45	42	47	55	60	50
3	6821 Elden Avenue	III	Lmax	21	29	29	55	60	50

1 The Fairfax County noise criteria are reported for the Residential Zoning District (Section 108-4-4.).
2 The "WMATA Criteria for Noise from Transit System Ancillary Facilities" are reported for land-use Area Category III, which includes high density urban residential and average semi-residential/commercial areas. These criteria are applied separately to transient ("Trans.") and continuous ("Cont.") noise sources.
Source: AECOM, March 2011.

1.1.7 Construction Impacts

Noise levels from construction activities at the proposed training facility, although temporary, could be a nuisance at nearby sensitive receptors. Noise levels during construction are difficult to predict and vary depending on the types of construction activity and the types of equipment used for each stage of work. Heavy machinery, the major source of noise in construction, is constantly moving in unpredictable patterns and is not usually at one location very long. Project construction activities could include site excavation, relocating utilities, and roadway grading. No heavy-duty impulsive equipment, such as pile drivers, is expected as part of the construction activities.

1.1.8 Potential Avoidance, Minimization and Mitigation Measures

Since none of the predicted noise levels from the Metro Police Training Facility is predicted to exceed the FTA, Fairfax County or the WMATA Ancillary Facility impact criteria, no mitigation measures are required. Therefore, the proposed project is predicted to be in full compliance with all applicable noise criteria.

1.1.9 Summary of Analysis

Based on the results of the noise modeling assessments, the following findings summarize the predicted impacts from the proposed Metro Police Training Facility:

- The 24-cumulative hour noise levels at the closest residences are not predicted to exceed the FTA *moderate* or *severe* impact criteria.

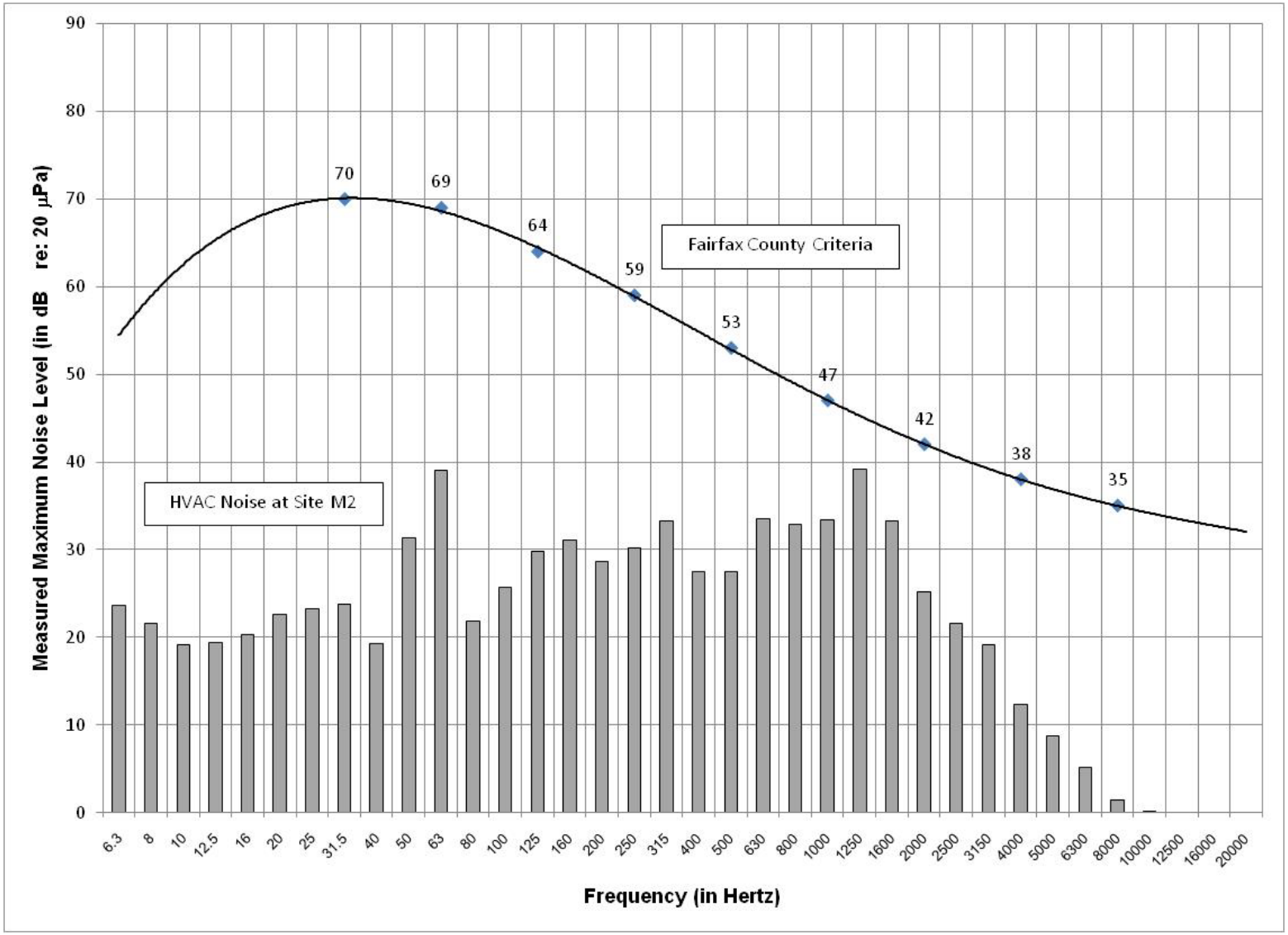
- Similarly, maximum noise levels from the firearms training and the rooftop HVAC mechanical equipment are also not predicted to exceed the Fairfax County noise limit of 55 dBA at the closest identified residences.

- Finally, maximum noise levels from the firearms training and the rooftop HVAC mechanical equipment are also not predicted to exceed the WMATA Ancillary Facilities noise limits of 60 dBA for transient sources and 50 dBA for continuous sources, respectively.

- No mitigation measures are required since the future noise levels from the proposed Metro Police Training Facility are not predicted to exceed any of the applicable noise criteria.

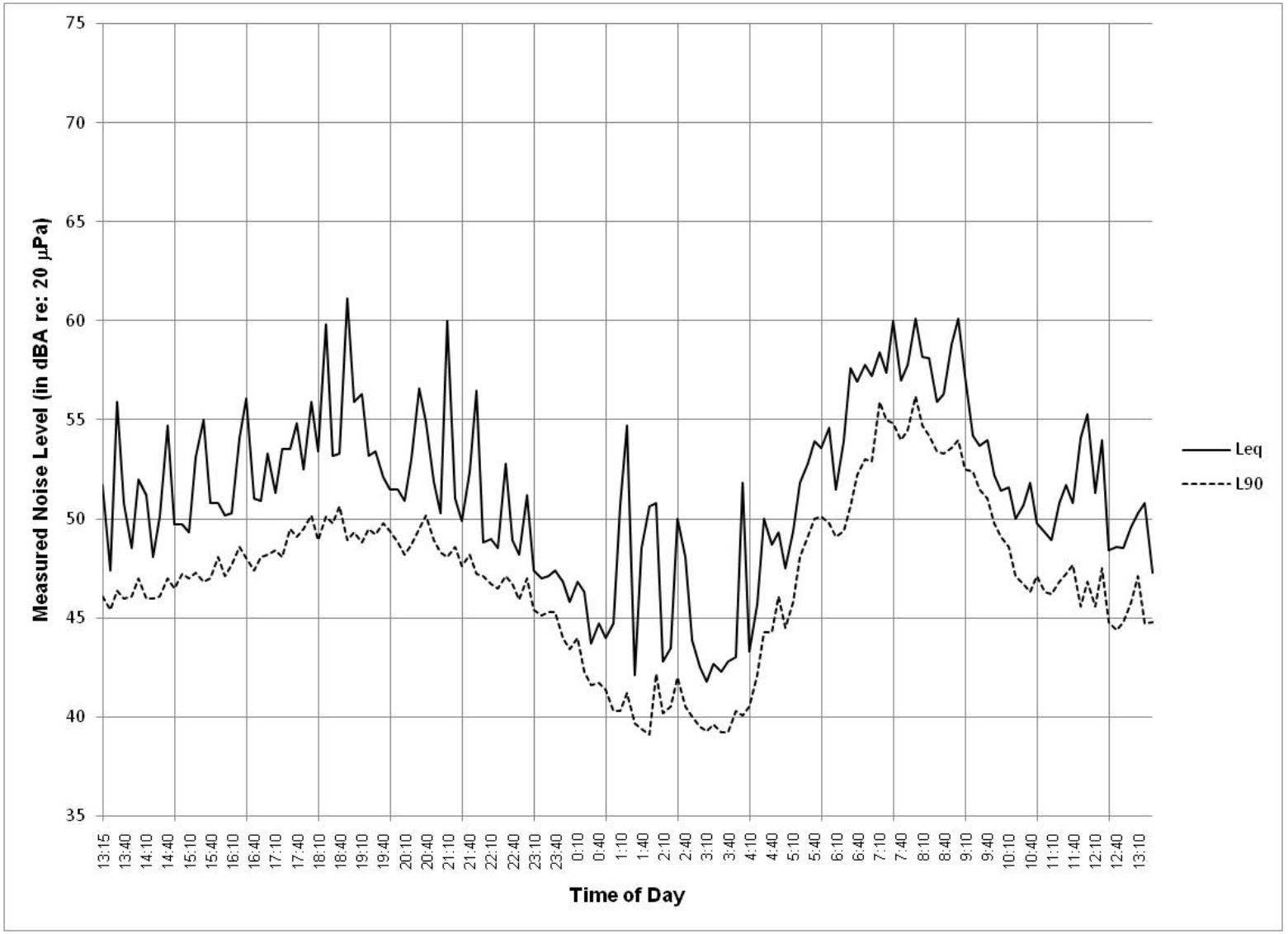
At each receptor site, several levels are shown including the measured background noise, the future predicted noise for the Build Alternative, the future cumulative noise with the project and the maximum noise level for a single event under the Build Alternative.
Source: AECOM, March 2011.

Figure 4: Existing and Future Predicted Noise Levels at Select Receiver Locations Closest to the Proposed WMATA Metro Police Training Facility in Fairfax County, VA



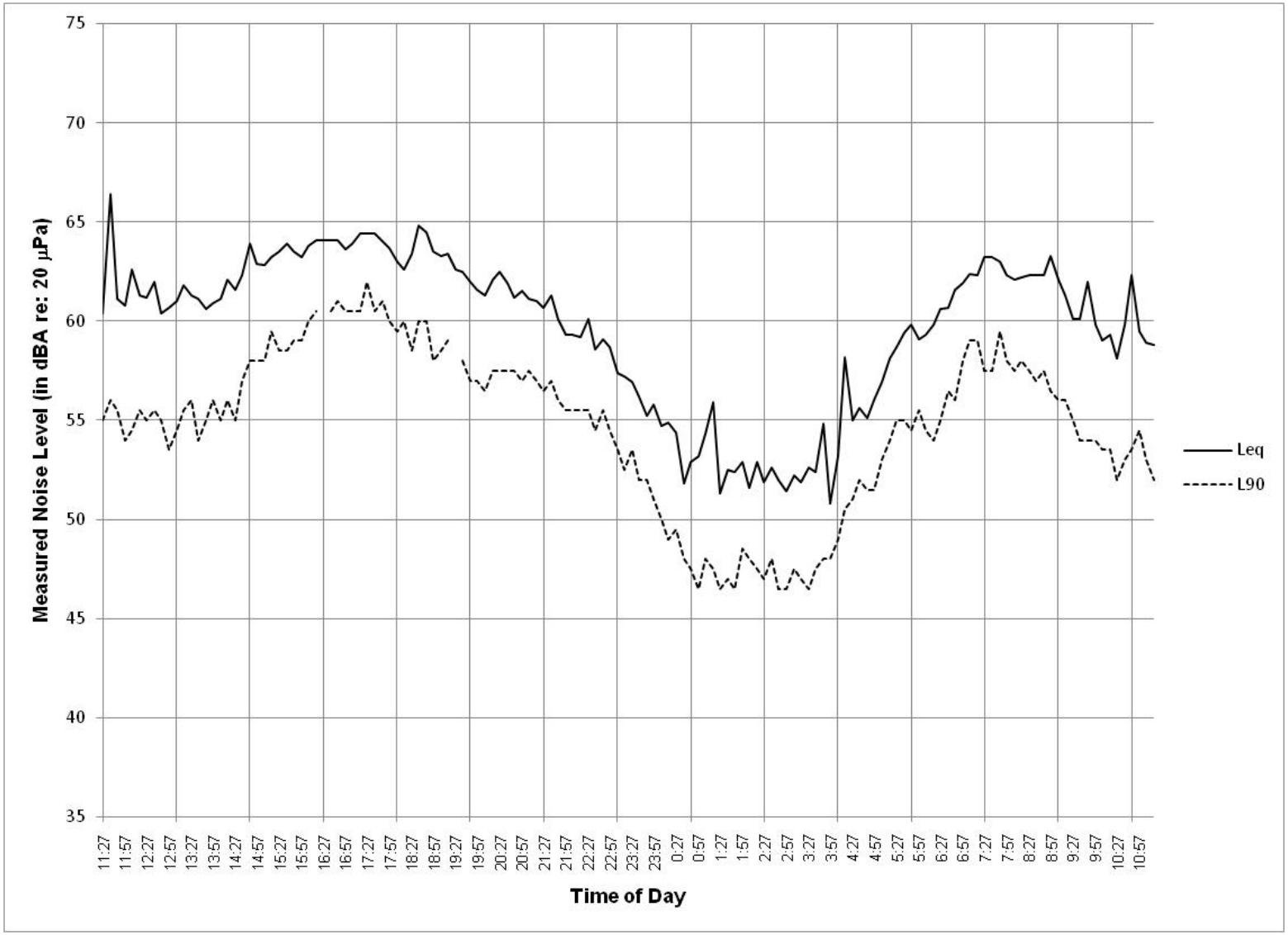
Source: AECOM, March 2011.

Figure 5: Comparison of the Rooftop HVAC Equipment Noise Levels and the Fairfax County Maximum Permissible Sound Pressure Levels at Site M2



Source: AECOM, March 2011.

Figure A1: Baseline Noise Levels Measured at Site 1 (Apartments on Metropolitan Center Drive, Fairfax County, VA) on February 15, 2011



Source: AECOM, March 2011.

Figure A2: Baseline Noise Levels Measured at Site 2 (Apartments on Meteor Place, Fairfax County, VA) on February 15, 2011