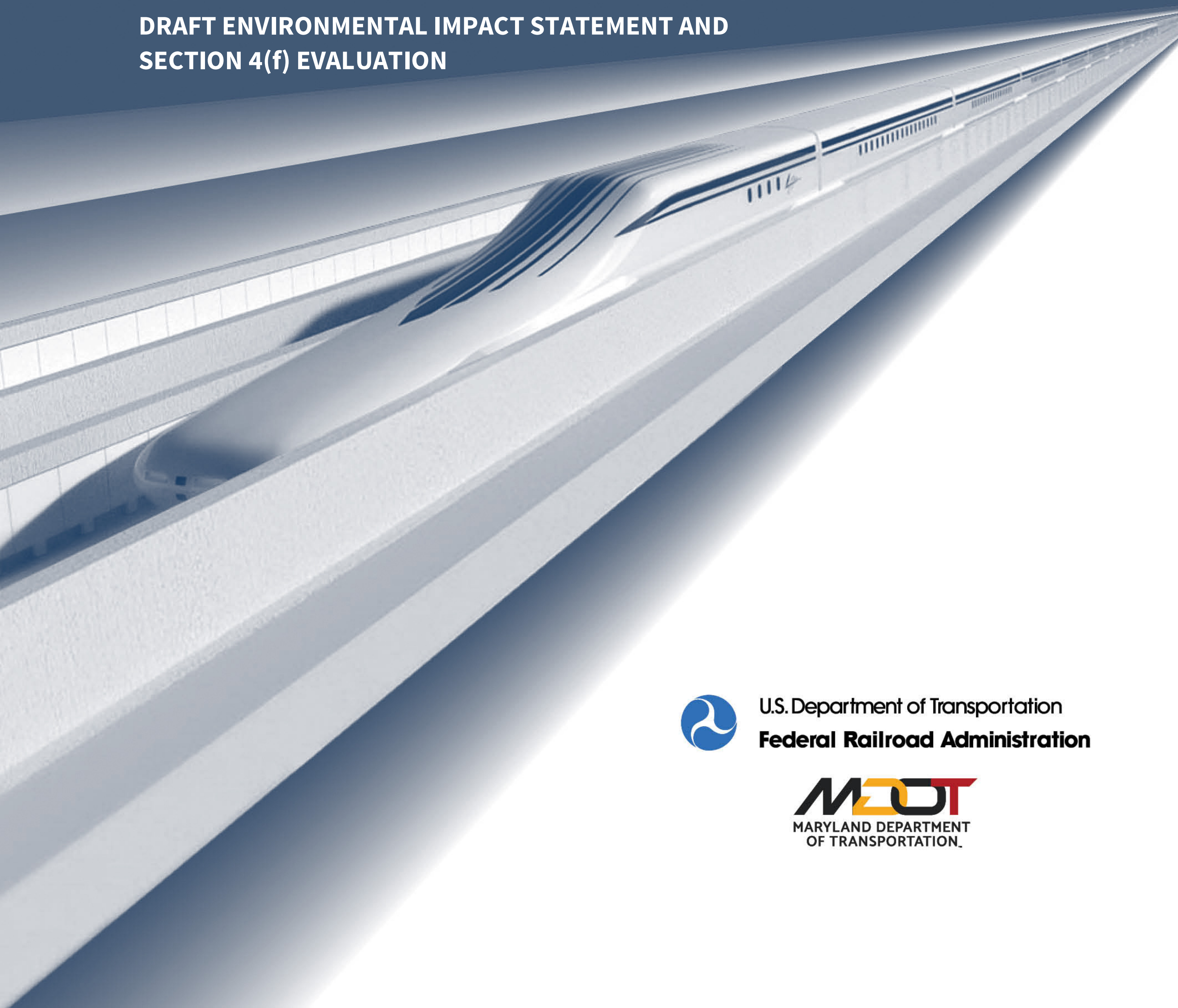
Appendix D.10

Noise and Vibration

BALTIMORE-WASHINGTON
SUPERCONDUCTING MAGLEV PROJECT

DRAFT ENVIRONMENTAL IMPACT STATEMENT AND
SECTION 4(f) EVALUATION



U.S. Department of Transportation
Federal Railroad Administration

MDOT
MARYLAND DEPARTMENT
OF TRANSPORTATION

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Appendix D.10 Noise and Vibration

D.10.1 Introduction

The Federal Railroad Administration conducted a noise and vibration assessment to assess the potential for impact from the construction and operation of the project. The noise and vibration assessment included a monitoring program to establish baseline conditions (noise only), a modeling analysis to predict future levels from long-term operations of the system, a modeling analysis to predict levels from temporary construction activities and a mitigation assessment to evaluate various control measures in potential impact areas. FRA conducted the noise and vibration assessment in accordance with the Federal Railroad Administration's (FRA) *High-Speed Ground Transportation Noise and Vibration Impact Assessment* manual (maglev trains) and the Federal Transit Administration's (FTA) *Transit Noise and Vibration Impact Assessment Manual* (ancillary facilities and construction).

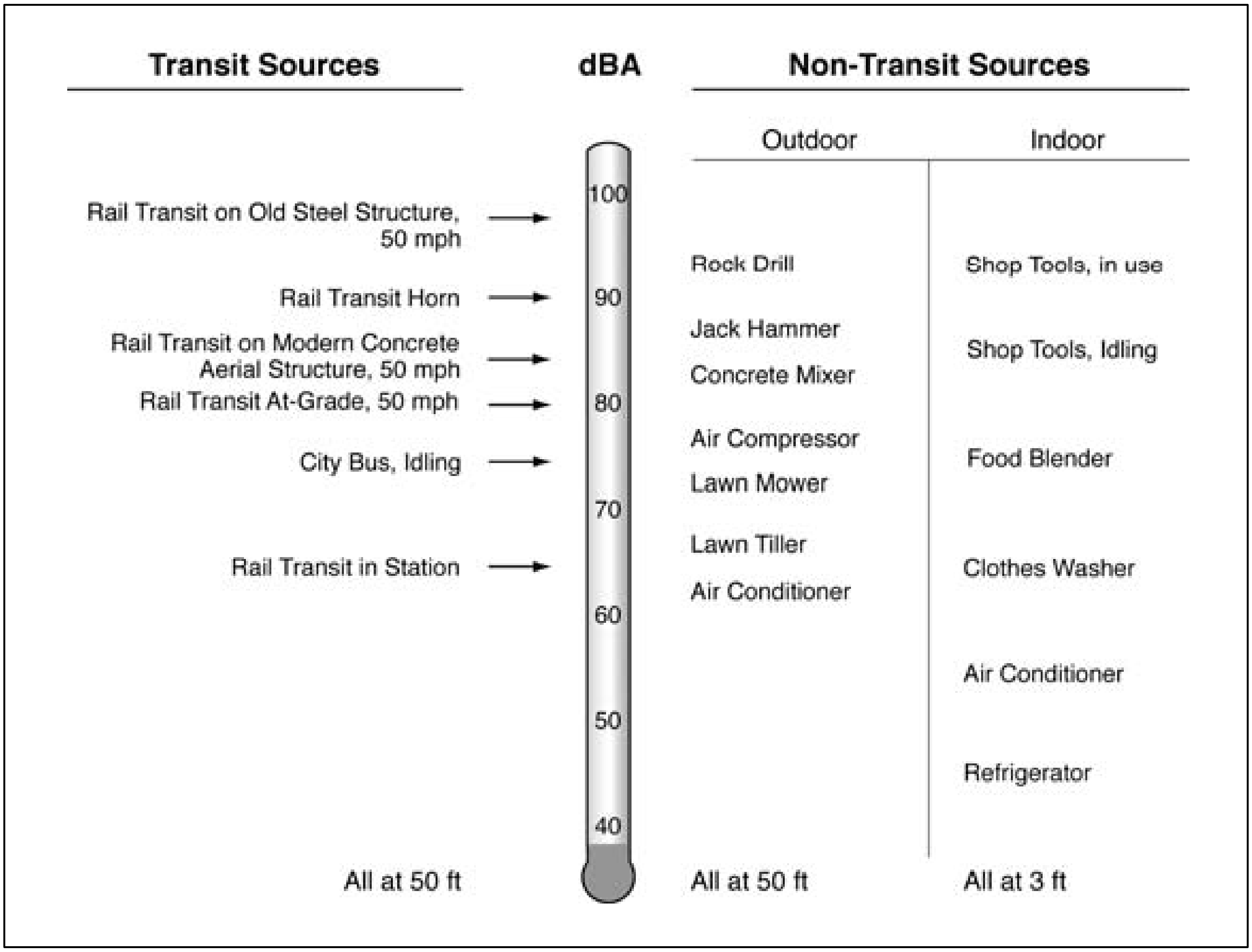
D.10.1.1 Noise Fundamentals

Noise is defined as unwanted or excessive sound, and can interfere with sleep, work, relaxation, and/or recreation. We base the extent to which noise interferes with daily activities on noise duration, loudness, noise frequency, time of day, and personal preferences. In order to establish a uniform noise measurement that simulates people's perception of loudness and annoyance, the weighted decibel measurement accounts for those frequencies most audible to the human ear. The A-weighted sound level, or "dBA," and it is the descriptor of noise levels most often used for community noise assessment. It is important to note that the dBA scale is logarithmic, meaning that each increase of 10 dBA describes a doubling of perceived loudness. For example, we perceive the background noise in an office at 50 dBA as twice as loud as in a library at 40 dBA. For most people to perceive an increase in noise, it must be at least 3 dBA. At 5 dBA, a change in noise level will be readily noticeable. FRA evaluated all noise levels in this analysis using the 24-hour day-night noise level (or Ldn) for residential receptors and the average peak hourly noise level (or Leq) for institutional and other non-residential receptors. Typical A-weighted sound levels found in our communities are shown in **Figure D.10-1**.

D.10.1.1.1 Vibration Fundamentals

Ground-borne vibration, unlike noise, typically travels along the surface of the ground and through building structures. Depending on the geological properties of the surrounding terrain and the type of building structure exposed to vibration, vibration propagation can be more or less efficient. Buildings with a solid foundation set in bedrock are "coupled" more efficiently to the surrounding ground and experience relatively higher vibration levels than buildings in sandier soil. Heavier buildings (such as masonry structures) are less susceptible to vibration than wood-frame buildings because they absorb more vibration energy.

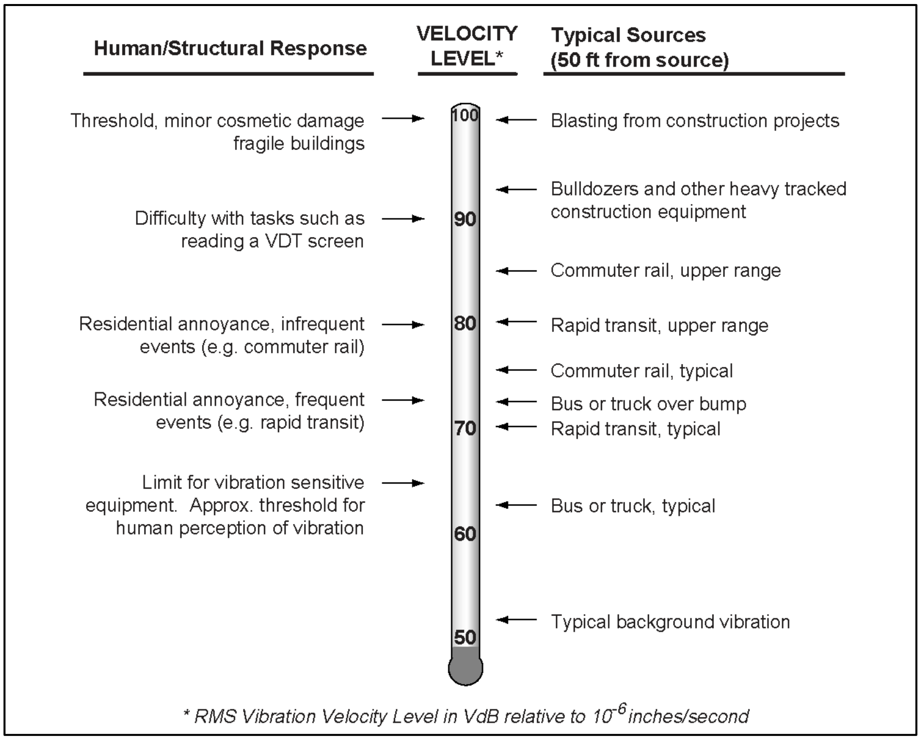
Figure D.10-1: Typical Sound Levels



Source: FTA, September 2018

The vibration velocity level is used to assess vibration impacts from all transportation and construction projects. More accurately, the human response to vibration used to assess nuisance impacts is the root mean square amplitude, expressed in inches per second (ips) or vibration velocity levels in decibels (VdB). Similar to noise decibels, vibration decibels are dimensionless and referenced to one micro-inch per second. The peak particle velocity level (or PPV) is used to assess potential damage during construction and indicates the stresses experienced by buildings rather than human annoyance. PPV is the maximum instantaneous positive or negative peak of the vibration signal. Typical ground-borne vibration levels from transit sources and construction activities are shown in **Figure D.10-2**.

Figure D.10-2: Typical Ground-Borne Vibration Levels



Source: FTA, September 2018

D.10.2 Regulatory Context and Methodology

D.10.2.1 Regulatory Context

D.10.2.1.1 Noise

FRA evaluated noise and vibration impacts from train operations using FRA's *High-Speed Ground Transportation Noise and Vibration Impact Assessment*[1] guidelines, which include all the methodologies and evaluation criteria for assessing potential impacts from Superconducting Magnetic Levitation Project (SCMAGLEV) trains. FRA assessed high-speed transit noise and vibration impacts based on land-use categories and sensitivity to noise and vibration from transit sources under FRA/FTA guidelines. As shown in **Table D.10-1**, FRA used the average hourly equivalent noise level or Leq(h) to assess impacts at highly-sensitive laboratories and research facilities (Land-Use Category 1) and at institutional receptors such as schools, libraries, museums and other non-residential sites (Land-Use Category 3). For example, only three locations within the Project Study Area were identified as Category 1 (the NASA Goddard Space Flight Center in Greenbelt, MD, the Goddard Geophysical and Astronomical Observatory in Glenn Dale, MD and the National Security Administration in Fort Meade, MD). Similarly, FRA used the average day-night noise level over a 24-hour period (or Ldn) to characterize noise exposure for residential areas (Land-Use

[1] Federal Railroad Administration, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Office of Railroad Policy and Development, DOT/FRA/ORD-12/15, Final Report, September 2012, Washington, D.C.

Category 2). The Ldn noise level includes a 10-decibel penalty for all nighttime events that occur between 10 pm and 7 am to reflect the heightened sensitivity during this period when residents are sleeping.

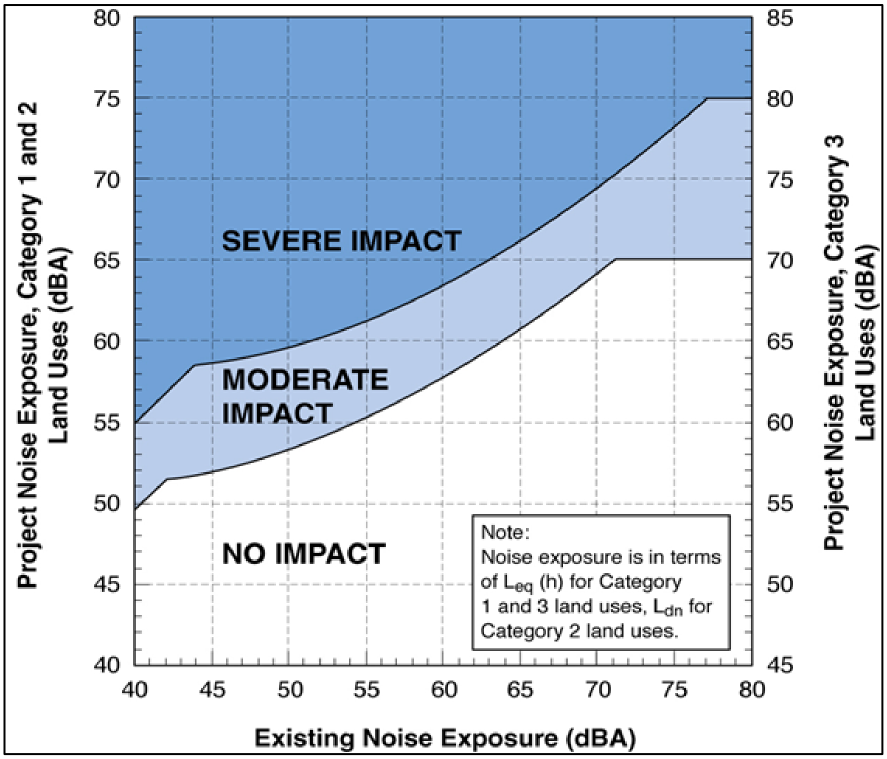
Table D.10-1: Land-Use Categories and Metrics for High-Speed Train Noise Impact Criteria

Land Use Category	Noise Metric (dBA)	Description
1	Outdoor Leq(h)[1]	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
2	Outdoor Ldn	Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor Leq(h)[1]	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, and museums can also be considered to be in this category. Certain historical sites, parks, campgrounds, and recreational facilities are also included.

Note 1: Leq for the noisiest hour of transit-related activity during hours of noise sensitivity.
Source: FTA, September 2018

As shown in **Figure D.10-3**, the FTA noise criteria delineate two categories of impact: ‘moderate’ and ‘severe’. ‘Moderate’ impact threshold defines areas where the change in noise is noticeable but may not cause a strong, adverse community reaction. ‘Severe’ impact threshold defines the noise limits above which new noise would highly annoy a significant percentage of the population.

Figure D.10-3: Noise Impact Criteria for High-Speed Rail Projects



Source: FTA, September 2018

D.10.2.1.2 Vibration

FRA defines vibration criteria in terms of human annoyance for the same land use categories as for noise. The vibration threshold of human perceptibility is approximately 65 VdB. As shown in **Table D.10-2**, FRA applied the vibration criteria for evaluating ground-borne vibration impacts from train passbys at nearby sensitive receptors. These vibration criteria are related to ground-borne vibration levels that are expected to result in human annoyance. Since human responses are most-accurately described with vibration velocity, FRA used the average velocity level (vibration decibels referenced to 1 micro-inch per second or VdB) to assess vibration impacts at the same land-use categories as for noise.

The FRA's experience with community response to ground-borne vibration indicates that when there are only a few train events per day, it would take higher vibration levels to evoke the same community response than would be expected from more frequent events. This is taken into account in the FRA criteria by distinguishing between projects with ‘frequent’, ‘occasional’, and ‘infrequent’ events, where the ‘frequent’ events category is defined as more than 70 events per day. Similarly, the ‘occasional’ events category is defined as between 30 and 70 events per day, while the ‘infrequent’ events category is defined as less than 30 events per day. Due to the proposed frequency of future train operations, FRA used the most stringent criteria attributed to ‘frequent’ events to assess vibration impacts.

For underground sections of the Build Alternatives where there is no airborne noise, ground-borne noise may be a concern due to the propagation of vibration through building structures that can manifest itself as a rumble indoors or rattling windows and dishes. Along elevated sections of the Build Alternatives, ground-borne noise is less of a concern since the airborne noise would dominate.

Table D.10-2: Ground-Borne Vibration (GBV) and Ground-Borne Noise (GBN) Impact Criteria for General Assessment

Receptor Land Use		Ground-Borne Vibration Impact Levels (VdB)			Ground-Borne Noise Impact Levels (dBA)		
Category	Description	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	Frequent Events	Occasional Events	Infrequent Events
1	Buildings where vibration would interfere with interior operations.	65[4]	65[4]	65[4]	N/A[5]	N/A[5]	N/A[5]
2	Residences and buildings where people normally sleep.	72	75	80	35	38	43
3	Institutional land uses with primarily daytime use.	75	78	83	40	43	48
Special Buildings	Concert Halls/TV Studios/ Recording Studios	65	65	65	25	25	25
	Auditoriums	72	80	80	30	38	38
	Theaters	72	80	80	35	43	43

Notes:
1. Frequent Events is defined as more than 70 vibration events of the same kind per day.
2. Occasional Events is defined as between 30 and 70 vibration events of the same kind per day.
3. Infrequent Events is defined as fewer than 30 vibration events of the same kind per day.
4. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.
5. Vibration-sensitive equipment is not sensitive to ground-borne noise.
Source: FTA, September 2018

D.10.2.1.3 Construction

FRA evaluated noise and vibration impacts during construction using FTA's *Transit Noise and Vibration Impact Assessment Manual* guidelines, which include all the methodologies and evaluation criteria for assessing potential impacts from temporary construction activities.

Noise

As shown in **Table D.10-3**, FRA used the average hourly equivalent noise level or Leq(h) to assess impacts at residences and other noise-sensitive receptors using the FTA noise criteria. Using the FTA general assessment guidelines, FRA compared the combined Leq.equip(1hr) noise levels for the two noisiest pieces of equipment for each phase of construction with the applicable criteria.

Table D.10-3: General Assessment Construction Noise Criteria

Land Use	Leq.equip(1hr), dBA	
	Day	Night
Residential	90	80
Commercial	100	100
Industrial	100	100

Source: FTA, September 2018

Vibration

Similarly, FRA used the peak particle velocity (or PPV) vibration level to assess the potential for damage at residences and other sensitive receptors using the FTA vibration criteria shown in **Table D.10-4.** FRA compared the maximum vibration level expected for each phase of construction with the applicable criteria to determine the onset and magnitude of impact. FRA used the vibration criteria shown in **Table D.10-4** to assess the potential for annoyance and interference.

Table D.10-4: Construction Vibration Damage Criteria

Building/ Structural Category	PPV in/sec	Approximate Lv [1]
I. Reinforced-concrete, steel or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Non-engineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

Note 1: RMS velocity in decibels, VdB re 1 micro-in/sec
Source: FTA, September 2018

D.10.2.2 Methodology

FRA determined noise and vibration levels from future train operations using FRA's *High-Speed Ground Transportation Noise and Vibration Impact Assessment* guidelines, which include all the methodologies for predicting levels from SCMAGLEV trains traveling at speeds up to 311 mph. Additionally, FRA evaluated noise and vibration from stations and other ancillary sources (such as fresh air and emergency egress facilities and the trainset maintenance facility) using the Federal Transit Administration's (FTA) *Transit Noise and Vibration Impact Assessment*.[2] FRA and FTA guidelines used in this analysis present the basic concepts, methods, and procedures for evaluating the extent and severity of noise and vibration impacts from transit projects.

FRA assessed project impacts at all eligible first- and second-row receptors within the 800-foot screening distance including almost 4,000 sites. Besides train headways, train speed profiles, track and ground elevation profiles, FRA used detailed mapping projected in a graphical information system to determine receptor distances for all proposed sources. FRA evaluated the following sources as part of the noise assessment: train operations including track, propulsion and aerodynamic noise, general noise at elevated passenger stations, fresh air and emergency egress facilities, trainset maintenance facilities, maintenance of way facilities and electrical power substations. The overall cumulative noise levels from the combined sources were used to assess impact. Detailed input data and modeling assumptions are outlined below.

Refer to Section 4.12 Ecological Resources for more information on impacts to wildlife.

D.10.2.2.1 Noise and Vibration Sources Evaluated

FRA evaluated project noise and vibration impacts using the FRA guidelines for the following sources:

- high-speed train operations; and,
- construction activities.

Similarly, FRA evaluated all other project impacts using the FTA guidelines for the following sources:

- passenger stations
- fresh air and emergency egress facilities (FA-EE);
- trainset maintenance facilities (TMF);
- maintenance of way facilities (MOW); and,
- electrical substations.

As shown in **Table D.10-5**, FRA conducted a detailed noise and vibration assessment of future operations for each of the 12 Build Alternatives, which include various combinations of passenger stations and ancillary facilities. All the Build Alternatives include Mount Vernon and BWI Marshall Airport Station. In addition to the two optional stations and three optional TMF sites, there are 12 different substation options.

[2] Federal Transit Administration, "Transit Noise and Vibration Impact Assessment," Office of Planning and Environment, FTA-VA-90-1003-06, May 2006, Washington, D.C.

D.10.2.2.2 Train Operations

FRA determined the average daily train operations by period of the day using the notional service plan for 2050, which include 7½ -minute headways during the peak periods and 10- to 15-minute headways during the off-peak periods.[3] (Attachment Figure A1)

Table D.10-5: Build Alternatives and Project Source Evaluation Matrix

Build Alternative	Station	TMF & MOW	Substation
J-01	Cherry Hill	MD 198	SS01
J-02	Cherry Hill	BARC Airstrip	SS02
J-03	Cherry Hill	BARC West	SS03
J-04	Camden Yards	MD 198	SS04
J-05	Camden Yards	BARC Airstrip	SS05
J-06	Camden Yards	BARC West	SS06
J1-01	Cherry Hill	MD 198	SS07
J1-02	Cherry Hill	BARC Airstrip	SS08
J1-03	Cherry Hill	BARC West	SS09
J1-04	Camden Yards	MD 198	SS10
J1-05	Camden Yards	BARC Airstrip	SS11
J1-06	Camden Yards	BARC West	SS12

Source: AECOM, 2020

- All trainset makeups consist of two end units (92' each) and 14 intermediate units (80' each).
- FRA applied maximum train speeds of 311 mph in accordance with the proposed speed profiles, which reflect acceleration (3.2 feet/sec) and deceleration near stations. (Attachment Figure A2)
- FRA utilized the default noise levels for each of the four train sub-sources including propulsion, guideway/structural and aerodynamic noise from the train nose and the turbulent boundary layer (which reflects the fluctuations in the air adjacent to the body of the train).[4]
- FRA also applied noise adjustments for train length, train speed, track elevations, ground attenuation effects and shielding effects from the 7' viaduct parapet. A typical viaduct section is shown in Attachment Figure A3.
- FRA utilized the default FRA ground-borne vibration curves for maglev trains. The default vibration curves included in the FRA guidance manual are based on

[3] Baltimore-Washington SCMAGLEV Project, Operations Plan, Revision: 2, May 6, 2020.
[4] FRA, "High-Speed", page 5-11.

measurements conducted for the former Transrapid test track in Germany.[5] By comparison, vibration measurements from the proposed SCMAGLEV system along the Yamanashi test track is approximately three times lower than the FRA estimates.[6]

- FRA also applied vibration adjustments for train speed, track elevations and ground attenuation effects that reflect a typical soil composition between sandy with low cohesion and rock or very stiff clay soil. A typical tunnel section is shown in Attachment Figure A3.

D.10.2.2.3 Stationary and Other Ancillary Sources

Since little information is available for the ancillary facilities (such as the activities proposed there), traditional activity levels were used as a surrogate. For example, the trainset maintenance facilities are expected to have most of their activities indoors including all maintenance, repair and inspection. Therefore, the FTA's railcar washing station was used to represent noise impacts from the TMF sites. Similarly, the FTA's rail yard was used to represent noise impacts from the MOW facilities. Any impacts related to the passenger stations or ancillary facilities predicted as part of this project are preliminary only and final design would address details on these activities.

- FRA modeled the proposed elevated Cherry Hill passenger station using a default FTA reference noise level of 70 dBA Lmax at 50 feet and an average dwell time of five minutes.
- FRA modeled substations using a default FTA reference noise level of 63 dBA Lmax at 50 feet, a source height of 5 feet, and 100 percent utilization from 5:00 a.m. to 11:00 p.m.
- FRA modeled the fresh air and emergency egress facilities using an estimated noise level of 62 dBA Lmax at 50 feet, a source height of 30 feet, and 100 percent utilization from 5:00 a.m. to 11:00 p.m.
- FRA modeled the trainset maintenance facilities using a default FTA reference noise level for train washing of 75 dBA Lmax at 50 feet, a source height of 8 feet, and duration time of 15 minutes for each of six trains serviced between 11:00 p.m. and 5:00 a.m.
- FRA modeled the maintenance of way facilities using a default FTA reference noise level for traditional "yard and shops" of 82 dBA Lmax at 50 feet for each of six trains serviced between 11:00 p.m. and 5:00 a.m.
- FRA did not evaluate any other noise sources from the proposed project such as track switches since their effects are negligible. Potential impacts due to startle effects at tunnel portals will be mitigated with proposed design features such as flared portals and extended noise-mitigation hoods.

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[5] FRA, "High-Speed", page 8-3.
[6] Aerodynamic noise from vehicles on the Yamanashi Maglev Test Line", Journal of Acoustical Society of America, 1999.

- There are no train horns or other warning devices (such as grade crossing bells) proposed as part of the project because the track is proposed along a dedicated guideway.

D.10.2.2.4 Construction

FRA assessed Construction noise using the prediction methods outlined in the FTA's guidance manual. The FTA references include maximum noise emission levels (Lmax) and equipment usage factors, which are then used to predict average hourly noise levels (Leq1h) at a given distance. During the preliminary phase of the project, FRA utilized the FTA 'General Assessment' guidelines to estimate the potential for impact. The General Assessment includes selecting only two of the loudest equipment and applying a 100 percent utilization or usage factor over a one-hour period. FRA added both noise sources for each stage of construction logarithmically and compared them to the applicable noise standards outlined above.

- FRA evaluated the following prototypical construction scenarios:
  - Tunnel – tunnel boring and excavation
  - Viaduct – viaduct construction
  - Stations – passenger station excavation and construction
  - FA/EE – fresh air and emergency egress facility excavation and construction
  - TMF – trainset maintenance facilities construction
  - MOW – maintenance of way facilities construction
  - Substations – electrical power substations construction
  - Laydown – Staging or laydown areas at tunnel portals
- The estimated equipment inventory for each construction scenario is shown in Attachment Figure A4.
- The default noise and vibration emission reference levels for each equipment type are also shown in Attachment Figure A4.
- No adjustments were applied for acoustically 'soft' ground (i.e., assume only 'hard' ground).
- FRA assessed all noise and vibration impacts at the exterior façade of the selected receptor locations. Building transmission losses were not applied as interior noise levels would be considerably lower.

D.10.3 Affected Environment

The Affected Environment contains a wide variety of land use types, ranging from wide-open rural areas to dense urban communities. As such, the existing noise exposures within the Project Study Area also ranges from quiet background along forested/agricultural open spaces (Beltsville Agricultural Research Center [BARC] and Patuxent Research Refuge [PRR]) to louder backgrounds in the downtown areas. Local noise conditions reflect the major land use types that they are in and their proximity to existing transportation corridors.

D.10.3.1 Noise

FRA completed a noise-monitoring program evaluating existing background noise levels within the Affected Environment at 20 representative locations within an 800-foot screening distance surrounding the Build Alternatives. As shown in **Figure D.10-4**, FRA measured noise levels between October 2018 and March 2019 over a 24-hour period at each site in accordance with FRA guidelines to determine the average ambient conditions on a typical weekday. Overall, the measured noise levels provide an overview of current conditions in communities along the project alignment.

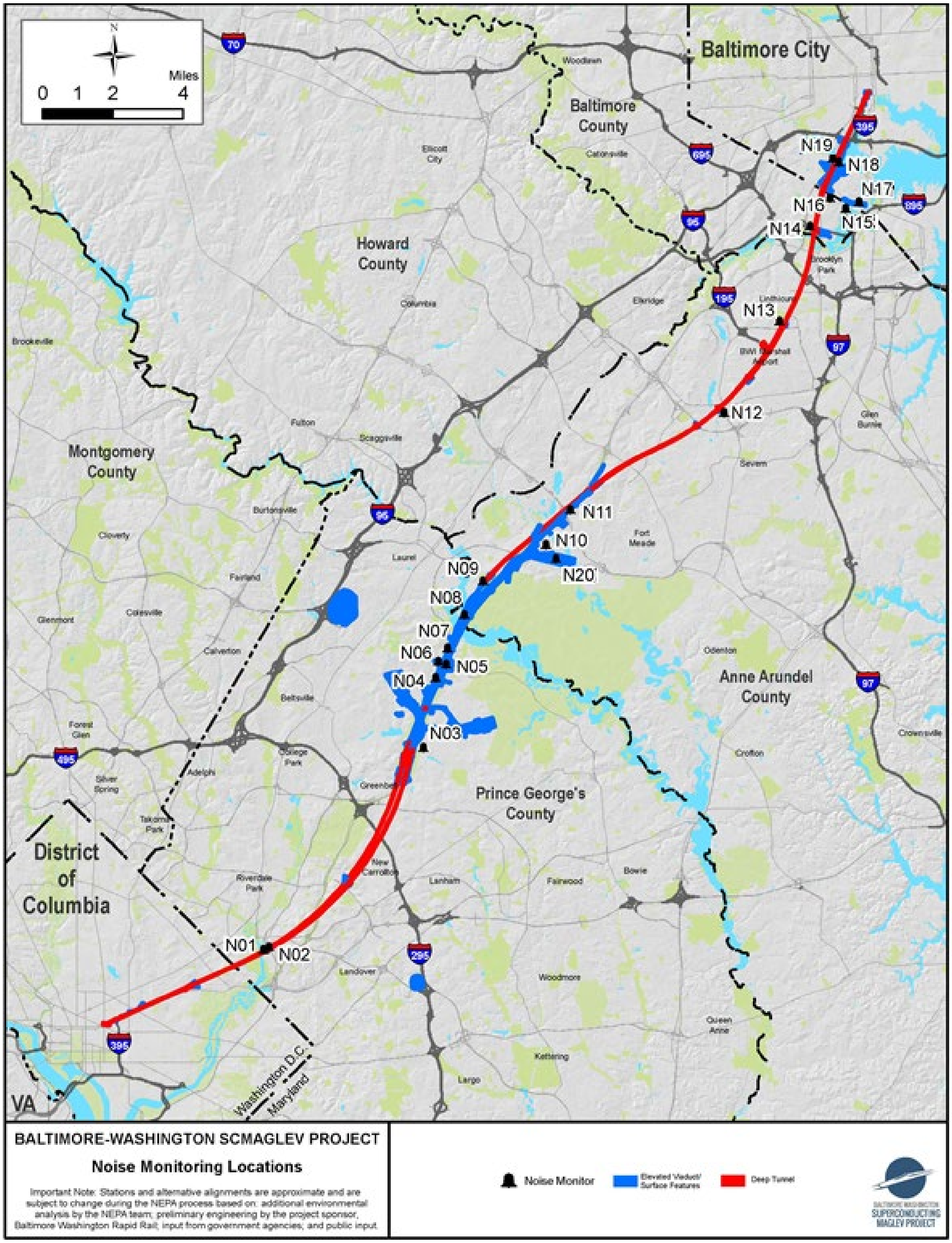
As shown **Table D.10-6**, measured day-night noise levels (or Ldn) for residences and other FRA Category 2 land-uses range from 55 dBA in Laurel, MD to 75 dBA in Linthicum Heights, MD. The observed noise levels reflect the range of land-uses in the project area including rural, suburban and urban communities.

Table D.10-6: Baseline Noise Monitoring Results

Receptor		Land-use	Noise Level (dBA)	
ID	Description	Category	Ldn	Leq(h)
N01	Anacostia River Trail	3	74	74
N02	M-NCPPC wooded property on Kenilworth Ave	3	65	63
N03	Norman A. Berg National Plant Materials Center	3	58	56
N04	MDOT property, Elmshorn Wy	2	63	61
N05	MDOT property, MD 195 Ramp	2	71	68
N06	Muirkirk Park (M-NCPPC)	2	64	60
N07	MDOT property, I-295 NB Ramp	2	67	63
N08	Maryland City Park	3	64	61
N09	Brock Ridge Elementary School	3	55	53
N10	8400 River Rd	3	62	60
N11	NSA National Cryptologic Museum	3	66	62
N12	MDOT property, Telegraph Rd	2	74	73
N13	Lindale Middle School, Flighttime Dr	3	60	60
N14	MDOT property, I-895 SB	2	75	72
N15	Southwest Area Park	3	66	64
N16	Unger's Field	2	62	56
N17	Cherry Hill Park	2	67	66
N18	Middle Branch Trail	3	68	63
N19	Waterview Ave	2	68	65
N20	Woodland Job Corps Center	3	58	57

Source: AECOM, October 2020

Figure D.10-4: Baseline Noise Monitoring Sites



Source: AECOM, 2020

D.10.3.2 Vibration

In lieu of existing vibration measurements, FRA estimates the existing background vibration to range from 50 VdB or lower in rural areas to 65 VdB near roadways. The background vibration velocity level of 50 VdB in residential areas or rural areas is well below the threshold of perception for humans of around 65 VdB. Within Buildings, operation of mechanical equipment, movement of people, or slamming of doors causes most perceptible indoor vibration. Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled trains and traffic on rough roads.

D.10.4 Environmental Consequences

D.10.4.1 No Build Alternative

D.10.4.1.1 Noise

Future noise levels for the No Build Alternative would be similar to existing conditions. Noise from a mix of transportation sources including the NEC and other passenger and freight rail traffic lines, aircraft overflights and motor vehicle traffic along regional and local roadways affects communities along the SCMAGLEV Project. Additionally, other commercial and industrial activities associated with urban and suburban communities also contribute to the ambient noise levels. Implementation of other planned and funded transportation projects could also affect the ambient noise. However, unless the planned projects are in the immediate vicinity, existing noise is unlikely to change. As a result, the No Build Alternative would not contribute to new noise impacts.

D.10.4.1.2 Vibration

FRA expects the vibration levels under the No Build Alternative to be similar to those currently experienced under existing conditions. Traffic, including heavy trucks and buses, rarely create perceptible vibration unless vehicles are operating very close to buildings or there are irregularities in the road, such as potholes or expansion joints. Similarly, the dominant source of vibration at receptors adjacent to existing rail corridors is existing rail service. FRA does not expect this to change significantly from the existing conditions. As a result, the No Build Alternative would not contribute to new vibration impacts.

D.10.4.2 Build Alternatives

D.10.4.2.1 Principal Conclusions and Impacts

FRA conducted a detailed noise and vibration assessment of future operations for each of the 12 proposed Build Alternatives. As shown in **Table D.10-7** and described in the following subsections, FRA predicted noise impacts at residences and institutional receptors along the proposed Build Alternatives. Along tunnel sections, FRA did not predict any airborne or community noise impacts since all train operations would be underground. Therefore, all predicted operational train noise impacts occur along the viaduct sections of the alignment due to the exposure of the train passbys along the elevated guideway. High train speeds generate operational impacts due to aerodynamic noise effects created by the air turbulence of a rapid train passby. Additionally, FRA also predicted noise impacts at residences adjacent to the proposed ancillary facilities, which include trainset maintenance facilities, fan plants, maintenance of way facilities and substations. FRA did not predict any noise impacts due to startle effects at tunnel portals since the portal design includes noise mitigation hoods to eliminate these effects. Overall, the FRA predicted fairly consistent corridor-wide noise impacts between the various Build Alternatives with only minor differences due to length of the viaduct section, the path of the guideway and the selection of the various ancillary facilities. The following subsections provide further details on the predicted noise impacts.

Table D.10-7: Corridor wide Impact Counts for Noise and Vibration[1]

Build	Noise					Vibration	
Alternative	Category 2[2]	Category 3[2]	'moderate' Totals[3]	'severe' Totals	Total	Vibration	GB-Noise
J-01	187 / 377	17 / 14	205	392	597	359	485
J-02	186 / 378	17 / 14	204	393	597	359	485
J-03	190 / 377	17 / 14	208	392	600	359	485
J-04	162 / 373	16 / 14	179	388	567	359	485
J-05	161 / 374	16 / 14	178	389	567	359	485
J-06	165 / 373	16 / 14	182	388	570	359	485
J1-01	195 / 96	7 / 9	203	105	308	340	564
J1-02	194 / 97	7 / 9	202	106	308	340	564
J1-03	198 / 96	7 / 9	206	105	311	340	564
J1-04	170 / 92	6 / 9	177	101	278	340	564
J1-05	169 / 93	6 / 9	176	102	278	340	564
J1-06	173 / 92	6 / 9	180	101	281	340	564

Note 1: Impact counts were tabulated for high-sensitivity receptors (FRA Category 1 land-uses), residential receptors (FRA Category 2 land-uses) and institutional receptors (FRA Category 3 land-uses).
Note 2: Category 2 and 3 results include both 'moderate' / 'severe' noise impacts.
Note 3: FRA also predicted one 'moderate' noise impact and one 'severe' noise impact at Category 1 land uses (Goddard GGAO and NSA Headquarters, respectively) for all Build Alternatives J-01 to J-06. FRA also predicted one 'moderate' noise impact at the NSA Headquarters for Build Alternatives J1-01 to J1-06.
Note 4: FRA predicted one vibration impact at the National Cryptology Museum (Category 3) in Fort Meade for all Build Alternatives.
Source: AECOM, October 2020

Similarly, FRA also predicted vibration impacts at residences and one institutional receptor (the National Cryptologic Museum adjacent to the National Security Agency in Fort Meade, MD). As shown in **Table D.10-7**, FRA predicted vibration impacts from train operations along both tunnel and viaduct sections of the guideway. FRA did not predict any vibration impacts from the ancillary facilities (including the trainset maintenance facilities) due to the low activity levels there.

FRA also predicted ground-borne noise impacts along tunnels sections only. Ground-borne noise or the rumbling sound from vibrating building surfaces is an indoor effect that is much lower than airborne noise. It is not a concern along viaduct sections where airborne noise dominates. Overall, the FRA predicted similar vibration impacts between the various Build Alternatives with only minor differences due to the path of the guideway.

D.10.4.2.2 Noise

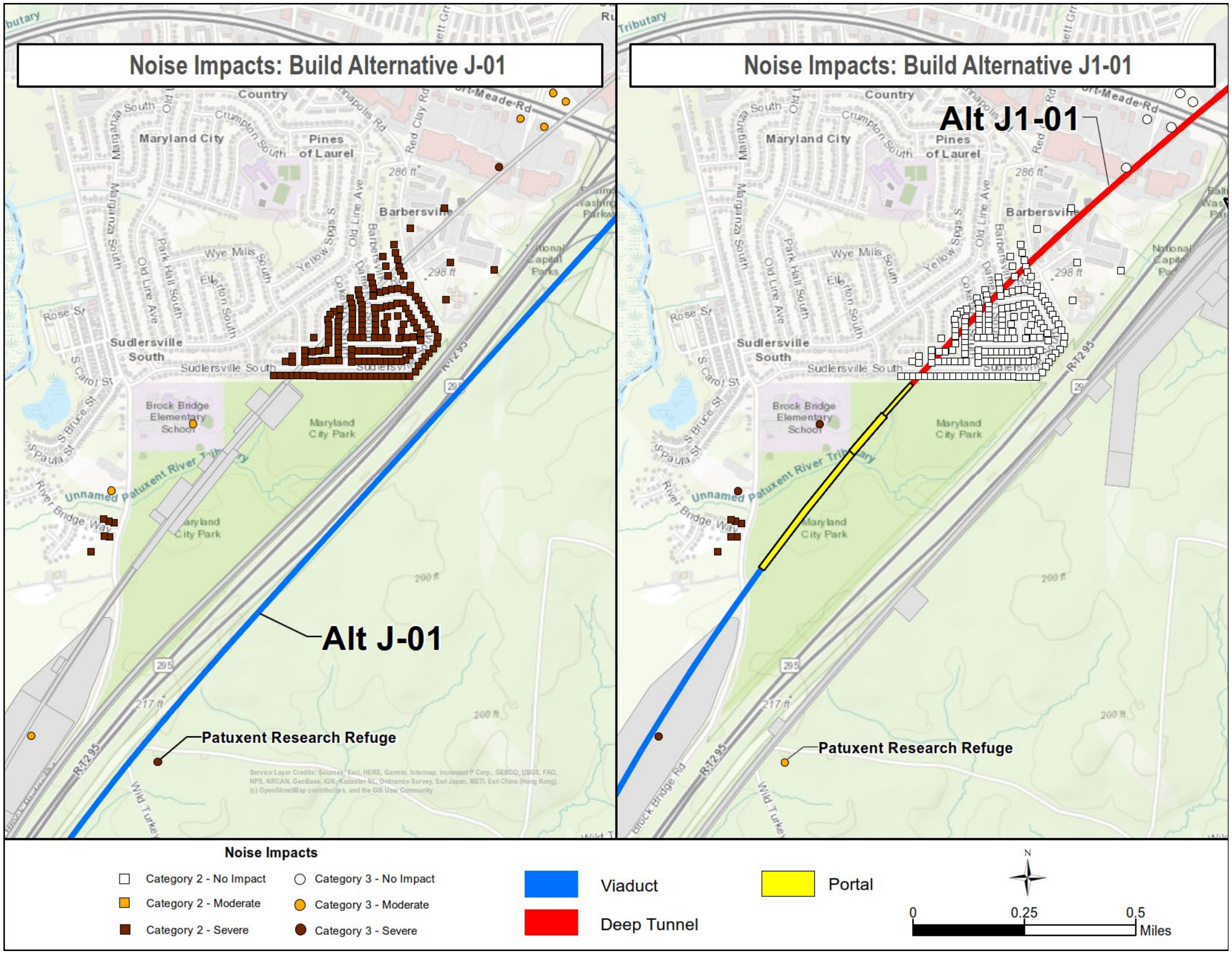
The primary noise source for the SCMAGLEV system at the maximum train speeds is the air turbulence effects (or turbulent boundary layer) caused by the air wash over the body of the train. At these maximum train speeds, the aerodynamic noise effects along the viaduct are orders of magnitude higher than the noise from the train propulsion system or the structural guideway (i.e., viaduct). This is due in part to the shielding effects of the proposed viaduct structure, which includes 7' side walls or parapets. The elevated parapets shield the propulsion and nose cone noise but not the structural noise or the turbulent boundary layer, which is 10' above the track. Due to the effects of the aerodynamic noise effects, FRA predicted no noise impacts at speeds below 150 mph.

For example, along the viaduct sections of the guideway utilizing proposed maximum train speeds, FRA predicted airborne noise impacts up to 2,100' from the guideway. This impact distance is due to a combination of the aerodynamic effects of high-speed train operations, the elevated guideway and the low background noise level.[7] To highlight the difference in noise impacts between viaduct and tunnel sections, **Figure D.10-5** shows a comparison between Build Alternatives J-01 and J1-01 in Maryland City near a tunnel portal. As a reminder, one set of receptors was used for all Build Alternatives, due to the similar nature of the alignments. FRA predicted 'severe' noise impacts at residences in Maryland City from the viaduct under Build Alternatives J-01 but no impacts from the tunnel under Build Alternatives J1-01. The severity of impact changes between each of the Build Alternatives depending on proximity to the guideway. At the Brock Bridge Elementary School, for example, the predicted level increases from 'moderate' noise impact under Build Alternatives J-01 to 'severe' noise impact under Build Alternatives J1-01 because it would be closer.

A unique phenomenon occurs at the tunnel portals when the high-speed trains exit the tunnel onto the viaduct. The rapid release of air pressure is associated with a sudden onset of sound that can cause residents startle or surprise especially when they are not expecting it. Current project designs include flared tunnel openings and noise mitigation hoods to minimize these effects. Therefore, these noise effects are minimized compared to the aerodynamic noise effects of the train passby.

[7] The FRA impact criteria are based on a sliding scale whereby low background noise level result in more stringent thresholds.

Figure D.10-5: Viaduct vs. Tunnel Noise Impacts



Source: AECOM, October 2020

As shown in **Table D.10-7**, noise impacts were categorized into ‘moderate’ and ‘severe’ impact levels. Although both impact categories require mitigation consideration, it is the ‘severe’ category that has the greatest adverse impact in the community and would warrant incorporation of mitigation. The number of ‘severe’ noise impacts predicted for each Build Alternative generally follows the viaduct section due to the preponderance of the aerodynamic noise effects. In other words, the longer the viaduct section is for each Build Alternative, the higher the number of predicted ‘severe’ noise impacts.

For example, FRA predicted 597 noise impacts for Build Alternatives J-01 but only 567 noise impacts for Build Alternatives J-04. This reduction of 5 percent is due primarily to the 8 percent reduction in the viaduct’s length between these Build Alternatives. Similarly, FRA predicted 308 noise impacts for Build Alternatives J1-01 or 48 percent less than Build Alternatives J-01. This reduction is due primarily to the 40 percent reduction in the viaduct’s length between these Build Alternatives. This trend applies to the other Build Alternatives as well.

As an example of the range of impacts, Appendix B.2 shows a complete display of all corridor wide noise impacts predicted for Build Alternatives J-01.

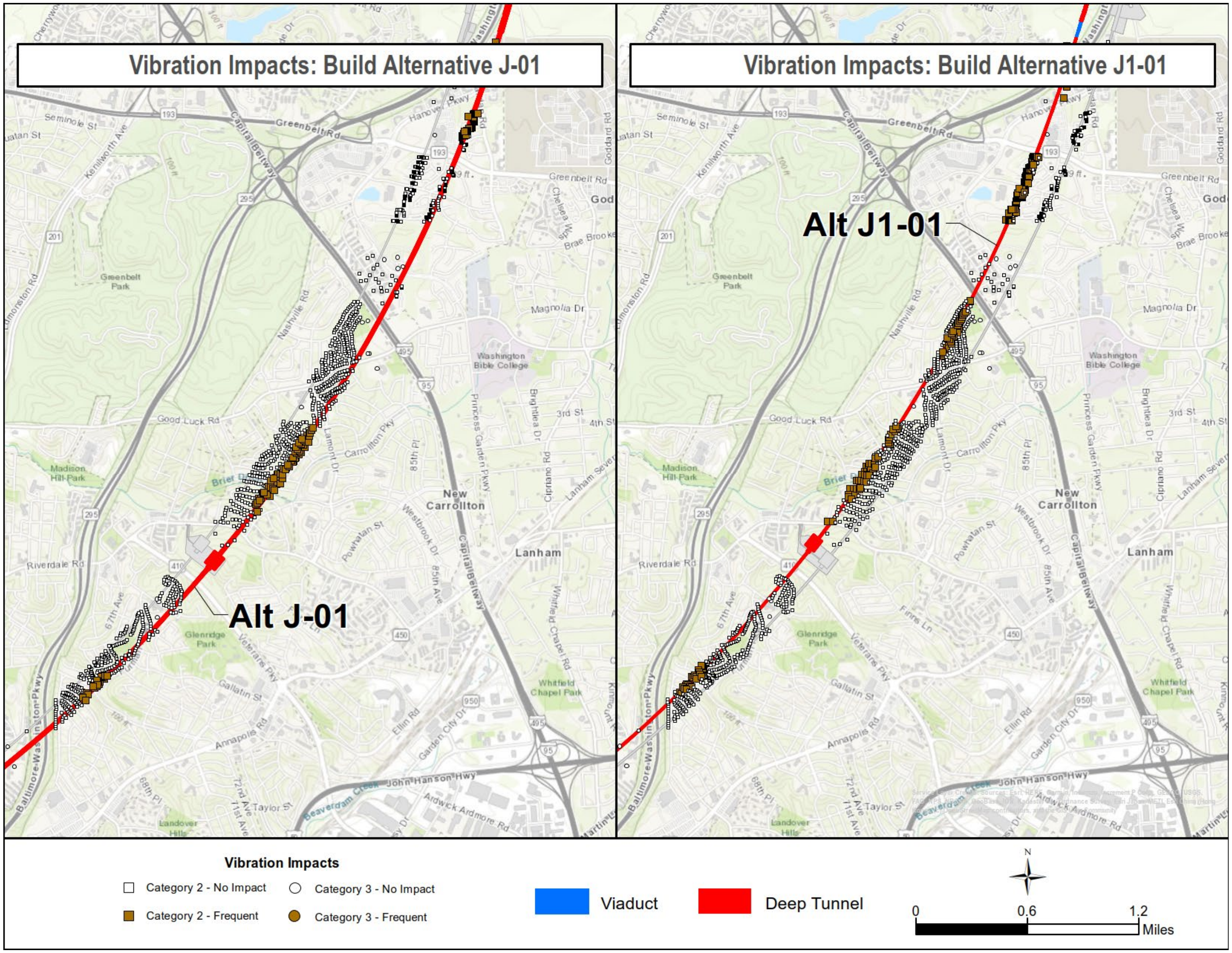
D.10.4.2.3 Ground-borne Vibration and Ground-borne Noise Effects

Most ground-borne vibration impacts are along tunnels sections of the alignment; with minor exceptions where receptors are within 150’ of the viaduct. Overall, FRA predicted vibration impacts up to 225’ from the guideway. Similarly, FRA predicted ground-borne noise impacts up to 250’ from the guideway. Additionally, all ground-borne vibration and noise impacts occur at maximum train speeds of 311 mph. No predicted impacts occur at speeds below 311 mph. Due to the unique nature of the SCMAGLEV technology, slow-moving trains utilize auxiliary wheels while entering stations and within the trainset maintenance facility. As a result, all vibration impacts are due to train operations along the guideway with no impacts due to ancillary facilities.

As shown in **Table D.10-7**, FRA predicted 359 vibration impacts for Build Alternatives J-01 to J-06 but only 340 impacts for Build Alternatives J1-01 to J1-06. This reduction of 5 percent does not match the 15 percent increase in tunnel sections between these alternatives. However, as shown in **Figure D.10-6**, FRA predicted lower vibration due to deeper tunneling under Build Alternatives J1-01 to J1-06 (particularly in New Carrolton south of the Capital Beltway) compared to Build Alternatives J-01 to J-06. As a reminder, one set of receptors was used for all Build Alternatives, due to the similar nature of the alignments

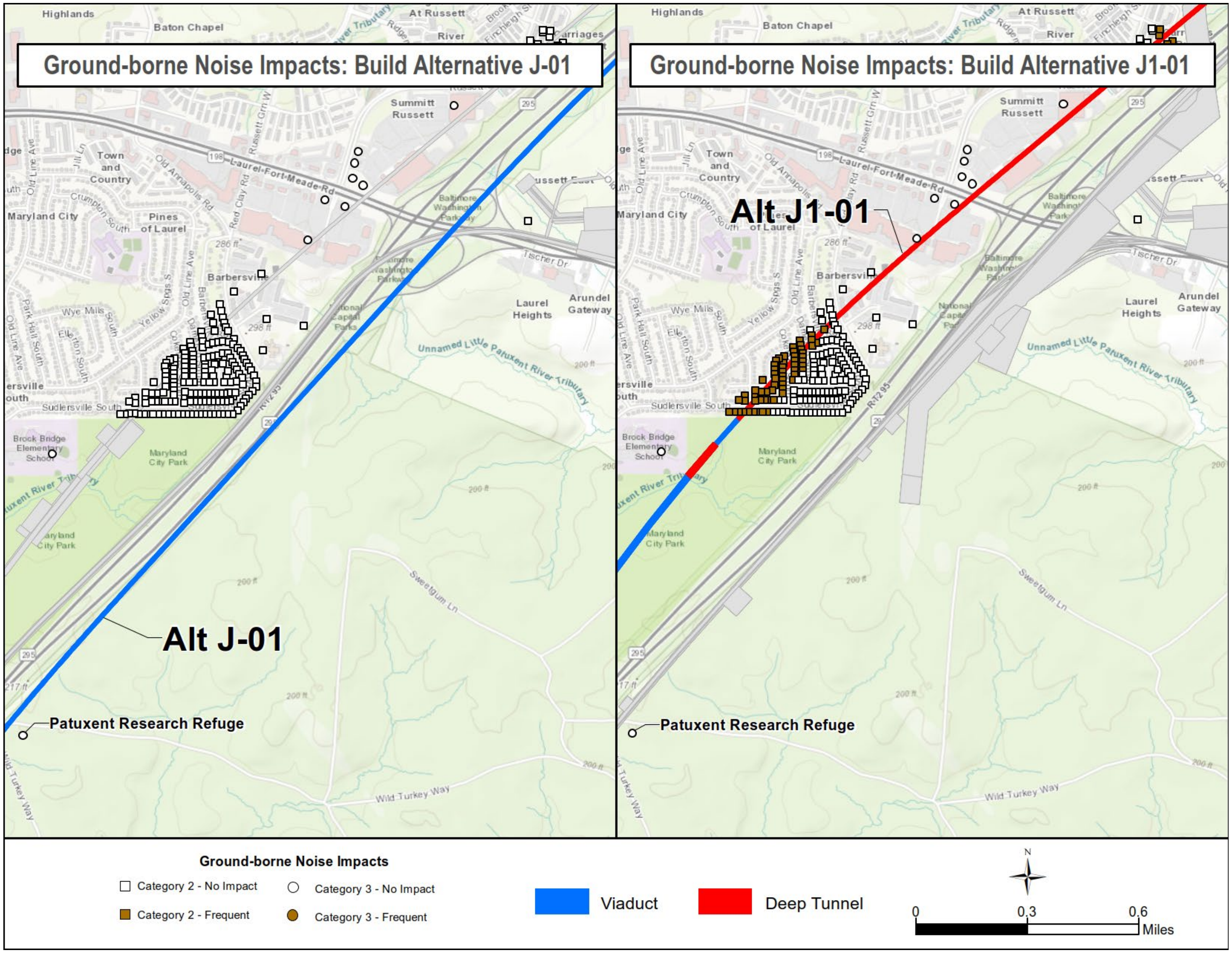
Similarly, FRA predicted 485 ground-borne noise impacts along tunnel sections for Build Alternatives J-01 to J-06 and 564 impacts for Build Alternatives J1-01 to J1-06. This increase of 16 percent reflects a 15 percent increase in tunnel sections and a 17 percent increase in the number of residences within 250’ of Build Alternatives J1-01 to J1-06. **Figure D.10-7** shows this change graphically.

Figure D.10-6: Comparison of Vibration Impacts



Source: AECOM, October 2020

Figure D.10-7: Comparison of Ground-borne Noise Impacts



Source: AECOM, October 2020

As an example of the range of impacts, Appendix B.2 shows a complete display of all corridor wide vibration impacts predicted for Build Alternatives J-01.

D.10.4.3 Short-term Construction Effects

D.10.4.3.1 Noise

Due to the size of the project and the facilities proposed for construction, temporary noise impacts are expected. To maintain the balance between constructing such a large project and quality of life for nearby communities, contractors utilize construction techniques and incorporate control measures to eliminate or minimize noise impacts. Project federal, State and local guidelines determine the appropriate control measures. The following is a preliminary estimation of the types of noise effects expected during the construction phase of the project.

FRA predicts that maximum one-hour construction noise levels would range from below the ambient background (less than 45 dBA) to 85 dBA for FA-EE facilities to 91 dBA for the staging/laydown area at tunnel portals to 94 dBA for the viaduct construction to 96 dBA for the station excavation activities. Since construction could occur day or night depending on the activity and urgency to complete, FRA predicts that several of these levels would exceed the daytime limit of 90 dBA and the nighttime limit of 80 dBA. Construction noise levels vary by activity type and location for each of the Build Alternatives. For example, for Build Alternatives J-01, J-02, J-03, J1-01, J1-02, and J1 03, FRA predicted four daytime noise impacts and 21 nighttime noise impacts. For Build Alternatives J-04, J-05, J-06, J1-04, J1-05, and J1-06, FRA predicted four daytime noise impacts and 20 nighttime noise impacts.

In summary, there are no predicted noise impacts from the tunnel boring machine as all activities would be underground. However, the removal of spoils from the TBM launch areas (which typically occur continuously 24/7 during this phase) could cause impacts at residences in the Maryland City and Fort Meade communities. Localized noise impacts are also expected from station and FA-EE excavation as these will require deep boring, pile driving and possibly blasting.

D.10.4.3.2 Vibration

FRA predicted maximum construction vibration levels that range from 0.012 in/sec PPV for FA/EE facilities excavation up to 0.121 in/sec for viaduct construction. Based on this preliminary assessment of potential vibration damage, FRA predicted no exceedances of FRA Category I damage threshold (0.5 in/sec for typical timber structures) or the Category II damage threshold (0.5 in/sec for masonry buildings) for any of the Build Alternatives.

Similar to the noise, there are no predicted vibration impacts from the tunnel boring machine along the proposed alignment due to the deep depth of the tunnels. However, the removal of spoils from the TBM launch areas (which typically occur continuously 24/7 during this phase) could cause impacts at residences in the Maryland City and Fort

Meade communities. Localized vibration impacts are also expected from station and FA/EE excavation as these will require deep boring, pile driving and possibly blasting.

D.10.5 Potential Mitigation Strategies

Noise and vibration impacts from both temporary construction activities and long-term operations exceeds the FRA criteria at several receptors in the project study area. As a result, FRA investigated several preliminary control measures to eliminate potential impacts or at least to minimize their severity.

D.10.5.1 Long-term Operations

Mitigation strategies include the application of design features to minimize or eliminate potential noise and vibration impacts at residential communities within the SCMAGLEV Project Affected Environment. Features such as taller parapet walls could minimize noise impacts along viaduct sections but would not eliminate them. Similarly, concrete-lined tunnels and concrete viaducts would reduce vibration transmission but not eliminate them. Additional mitigation measures would be required to reduce noise and vibration impacts. The following proposed noise and vibration-reducing design features would minimize and potentially eliminate all noise and vibration impacts.

- Track design features
  - Sound attenuation hood or shroud to eliminate noise impacts predicted along elevated or at-grade sections of track by extending the hoods near portals to cover longer sections of track along residential communities (See Section 4.21 Construction, and Chapter 3 Alternatives Considered).
  - Similar to underground tunnel sections, noise hoods or shrouds would enclose the noise from SCMAGLEV operations, thereby eliminating any escaping noise to the nearby communities.

- Tunnel portal design features
  - Aerodynamic design of the nose of the SCMAGLEV trainset to minimize portal startle effects.
  - Eliminating all gaps between railcars.
  - Flared tunnel portals similar to trumpets.
  - Elongated portals.
  - Perforated portal hoods to reduce aerodynamic effects there.
  - Constructing air shafts along the tunnel to relieve the micro-pressure waves
  - Adopting larger tunnel cross-sections
  - Installing specially designed noise mitigation hoods.
  - Creating elevated “tunnels” with enclosed track to eliminate portals all together.

- Augmented Parapet Walls (Refer to Chapter 3 Alternatives Considered and Appendix G for design details)
  - Increasing the parapet height from seven to over 15 feet would eliminate ‘severe’ impacts predicted at residences along the SCMAGLEV Project.
- Sound Attenuation Walls
  - Noise barriers (like those constructed by the Maryland Department of Transportation State Highway Administration (MDOT SHA)) are an effective method to eliminate or reduce noise impacts along residential communities with large clusters of homes.
  - Ground-level noise barriers at the property lines are most effective when there are no openings or gaps that allow sound to pass through.
  - The Final Design phase of the SCMAGLEV Project would determine proper sizing and location.
- Vibration control measures for the SCMAGLEV Project would require further research and investigation to find a suitable solution. Based on the limited information available on the use of maglev or SCMAGLEV train service around the world, experience with source-specific vibration control measures is very limited. Applying first-order principles and experience gained from using successful control measures for other concrete-constructed systems has resulted in successful mitigation of vibration impacts. Typical vibration mitigation would include resilient control such as:
  - Resilient track beds and resiliently supported viaducts would de-couple the track structure from the surrounding support system and thereby ‘break’ the vibration path between the track and the nearby vibration-sensitive receptors. These resilient materials and devices (typically used for buildings in earthquake zones) are those that can recoil or “spring-back” into shape after being compressed. These can come in many forms, including support pads, springs or other resilient material suitable for the structures proposed on this SCMAGLEV Project.
  - Similar to floating slabs for conventional track systems, a resiliently supported track bed that accommodates the SCMAGLEV electrical and magnetic propulsion and guidance systems would reduce the impact energy caused by the high-speed SCMAGLEV train passing by.
- At FA-EE Facilities, silencers and acoustical louvers are standard control measures typically used to eliminate noise impacts related to tunnel ventilation fans. Attenuator design would reduce low-frequency fan noise traveling along ventilation ducts. Attenuators include perforated metals with sound absorbing materials inside. FA/EE silencers are used in either supply or exhaust capacities.

- Acoustical louvers, which are architectural elements that allow air intake and exhaust flows to buildings, are also used to provide supplemental noise reduction. They include perforated metal panels with sound absorbing materials inside the louver panels. Final Design phase of the SCMAGLEV Project would determine proper sizing and location.
- Due to the sheer size and location of substations, investigation and design of equipment enclosures and acoustical louvers would eliminate noise impacts by isolating the noise inside the building or enclosure. Final Design phase of the SCMAGLEV Project would determine proper sizing of louvers and enclosure wall heights.
- At TMF and MOW facilities, equipment enclosures, perimeter noise barriers and relocating loud maintenance activities indoors are all typical measures used to eliminate noise impacts related to guideway maintenance facilities. Final Design of the SCMAGLEV Project would determine proper sizing and design of enclosure wall heights.

D.10.5.2 Short-term Construction

Unlike long-term operations, temporary construction mitigation would minimize nuisance, disruptions and potential damage during peak activity periods. For example, to minimize potential noise and vibration impacts at residences near staging, laydown and tunnel boring machine (TBM) launch sites, close coordination is required between the selected contractor and the affected properties. The Project Sponsor would require its contractors to implement appropriate noise and vibration control measures that would minimize impacts and extended disruption of normal activities.

In addition, the following may be implemented:

- At staging and laydown sites such as the TBM launch sites, consider installing acoustical curtains or other temporary noise shields to perimeter fencing to act as a temporary noise barrier.
- Strategic placement of containers or other barriers along the perimeter of staging areas would shield nearby residences from construction activities within the laydown area.
- Substituting impulsive equipment such as pile drivers and hoe rams with augers and vibratory pile drivers whenever possible.
- For continuous stationary equipment such as cranes, generators or pumps, enclose or shroud this equipment with temporary or semi-permanent barriers or acoustical enclosures.
- Acoustical curtains or other limp mass barriers hung so as to shield nearby noise-sensitive receivers from the loudest equipment or activities.

- In general, utilize equipment enclosures or shrouds for all exposed stationary equipment while other solutions (such as portable acoustical curtains hung from cranes) may be more practical for mobile sources.
- All equipment should include properly tuned exhaust mufflers or attenuators that comply with the local and municipal noise ordinances.
- Vibration impacts minimized by substituting impact devices with less vibratory equipment such as augers versus pile drivers.
- Additionally, utilize regional roadways rather than local streets for excavation of spoils and new deliveries to further minimize the construction impacts (i.e., noise, vibration, air quality, visual, traffic, etc.) on the nearby community.

Depending on the contractor's approach and equipment selection, the aforementioned control measures will significantly eliminate or reduce all noise and vibration impacts.

D.10.6 Attachments: Support Information

- Table A1: Notional Service Plan for the Year 2050
- Figure A2: Train Speed Profiles
- Figure A3: Typical Track Sections
- Table A4: Construction Equipment Inventory for Noise and Vibration
- Table A5: Predicted Operational Noise Levels at Discrete Receptors for Build Alternatives J & J1 (in dBA)
- Table A6: Predicted Operational Vibration Levels at Discrete Receptors for Build Alternatives J & J1 (in VdB)
- Figure A7: Corridor wide Noise Impacts for Build Alternatives J-01
- Figure A8: Corridor wide Vibration Impacts for Build Alternatives J-01

Table A1: Notional Service Plan for the Year 2050

Hour	Baltimore to Washington	Washington to Baltimore
0500 - 0600	4	4
0600 - 0700	6	6
0700 - 0800	8	8
0800 - 0900	8	8
0900 - 1000	8	8
1000 - 1100	6	6
1100 - 1200	4	4
1200 - 1300	4	4
1300 - 1400	4	4

Hour	Baltimore to Washington	Washington to Baltimore
1400 - 1500	4	4
1500 - 1600	6	6
1600 - 1700	8	8
1700 - 1800	8	8
1800 - 1900	8	8
1900 - 2000	6	6
2000 - 2100	4	4
2100 - 2200	4	4
2200 - 2300	4	4
2300 - 0500 Maintenance Window	0	0

Source: Baltimore-Washington SCMAGLEV Project, Operations Plan, Revision: 2, May 6, 2020.

Figure A2-1: Train Speed Profile for Washington - BWI - Cherry Hill

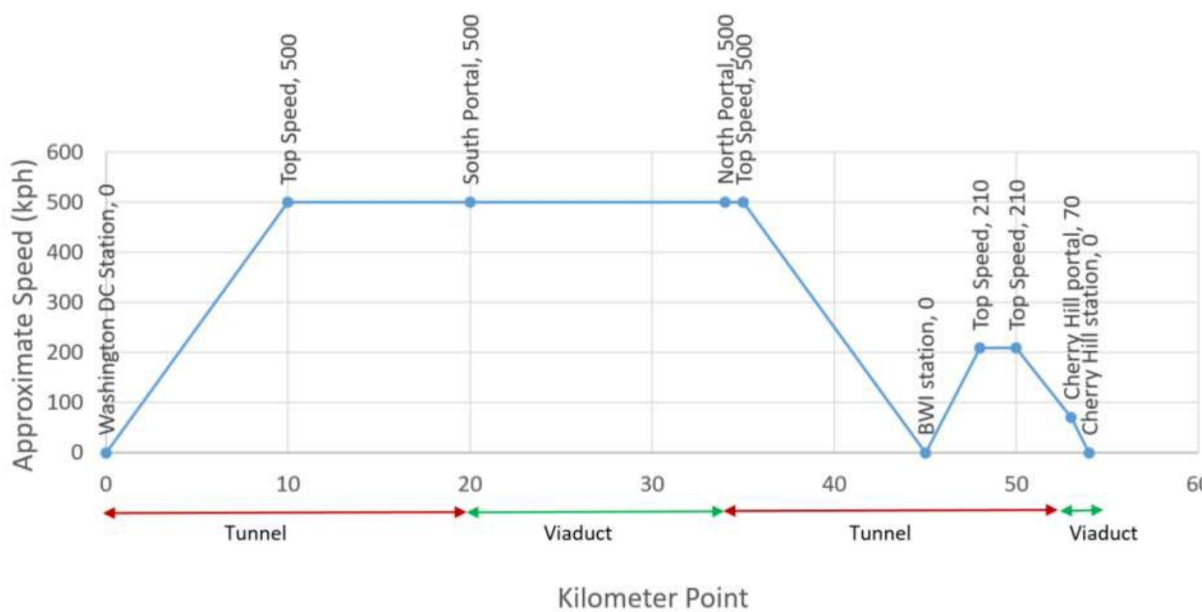
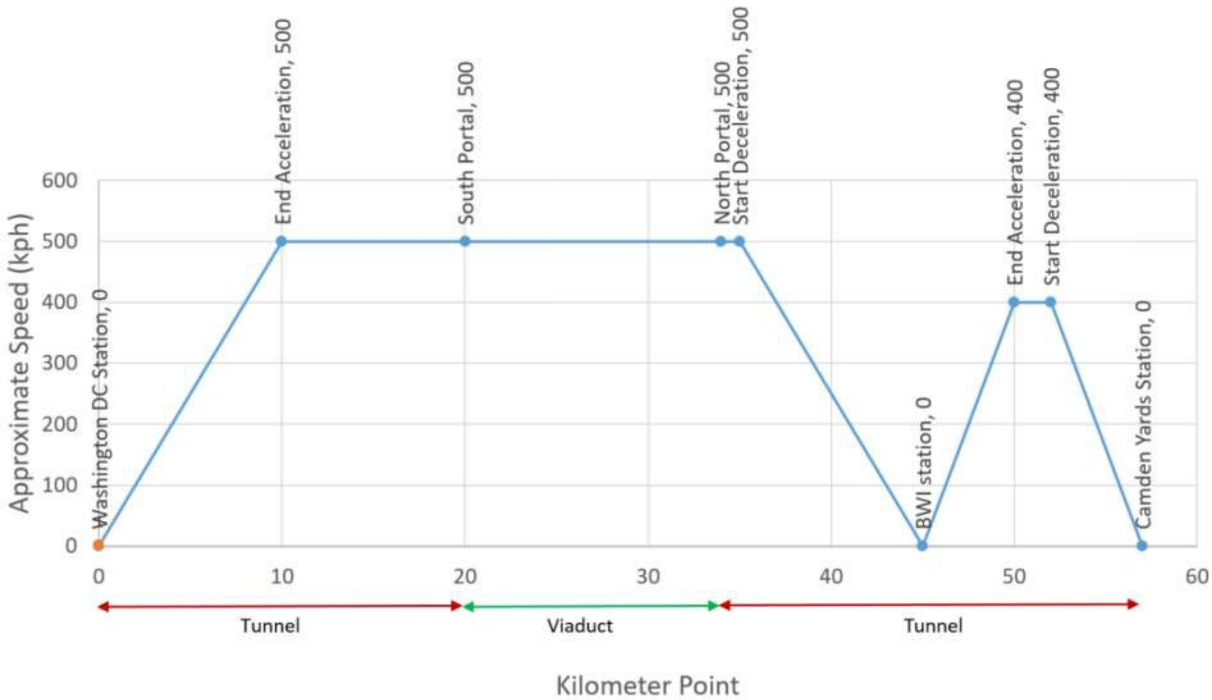
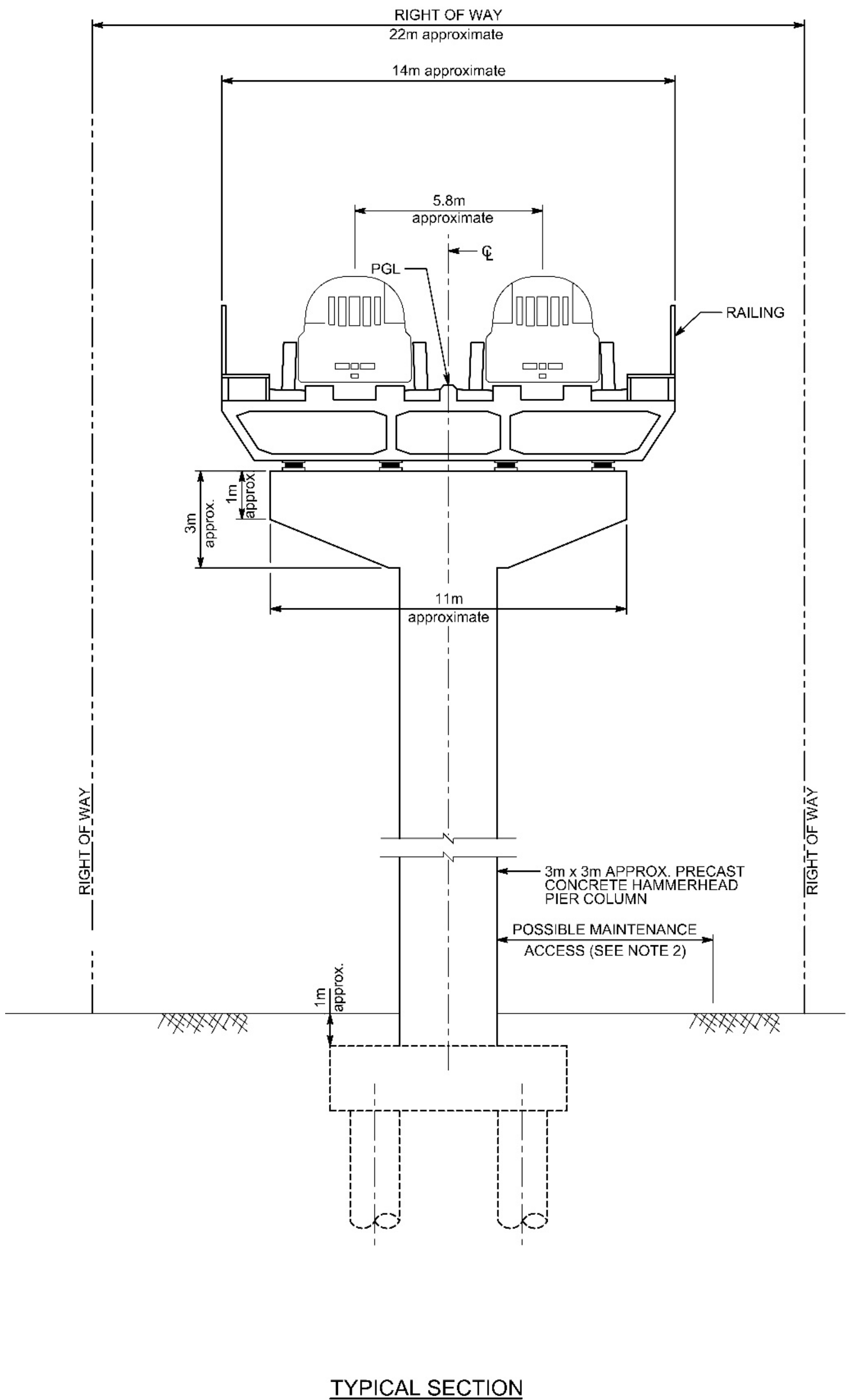


Figure A2-2: Train Speed Profile for Washington - BWI - Camden Yards



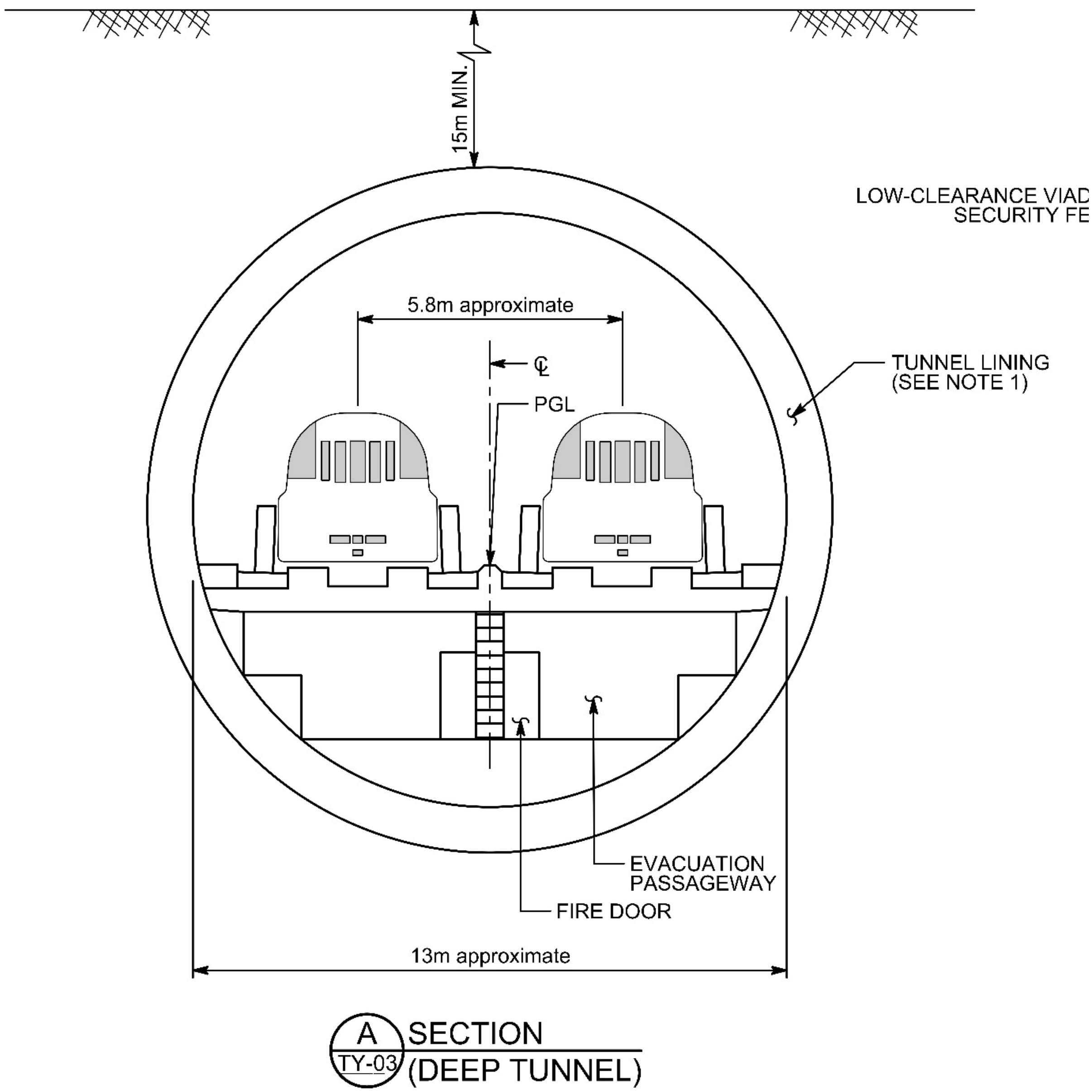
Source: Baltimore-Washington SCMAGLEV Project, Train Speed Profiles, Revision: 2, May 6, 2020.

Figure A3-1: Typical Viaduct Section



Source: Structural Typical Sections_20200610.pdf

Figure A3-2: Typical Deep Tunnel Section



Source: Structural Typical Sections_20200610.pdf

Table A4-1: Construction Equipment Inventory for Noise

Construction Equipment	Typical Noise[1]	Construction Scenarios							
		Tunnel	Viaduct	Stations	FA/EE	TMF	MOW	Substations	Laydown
Air Compressor	80								
Backhoe	80								
Ballast Equalizer	82								
Ballast Tamper	83								
Compactor	82								
Concrete Mixer	85								
Concrete Pump	82								
Concrete Vibrator	76								
Crane, Derrick	88		1						
Crane, Mobile	83							1	
Dozer	85		1			1	1	1	
Generator	82								1
Grader	85					1	1		
Impact Wrench	85								
Jack Hammer	88			1	1				
Loader	80								
Paver	85								
Pile Driver (Impact)	101								
Pile Driver (Vibratory)	95								
Pneumatic Tool	85								
Pump	77								
Rail Saw	90								

Construction Equipment	Typical Noise[1]	Construction Scenarios							
		Tunnel	Viaduct	Stations	FA/EE	TMF	MOW	Substations	Laydown
Rock Drill	85			1	1				
Roller	85								
Saw	76								
Scarifier	83								
Scraper	85								
Shovel	82								
Spike Driver	77								
Tie Cutter	84								
Tie Handler	80								
Tie Inserter	85								
Truck	84								1
TBM, large	30	1							

Note 1: Typical default FTA construction noise levels are reported in A-weighted decibels (dBA) at 50’ from the source.
Source: AECOM, October 2020

Table A4-2: Construction Equipment Inventory for Vibration

Construction Equipment	Reference		Construction Scenarios							
	PPV[1]	RMS[2]	Tunnel	Viaduct	Stations	FA/EE	TMF	MOW	Substations	Laydown
Pile driver (impact), Upper	1.518	112								
Pile driver (impact), Typical	0.644	104								
Pile driver (vibratory), Upper	0.734	105								
Pile driver (vibratory), Typical	0.170	93		1						
Clam shovel drop (slurry wall)	0.202	94								
Hydromill (slurry wall), soil	0.008	66	1		1	1				
Hydromill (slurry wall), rock	0.017	75								
Vibratory roller	0.210	94								
Hoe ram	0.089	87								
Large bulldozer	0.089	87					1	1		
Caisson drilling	0.089	87		1	1	1				
Loaded trucks	0.076	86					1	1	1	1
Jackhammer	0.035	79								
Small bulldozer	0.003	58							1	1
TBM, large	0.543	103	1							

Note 1: Typical default FTA construction PPV vibration velocity levels are reported in inches per second at 25’ from the source.
Note 2: Typical default FTA construction RMS vibration velocity levels are reported in vibration decibels (or VdB) re: 1 micro-in/sec at 25’ from the source.
Source: AECOM, October 2020

Tables A5-1: Predicted Operational Noise Levels at Discrete Receptors for Build Alternatives J (in dBA)

Receptor		Existing Condition	Build Alternative							
ID	Description		J-01	J-02	J-03	J-04	J-05	J-06	MOD	SEV
1	Anacostia River Trail	74	54	54	54	54	54	54	70	77
2	M-NCPPC wooded property on Kenilworth Ave	63	49	49	49	49	49	49	65	70
3	Norman A. Berg National Plant Materials Center	56	67	67	67	67	67	67	61	67
4	MDOT property, Elmshorn Wy	63	74	72	72	74	72	72	60	65
5	MDOT property, MD 195 Ramp	71	83	83	83	83	83	83	65	70
6	Muirkirk Park (M-NCPPC)	64	69	69	69	69	69	69	60	66
7	MDOT property, I-295 NB Ramp	67	71	71	71	71	71	71	62	68
8	Maryland City Park	61	69	69	69	69	69	69	63	69
9	Brock Ridge Elementary School	53	65	65	65	65	65	65	59	66
10	8400 River Rd	60	67	67	67	67	67	67	63	68
11	NSA National Cryptologic Museum	62	70	70	70	70	70	70	64	70
12	MDOT property, Telegraph Rd	74	61	61	61	61	61	61	65	72
13	Lindale Middle School, Flighttime Dr	60	46	46	46	46	46	46	63	68
14	MDOT property, I-895 SB	75	64	64	64	64	64	64	65	73
15	Southwest Area Park	64	36	36	36	36	36	36	65	71
16	Unger's Field	62	62	62	62	62	62	62	59	65
17	Cherry Hill Park	67	54	54	54	54	54	54	62	68
18	Middle Branch Trail	63	66	66	66	35	35	35	65	70
19	Waterview Ave	68	65	65	65	58	58	58	63	68
20	Woodland Job Corps Center	57	63	63	63	63	63	63	61	67

Source: AECOM, December 2020

Tables A5-2: Predicted Operational Noise Levels at Discrete Receptors for Build Alternatives J1 (in dBA)

Receptor		Existing Condition	Build Alternative							
ID	Description		J1-01	J1-02	J1-03	J1-04	J1-05	J1-06	MOD	SEV
1	Anacostia River Trail	74	54	54	54	54	54	54	70	77
2	M-NCPPC wooded property on Kenilworth Ave	63	49	49	49	49	49	49	65	70
3	Norman A. Berg National Plant Materials Center	56	26	31	30	26	31	30	61	67
4	MDOT property, Elmshorn Wy	63	78	78	78	78	78	78	60	65
5	MDOT property, MD 195 Ramp	71	72	72	72	72	72	72	65	70
6	Muirkirk Park (M-NCPPC)	64	71	71	71	71	71	71	60	66
7	MDOT property, I-295 NB Ramp	67	75	75	75	75	75	75	62	68
8	Maryland City Park	61	72	72	72	72	72	72	63	69
9	Brock Ridge Elementary School	53	72	72	72	72	72	72	59	66
10	8400 River Rd	60	41	30	30	41	30	30	63	68
11	NSA National Cryptologic Museum	62	36	36	36	36	36	36	64	70
12	MDOT property, Telegraph Rd	74	61	61	61	61	61	61	65	72
13	Lindale Middle School, Flighttime Dr	60	46	46	46	46	46	46	63	68
14	MDOT property, I-895 SB	75	64	64	64	64	64	64	65	73
15	Southwest Area Park	64	36	36	36	36	36	36	65	71
16	Unger's Field	62	62	62	62	62	62	62	59	65
17	Cherry Hill Park	67	54	54	54	54	54	54	62	68
18	Middle Branch Trail	63	66	66	66	35	35	35	65	70
19	Waterview Ave	68	65	65	65	58	58	58	63	68
20	Woodland Job Corps Center	57	45	30	30	45	30	30	61	67

Source: AECOM, October 2020

Tables A6-1: Predicted Operational Vibration Levels at Discrete Receptors for Build Alternatives J (in VdB)

Receptor		Build Alternative				Impact Criteria	
		Vibration		GB-Noise			
ID	Description	01,02,03	04,05,06	01,02,03	04,05,06	VdB	dBA
1	Anacostia River Trail	56	56	21	21	75	40
2	M-NCPPC wooded property on Kenilworth Ave	57	57	22	22	75	40
3	Norman A. Berg National Plant Materials Center	55	55	20	20	75	40
4	MDOT property, Elmshorn Wy	59	59	24	24	72	35
5	MDOT property, MD 195 Ramp	80	80	45	45	72	35
6	Muirkirk Park (M-NCPPC)	55	55	20	20	72	35
7	MDOT property, I-295 NB Ramp	57	57	22	22	72	35
8	Maryland City Park	56	56	21	21	75	40
9	Brock Ridge Elementary School	55	55	20	20	75	40
10	8400 River Rd	55	55	20	20	75	40
11	NSA National Cryptologic Museum	55	55	20	20	75	40
12	MDOT property, Telegraph Rd	79	79	44	44	75	40
13	Lindale Middle School, Flighttime Dr	33	33	0	0	72	35
14	MDOT property, I-895 SB	27	30	0	0	75	40
15	Southwest Area Park	35	47	0	12	72	35
16	Unger's Field	30	44	0	9	72	35
17	Cherry Hill Park	30	44	0	9	75	40
18	Middle Branch Trail	28	40	0	5	72	35
19	Waterview Ave	27	47	0	12	75	40
20	Woodland Job Corps Center	26	44	0	9	72	35

Source: AECOM, October 2020

Table A6-2: Predicted Operational Vibration Levels at Discrete Receptors for Build Alternatives J1 (in VdB)

Receptor		Build Alternative				Impact Criteria	
		Vibration		GB-Noise			
ID	Description	01,02,03	04,05,06	01,02,03	04,05,06	VdB	dBA
1	Anacostia River Trail	61	61	26	26	75	40
2	M-NCPPC wooded property on Kenilworth Ave	62	62	27	27	75	40
3	Norman A. Berg National Plant Materials Center	55	55	20	20	75	40
4	MDOT property, Elmshorn Wy	73	73	38	38	72	35
5	MDOT property, MD 195 Ramp	60	60	25	25	72	35
6	Muirkirk Park (M-NCPPC)	58	58	23	23	72	35
7	MDOT property, I-295 NB Ramp	67	67	32	32	72	35
8	Maryland City Park	73	73	38	38	75	40
9	Brock Ridge Elementary School	62	62	27	27	75	40
10	8400 River Rd	55	55	20	20	75	40
11	NSA National Cryptologic Museum	55	55	20	20	75	40
12	MDOT property, Telegraph Rd	63	63	28	28	75	40
13	Lindale Middle School, Flighttime Dr	33	33	0	0	72	35
14	MDOT property, I-895 SB	27	30	0	0	75	40
15	Southwest Area Park	35	47	0	12	72	35
16	Unger's Field	30	44	0	9	72	35
17	Cherry Hill Park	30	44	0	9	75	40
18	Middle Branch Trail	25	40	0	5	72	35
19	Waterview Ave	27	47	0	12	75	40
20	Woodland Job Corps Center	26	44	0	9	72	35

Source: AECOM, October 2020