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MARYLAND DEPARTMENT OF TRANSPORTATION

BALTIMORE-WASHINGTON
SUPERCONDUCTING MAGLEV PROJECT

Final
Alternatives Report

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Chapter 1. Introduction

A. Project Description and Background

The Federal Railroad Administration (FRA), in coordination with the Maryland Department of Transportation (MDOT), is preparing an Environmental Impact Statement (EIS) for the proposed Baltimore-Washington Superconducting Magnetic Levitation (SCMAGLEV) Project (the Project[1]) between Baltimore, Maryland and Washington, DC with an intermediate stop at the Baltimore/Washington International Thurgood Marshall Airport (BWI Marshall Airport). The proposed SCMAGLEV passenger train system would provide an approximately 15-minute trip service between newly constructed independent stations, potentially with intermodal connections. SCMAGLEV trains would run on a dedicated guideway with bi-directional service, utilize an automatic train control system, and have no at-grade crossings. Implementation of the SCMAGLEV system would also include construction of power substations, vent plants, one rolling stock depot (RSD), and other maintenance and/or ancillary facilities.

Congress has expressed its intent in the Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), as amended, that funding for this Project be used to construct and operate a safe, revenue-producing, high-speed ground transportation system.[2] In March 2015, FRA issued a Notice of Funding Availability (NOFA) to solicit applications for construction of high-speed rail. In April 2015, acting on behalf of the project sponsor, Baltimore Washington Rapid Rail (BWRR), MDOT submitted an application to FRA for the SAFETEA-LU funds to perform preliminary engineering (PE) and National Environmental Policy Act (NEPA) work related to BWRR's SCMAGLEV proposal.

In November 2015, the Maryland Public Service Commission approved BWRR's application to acquire a passenger railroad franchise to deploy a SCMAGLEV system between Baltimore and Washington, DC. BWRR, a private corporation, is the Project sponsor and developer of the proposed SCMAGLEV service that would be capable of 311 mph (500 km/h) operating speed. In 2016, FRA awarded a $27.8 million Maglev grant to MDOT for PE and to complete a NEPA study of the SCMAGLEV Project. BWRR will provide a 20 percent match contribution for the NEPA study and PE work.

On November 25, 2016, FRA and MDOT initiated the formal NEPA process and issued a Notice of Intent (NOI) in the Federal Register to prepare an EIS. FRA and MDOT held public and agency scoping meetings in December 2016. Project team members were available to gather input and feedback from members of the public and elected officials on the draft Purpose and Need statement; goals and objectives; scope for potential alternatives for consideration; issues to be addressed in the environmental review; and methodologies to be used to evaluate impacts. FRA and MDOT published the Scoping Report in May 2017 and the Purpose and Need document in October 2017. The project website (http://bwmaglev.info) includes both documents, along with the NOI and the other public meeting materials to date.

1 For purposes of this study, magnetic levitation (maglev) is defined as an advanced transportation technology in which magnetic forces lift, propel, and guide a vehicle over a specially designed guideway. This study proposes to implement superconducting maglev (SCMAGLEV) technology, which differs from other maglev systems (such as the German Transrapid system) in that SCMAGLEV accelerates and decelerates through an electromagnetic force generated between superconducting magnets on the vehicle and reaction coils on the guideway sidewalls. The superconducting magnetism is much stronger than ordinary normal conducting electromagnets. Additionally, SCMAGLEV uses inductive magnetic reactions with no active control and rides in a U-shaped guideway; whereas, the German Transrapid system uses attractive reactions that need active controls and rides in a T-shaped guideway.

2 Notice of Funding Availability and Solicitation of Applications for Magnetic Levitation Projects. Federal Register 80, no. 54 (March 20, 2015): 15053-15057 (hereafter referred to as NOFA), Section 3.2, Project Eligibility. BWRR's "Response to the NOFA", dated April 17, 2015, states "The Project involves the Baltimore, Maryland – Washington, DC segment of the New York, NY – Washington, DC federally designated high-speed ground transportation corridor."

In February 2017, FRA initiated a screening process of preliminary alternatives that consisted of two rounds of public informational meetings via open houses to present initial alternatives and to highlight the findings of the preliminary alternatives screening analysis. MDOT and FRA held open houses for both initial alternatives and preliminary alternatives screening results in April 2017 and October 2017 respectively, and included informal discussions between project team members and meeting attendees at multiple locations throughout the study area. Chapter 5 provides more information on agency and public involvement. The October 2017 public meetings also included a formal presentation from FRA. The first phase of the screening process evaluated 14 potential build alignments and concluded with the advancement of two in the Preliminary Alternatives Screening Report (PASR), published January 2018 on the project website.

In February 2018, FRA initiated further study on the two build alternatives recommended from the PASR, which is the subject of this Alternatives Report.

B. NEPA Requirements for Alternatives Development

The Council on Environmental Quality (CEQ) regulations (40 CFR Part 1500 et seq.), Section 1502.14(a), requires the lead agency to “rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for” eliminating them.

CEQ’s Forty Questions, Question 2a, states that in “determining the scope of alternatives to be considered, the emphasis is on what is ‘reasonable’ rather than on whether the proponent or applicant likes or is itself capable of carrying out a particular alternative. Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant.”

CEQ’s Forty Questions, Question 2b, elaborates to say “an alternative that is outside the legal jurisdiction of the lead agency must still be analyzed in the EIS if it is reasonable. A potential conflict with local or federal law does not necessarily render an alternative unreasonable, although such conflicts must be considered.” Question 2b also states “alternatives that are outside the scope of what Congress has approved or funded must still be evaluated in the EIS if they are reasonable, because the EIS may serve as the basis for modifying the Congressional approval or funding in light of NEPA's goals and policies.” The contents of this report will serve as further documentation of the alternatives development process for compliance with NEPA.

FRA considered other laws, regulations and Executive Orders during the evaluation of alternatives (e.g., Endangered Species Act, Executive Order 11988 – Floodplain Management, as amended; Section 4(f) of the U.S. DOT Act; Section 106 of the National Historic Preservation Act; and Section 404 of the Clean Water Act) for their influence on the Project’s development and evaluation of alternatives. Subsequently, FRA coordinated the development of the Purpose and Need and alternatives with other Federal agencies that have jurisdiction under those laws (23 U.S.C. § 139(d)(8)).

At the conclusion of the alternatives development process FRA will include a discussion of alternatives in the EIS in accordance with Section 102(2)(E) of NEPA (42 U.S.C. §4332(2)(E)) and 40 CFR 1508.9(b).

C. Purpose of this Report

The purpose of this Alternatives Report is to document the continuing alternatives development, refinement and environmental evaluation of two potential build alternatives along the Baltimore-Washington Parkway (BWP): Alternatives J (BWP East) and J1 (BWP West). The report will also determine if build alternatives are reasonable and feasible for further evaluation in the Draft Environmental Impact Statement (DEIS). This Alternatives Report concludes with a recommendation of alternatives to advance for more detailed study in the DEIS.

The primary purpose of the January 2018 Preliminary Alternatives Screening Report (PASR)[3] was to determine the most technically and environmentally feasible alignments (referred to as preliminary alternatives). Alternatives studied in the PASR lay primarily within corridors associated with the Baltimore-Washington Parkway (BWP), Amtrak's Northeast Corridor (NEC), and the Washington, Baltimore and Annapolis Trail (WB&A) corridor. The PASR described the two-level screening process of a wide range of preliminary alternatives, documented the initial desktop level analysis of their physical and environmental impacts, and concluded with the recommendation of Alternatives J and J1 for further study. However, it contained limited information on SCMAGLEV's passenger stations and required ancillary facilities. The PASR included a high-level consideration of station zones and potential sites for a rolling stock depot (RSD). The PASR did not quantify potential impacts resulting from station or RSD construction with the understanding that these impacts would be studied further and documented in this Alternatives Report.

This report documents the advancement of the alternatives development process and includes an analysis of refined Alternatives J and J1, including footprints of SCMAGLEV ancillary facilities. FRA and MDOT conducted a second desktop level environmental evaluation utilizing readily available data from various sources to quantify impacts along refined alignments and SCMAGLEV ancillary facilities within the Limits of Disturbance (LOD). Ancillary facilities include potential station and RSD sites, power substations, vent plants, and potential tunnel boring machine (TBM) launch sites.

FRA will continue to provide opportunities for agency comments on the alternatives to be considered during the environmental review process (23 U.S.C. § 139(f)(4)). In addition, further review and comment on alternatives will occur during the public circulation of this document.

3 The PASR is available for download on the project website http://www.bwmaglev.info/.

Chapter 2. Purpose and Need

A. Why SCMAGLEV?

The purpose of the SCMAGLEV Project is to evaluate, and ultimately construct and operate a safe, revenue-producing, high-speed ground transportation system that achieves the optimum operating speed of the SCMAGLEV technology to significantly reduce travel time in order to help meet the capacity and ridership needs of the Baltimore-Washington region. To achieve the operational and safety metrics needed for a SCMAGLEV system, the Project must include:

- Infrastructure, vehicles, and operating procedures required for the SCMAGLEV system.
- An alignment which allows the highest practical speed that can be attained by SCMAGLEV technology at a given location and which avoids the need for reduction in speed other than that imposed by the normal acceleration and braking curves into and out of passenger stations.
- A system that complies with federal safety requirements.
- Avoidance, minimization, and mitigation of impacts to the human and natural environment.

The objectives of the SCMAGLEV project are to:

- Improve redundancy and mobility options for transportation between the metropolitan areas of Baltimore and Washington, DC.
- Provide connectivity to existing transportation modes in the region (e.g., heavy rail, light rail, bus, air).
- Provide a complementary alternative to future rail expansion opportunities on adjacent corridors.
- Support local and regional economic growth.

The project is needed to address the following issues and challenges: increasing population and employment; growing demands on the existing transportation network; inadequate capacity of the existing transportation network; increasing travel times; decreasing mobility; and to maintain economic viability in the Baltimore-Washington region. The Baltimore-Washington region is one of the largest and densest population centers in the United States. Over the next 25 years, the population in the region is projected to increase by approximately 20 percent with employment workforce increasing approximately 25 percent.[4] Similarly, the number of visitors to the region is also projected to increase with tourism serving as a significant economic driver in both the City of Baltimore and Washington, DC. As the population, workforce, and tourism continue to grow, the demand on the transportation infrastructure between Baltimore and Washington, DC will continue to increase along major roadways and railways, including I-95, the Baltimore-Washington Parkway, MD 295, US 29, US 1, and the NEC.

The conditions above translate into the need to evaluate and implement an improved mobility option of travel between the Baltimore and Washington, DC metropolitan areas utilizing SCMAGLEV technology that achieves optimal operating speed and minimizes impacts to the human and natural environment.[5]

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4 The 2015 to 2040 population and employment forecasts are based on the Baltimore Metropolitan Council (BMC) Round 8A Forecast and Metropolitan Washington Council of Governments (COG) Round 9.0 Cooperative Forecasts.

5 The full Purpose and Need Report is available on the project website (http://www.bwmaglev.info).

B. Guidance for Alternatives Development

The Purpose and Need guided FRA's decision-making relating to the Project. FRA applied criteria during the preliminary alternatives screening process that consisted of a fatal flaw analysis to identify alignments that meet the geometric requirements necessary to achieve and maintain the highest practical operating speed of the SCMAGLEV technology. FRA also identified potential station zones where it would be feasible to locate a station using intermodal connectivity (opportunity for passengers to utilize multiple options/modes of transportation during a single trip) criteria during preliminary screening. FRA analyzed preliminary alignments with respect to human factors, natural areas and wildlife, and constructability factors and concluded with two build alternatives continuing for further study in this Alternatives Report.

The alternatives development will progress by seeking opportunities to further refine alternatives to avoid, minimize, and mitigate impacts to the human and natural environments while achieving optimum operational efficiencies.

Chapter 3. Alternatives Development

A. Screening Process

Overview of the Two Level Screening Process

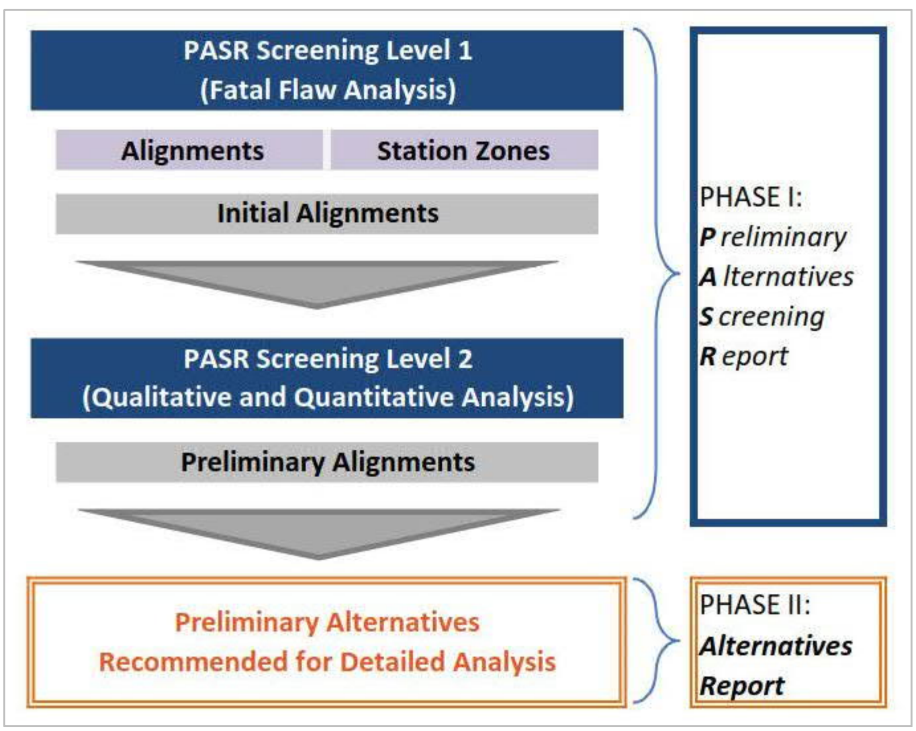
The January 2018 PASR documented the screening methodology and results for the first phase (Phase 1) of the alternatives development process of the SCMAGLEV Project. FRA and MDOT identified a broad range of alignments by examining previous magnetic levitation (maglev) studies conducted in the Baltimore-Washington region, considering agency and public input from outreach conducted to date, and coordinating with BWRR.

During Phase I, FRA and MDOT performed the screening of preliminary alignments utilizing a two-level process:

- Screening Level 1 included the screening of the 14 initial alignments and 10 station zones using a fatal flaw analysis.
- Screening Level 2 included the preliminary impact evaluation of the retained alignments from Screening Level 1, using a quantitative and qualitative analysis that yielded the alignments to be studied in this Alternatives Report (Phase II).

Figure 1 illustrates the Alternatives Development Process conducted by FRA and MDOT.

Figure 1: SCMAGLEV Alternatives Development Process



B. Recap of Phase I: Preliminary Alternatives Screening Analysis

This section provides a summary of the January 2018 PASR highlighting FRA and MDOT's evaluation of the initial alignments and station zones during Phase I to determine the preliminary alternatives for further study.

Initial Alignments and Station Zones

Screening Level 1 began with FRA, MDOT and BWRR identifying 14 initial build alignments (Alignments A, B, C, D, E, E1, F, G, G1, H, I, I1, J, and J1) and 10 station zones (five in Baltimore: Harbor East, Inner Harbor, Port Covington, Westport-Cherry Hill, Penn Station; one at BWI Marshall Airport, and; four in Washington, DC: Washington Union Station, NoMa-Gallaudet, Farragut Square, and Mount Vernon Square). All alignments included a connection with the BWI Marshall Airport. FRA and MDOT considered reasonable alignments that are practical or feasible from the technical, environmental, and constructability standpoint. Adverse environmental impacts of reasonable alignments can potentially be avoided or mitigated in the DEIS.

A No Build Alternative is required pursuant to CEQ regulations for implementing NEPA (40 CFR 1502.14). FRA and MDOT will utilize the No Build Alternative to serve as a baseline for comparing the feasibility, profitability, impact evaluation, and other such factors in the DEIS.

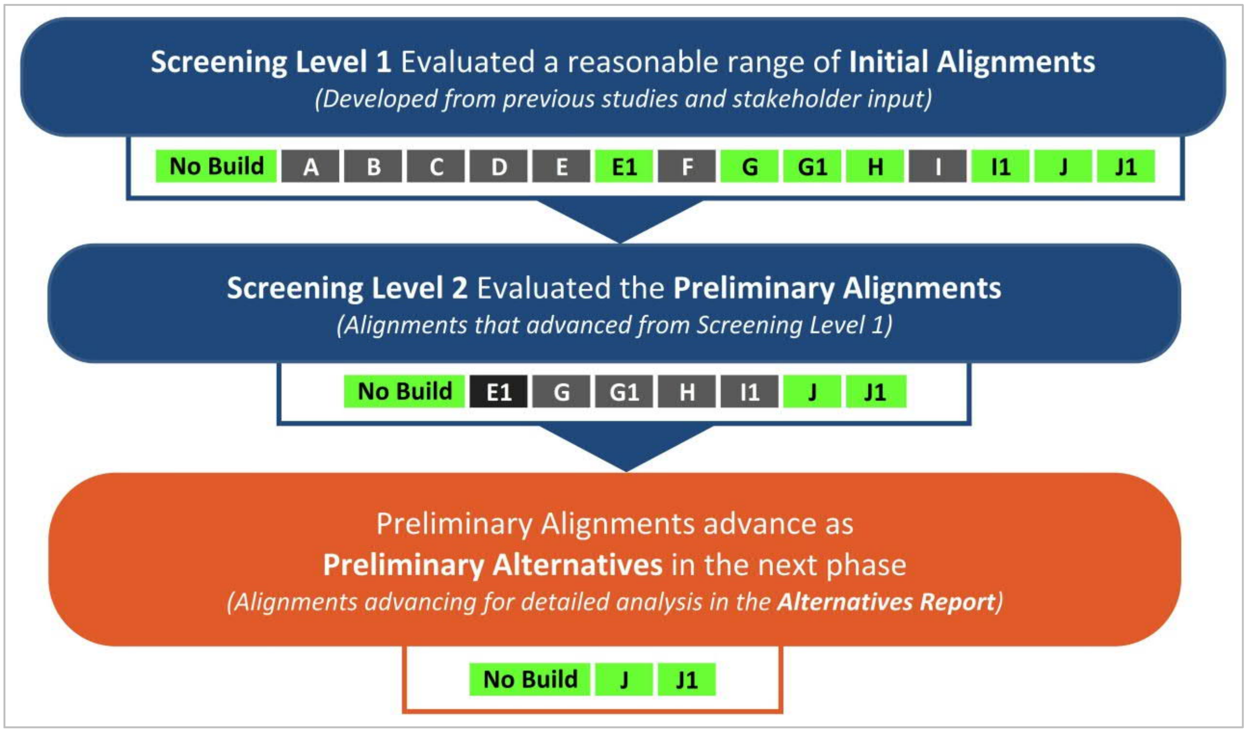
Appendix A contains descriptions of the Initial alignments (Table A-1) and provides an illustration in Figure A-1. Appendix A also contains Figures A-2 through A-4 that show the various station zones screened in the PASR. Please refer to the PASR for additional information.

Preliminary Screening Results

ALIGNMENTS

During Screening Level 1 of alignments, FRA and MDOT dismissed alignments A, B, C, D, E, F, and I, as they did not meet the minimum radius for highest practical speed operation. FRA and MDOT advanced seven preliminary alignments, E1, G, G1, H, I1, J, and J1, to Screening Level 2. FRA and MDOT subsequently dismissed alignments E1, G, G1, H and I1 in Screening Level 2 based on a desktop level analysis for potential environmental impacts, human factors, and a construction feasibility analysis. FRA and MDOT retained alignments J and J1 (plus the No Build) for continued analysis in this Alternatives Report. Please refer to Figure 2 for an illustration summarizing the alignments screened in the PASR. The PASR is available for download on the project website (http://www.bwmaglev.info/).

Figure 2: Alignments Screened in the PASR



Note: Please refer to Table A-1 in Appendix A for the descriptions of Alignments A through J1 and the No Build Alternative

STATION ZONES

FRA and MDOT also conducted an initial screening of station zones in the PASR and eliminated four from further study (Harbor East and Penn Station in Baltimore and Union Station and Farragut Square in Washington, DC), leaving six stations zones (Inner Harbor, Port Covington, and Westport-Cherry Hill in Baltimore; BWI Marshall Airport; and NoMa-Gallaudet and Mount Vernon Square in Washington, DC). Screening Level 1 indicated that all six remaining station zones are feasible for SCMAGLEV passenger stations.

Station zones were not evaluated for Screening Level 2 as additional details and specific station designs were not developed for Phase I analysis. FRA and MDOT are coordinating with the Federal Aviation Administration (FAA) and MDOT's Maryland Aviation Administration (MAA) regarding the potential intermediate station at BWI Marshall Airport. Please refer to the PASR for additional screening information regarding station zones (http://bwmaglev.info).

Following the PASR, BWRR developed specific station locations for the retained station zones for analysis by the NEPA Team. Chapter 4 of this Alternatives Report presents the latest analysis results.

C. Phase II: Alternatives Analysis

Following the completion of the PASR, the NEPA team held follow up meetings with individual (or small groups of) Federal, State, and local agencies to receive their site-specific comments on the alternatives (see Chapter 5 and Appendix G). Using this feedback, the project team made a number of improvements to Alternatives J and J1 to make the alignments and other project components more compatible with the surrounding environment. These improvements include:

- minor horizontal and/or vertical shifts,
- the lengthening of tunnel sections (and corresponding shifts to the transition portal structures), and
- refinements to the RSD sites.

These improvements, plus the addition of the station and ancillary facility footprints, form the basis for the Phase II evaluation documented in this Alternatives Report. See Appendix B for more information regarding the SCMAGLEV system requirements and descriptions of ancillary facilities and other components. See Appendix E for the 12 sheet set of project maps illustrating potential build Alternatives J and J1.

1. Description of Refined Alignments (Build Alternatives J and J1)

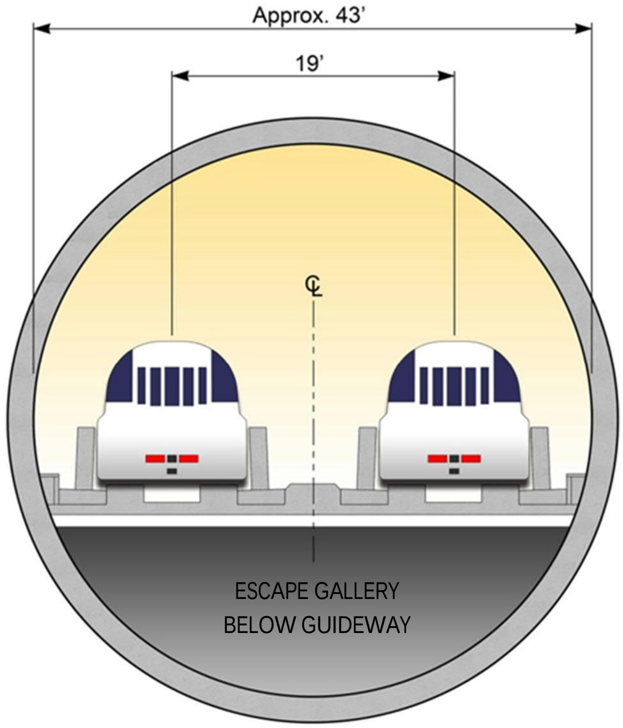
ALTERNATIVE J (BWP EAST)

Alternative J (BWP East) would include a newly constructed independent station in Washington, DC. The proposed alignment would tunnel (see Figure 3 and Figure 4) under Washington, DC from the southern terminus. Alternative J would continue in deep tunnel (typically 80 feet to 260 feet deep, the variation primarily from the existing ground contours above the proposed tunnel; however, the minimum depth would be one tunnel diameter, approximately 50 feet.) until crossing under the Capital Beltway (I-95/I-495). It would transition to the elevated guideway, or viaduct (see Figure 5 and Figure 6), on the east side of the Baltimore-Washington Parkway between the National Aeronautical Space Administration (NASA) Goddard Space Flight Center overpass and Beaver Dam Road. The viaduct will have a minimum underclearance of 18 feet, but the typical height ranges between approximately 40 feet and 140 feet above the surface depending on topography. A portal structure would be required for each location where the alignment transitions between tunnel and viaduct. Then, Alternative J would generally follow the eastside of the Baltimore-Washington Parkway travel lanes on viaduct through federal lands (including the National Park Service (NPS),,), the U.S. Department of Agriculture's Beltsville Agricultural Research Center (BARC), the U.S. Fish and Wildlife Patuxent Research Refuge (PRR), and Fort George G. Meade), and run adjacent to federal facilities (U.S. Secret Service (USSS) and National Security Agency (NSA)) before returning to a tunnel towards an underground BWI Marshall Airport station. Alternative J would then continue in a tunnel to Baltimore, Maryland. The northern terminus station would be a newly constructed independent station.

Alternative J would consist of approximately 67% tunnel, which translated to about nine miles of aboveground guideway and has two options for the RSD facility. The first RSD option would be near the southern transition portal on BARC property. The second RSD option would be near the northern transition portal on the north side on MD 198, adjacent to Fort George G. Meade. See Figure 7 for an overview map of Alternative J.

Alternative J would range in length approximately 33 to 35 miles, depending on the terminal station options. The viaduct would cross open and forested lands adjacent to the Baltimore-Washington Parkway, and would cross wetland areas and other resource areas. Based on conceptual engineering, the closest residential buildings would be approximately 80 feet from the viaduct portion of the project near Laurel, MD around Sta. 124+000 (Sheet 5 of 12 in Appendix E).

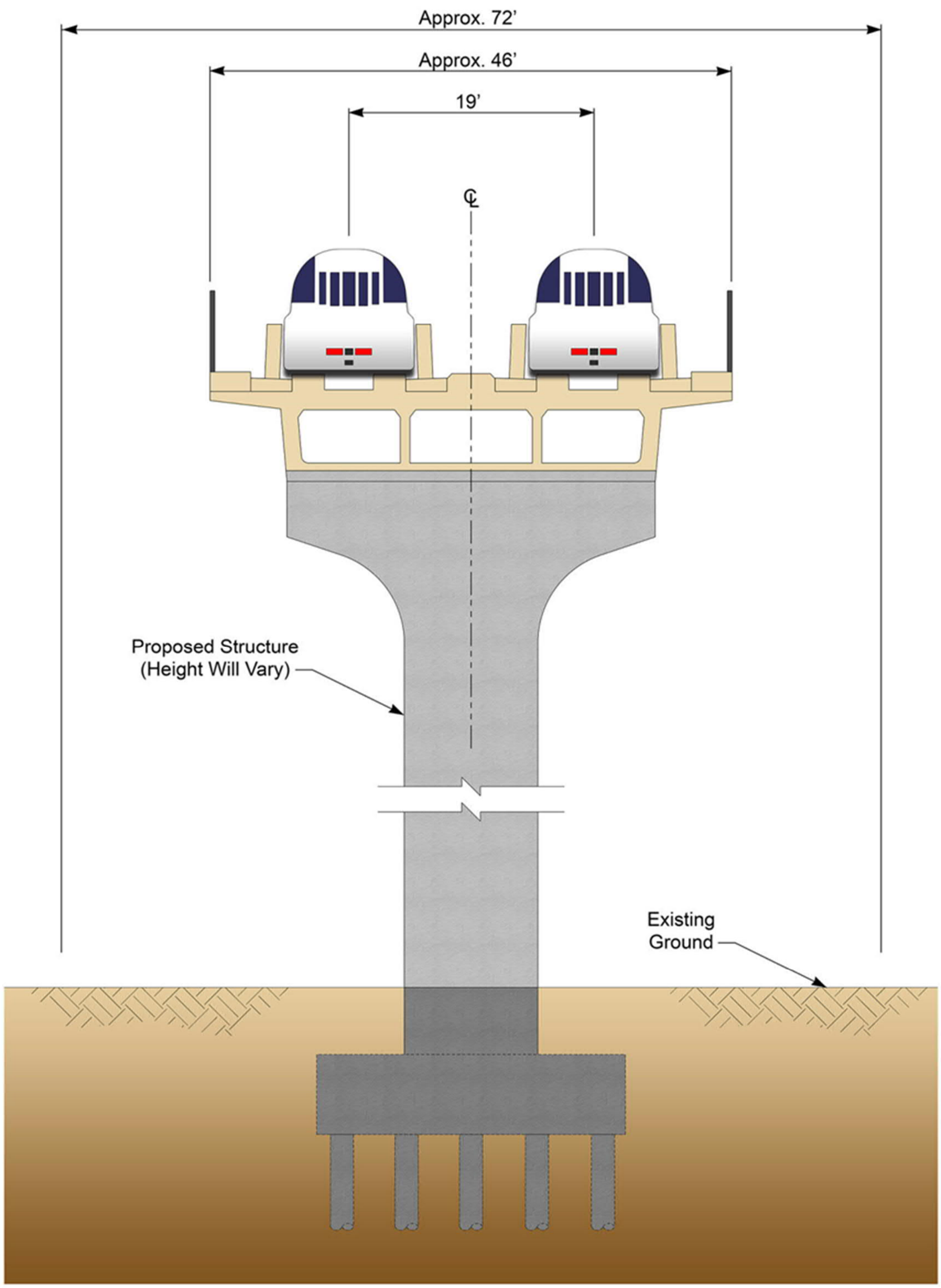
Figure 3: Typical Tunnel Section



(Not to Scale)

Figure 4: Picture inside Tunnel (example from Japan)

Figure 5: Typical Viaduct Section



(Not to Scale)

Figure 6: Picture of Yamanashi Maglev Line Viaduct Section (example from Japan)

ALTERNATIVE J1 (BWP WEST)

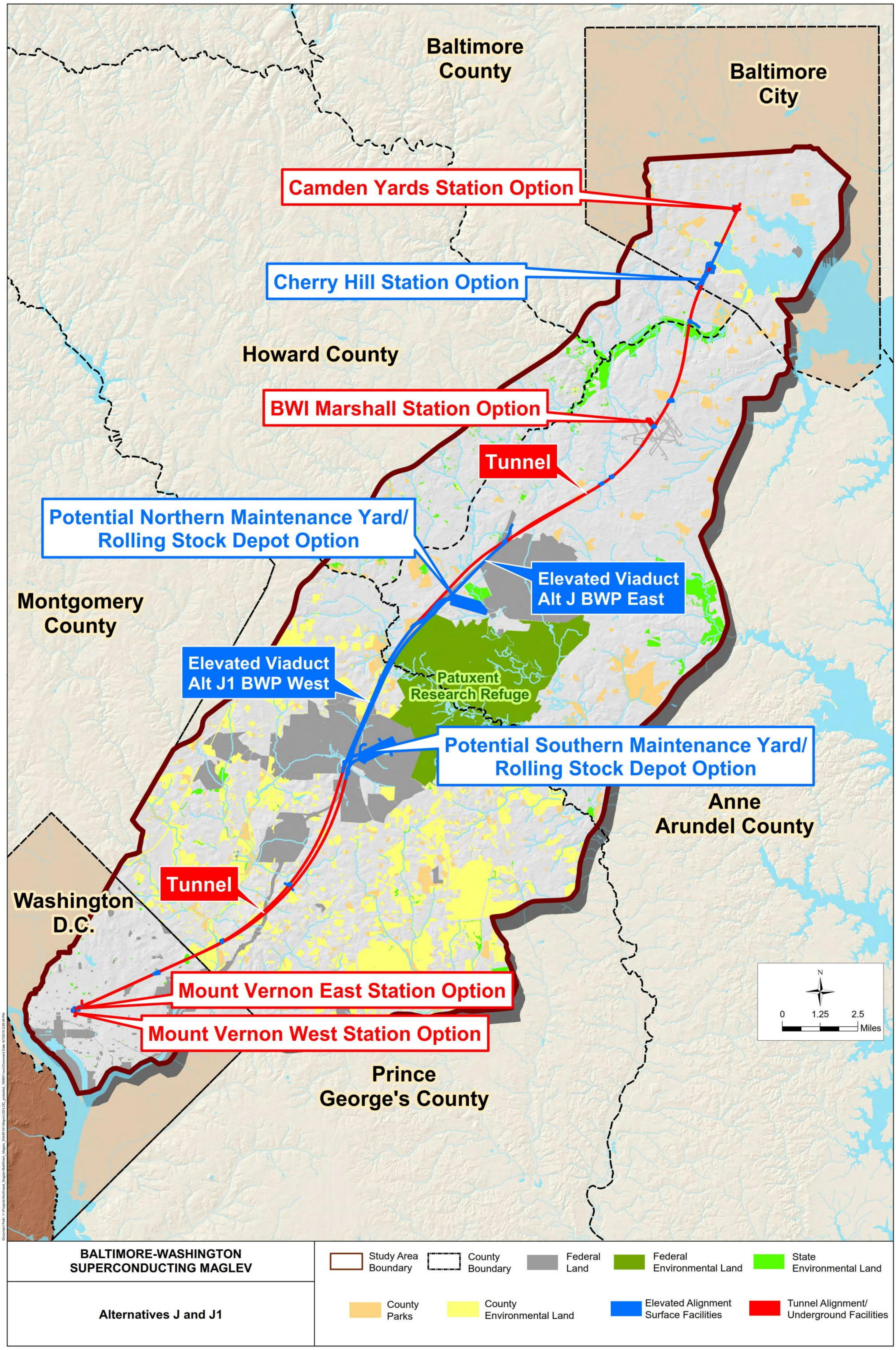
Alternative J1 (BWP West) would also include a newly constructed independent station in Washington, DC. Similar to Alternative J, Alternative J1 would tunnel under Washington, DC from the southern terminus. It would continue in deep tunnel (typically 80 feet to 260 feet deep) until crossing under I-95/I-495. It would transition to the viaduct, but unlike Alternative J, Alternative J1 would align on the west side of the Baltimore-Washington Parkway between the NASA overpass and Beaver Dam Road. Then, Alternative J1 would generally follow the west side of the Baltimore-Washington Parkway travel lanes on viaduct through BARC and NPS; then continuing on viaduct adjacent to residential developments in South Laurel, before transitioning into a tunnel south of Maryland City to turn to the east towards an underground BWI Marshall Airport station. The alignment would continue in tunnel to Baltimore, Maryland. The northern terminus station would be a newly constructed independent station. This alternative would avoid the PRR, USSS and NSA facilities and would tunnel under Fort George G. Meade. See Figure 7 for an overview map of Alternative J1

Alternative J1 would range in length approximately 33 to 36 miles, depending on the terminus station options. It would consist of approximately 79% tunnel, which translated to about four and a half miles of aboveground guideway (more tunnel length compared to Alternative J). Alternative J1 would utilize the same RSD options under consideration for Alternative J; however, Alternative J1 would have flyovers (connecting ramp tracks) crossing over the Baltimore-Washington Parkway to reach either RSD location, which would have additional impact to NPS property. The flyover is located in close proximity to the existing roadway overpass to lessen the visual impact to the extent practical.

The Alternative J1 alignment would follow the Baltimore-Washington Parkway along the west side, running on open and forested land and crossing wetland and other resource areas. Based on conceptual engineering, the nearest existing residential buildings would be approximately 65 feet from the viaduct portion of the project near Laurel, MD around Sta. 123+700 (Sheet 5 of 12 in Appendix E).

See Appendix B for more information regarding the SCMAGLEV system requirements and components. See Appendix E for the alternatives drawings.

Figure 7: Overview Map of Project Components Studied in the Alternatives Report



2. Description of Station Zones and SCMAGLEV Passenger Station Concepts

For Phase II, BWRR developed potential station locations for the six station zones retained from the PASR. BWRR developed five concepts in the Baltimore zones: two specific station concepts in the Inner Harbor Zone (underground Camden Yards and underground Calvert/Light Street) and in the Westport-Cherry Hill Zone (underground Westport and elevated Cherry Hill); and one station concept in the Port Covington Zone (underground Port Covington).

BWRR developed one station concept under BWI Marshall Airport (underground BWI Marshall).

Finally, BWRR developed four concepts in the Washington, DC zones: two in the NoMa Gallaudet Zone (both an elevated and underground option near NoMa adjacent to New York Avenue); and two in the Mount Vernon Square Zone (underground New York Avenue east and underground New York Avenue west).

The potential SCMAGLEV station options are interchangeable with either alternative. The intermediate station at BWI Marshall Airport is common to all options; however, the potential terminus stations in Baltimore and Washington, DC vary.

Preferred methods of construction for each type of station are discussed in further detail in Section 4 – Anticipated Construction Methods, SCMAGLEV Stations of this chapter. Please refer to Chapter 4 for the evaluation criteria, the station assessment table, and the evaluation discussion.

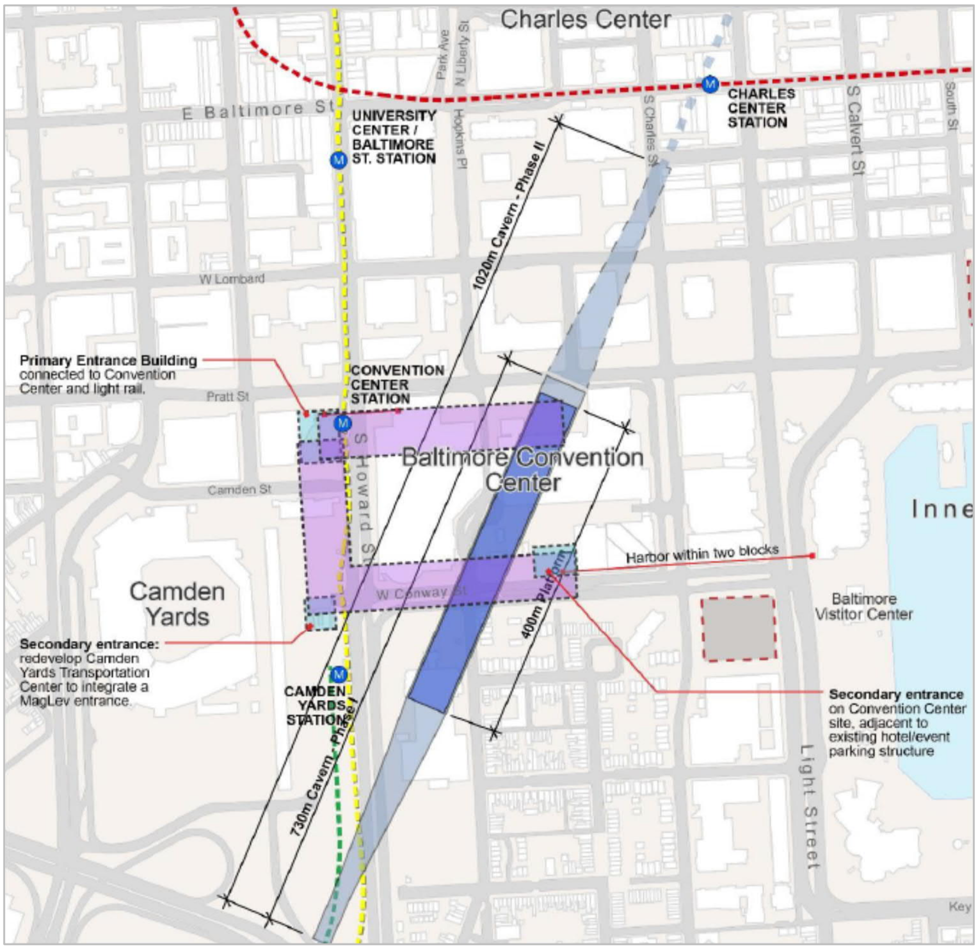
DESCRIPTION OF THE BALTIMORE, MARYLAND STATION OPTIONS

Camden Yards SCMAGLEV Station Concept (Underground)

The Baltimore Inner Harbor Zone could have an underground station adjacent to Camden Yards below the Convention Center. The station cavern would extend underground on a diagonal from approximately Martin Luther King Jr Boulevard to just north of Pratt Street. Station entrances could be at three possible locations: the corner of Howard and Camden Streets; the Camden MARC Station; or adjacent to the Convention Center along Conway Street.

Please see Figure 8 below for an illustration of the Camden Yards Station concept.

Figure 8: Camden Yards SCMAGLEV Underground Station Concept



The vertical profile for the tunnel under Baltimore, would be at least 82 feet underground (measured vertically from the profile grade line to the existing ground surface). Station vent shaft design has not been finalized, but it is anticipated that the vent draft relief shaft would require a cross-sectional area of approximately 33 feet by 33 feet and be located in the vicinity of any underground station, to allow the vent draft relief shaft to connect to the station cavern.

Calvert / Light Street Station Concept (Underground)

The underground SCMAGLEV station concept near Calvert / Light Street in Baltimore would potentially have an entrance at the Inner Harbor (replacing the McKeldin Fountain), with a secondary entrance at the back of the Convention Center (adjacent to the existing parking structure). The station cavern would extend underground on a diagonal from approximately Lee Street to just north of Pratt Street while the platform would extend from the intersection of Conway and Charles Street to the intersection of Calvert/Light/Pratt Streets..

Please see Figure 9 below for an illustration of the Calvert/Light Street Underground Station concept.

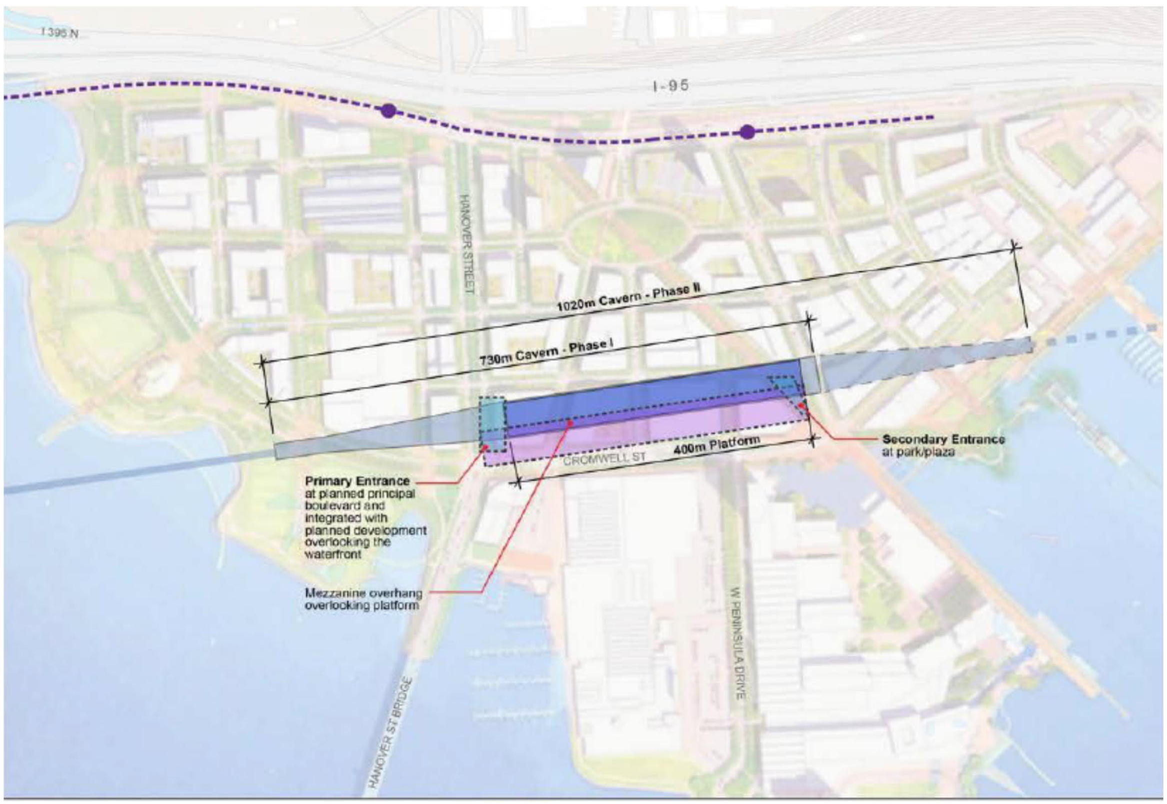
Figure 9: Calvert / Light Street SCMAGLEV Underground Station Concept

Port Covington Station Concept (Underground)

Port Covington is an old railroad terminal and port that was converted to commercial use after port operations ended. Plans for New Port Covington residential and commercial redevelopment were unveiled by others in 2016. The underground station concept in Port Covington would extend on a diagonal from approximately Hanover Street to just north of Peninsula Drive. The potential station entrances would be at either end of the platform. The entrance locations would be in planned park space on the east side and integrated with the planned development overlooking the waterfront on the west side.

Please see Figure 10 below for an illustration of the Port Covington Underground Station concept with the potential development plan for New Port Covington.

Figure 10: Port Covington SCMAGLEV Underground Station Concept

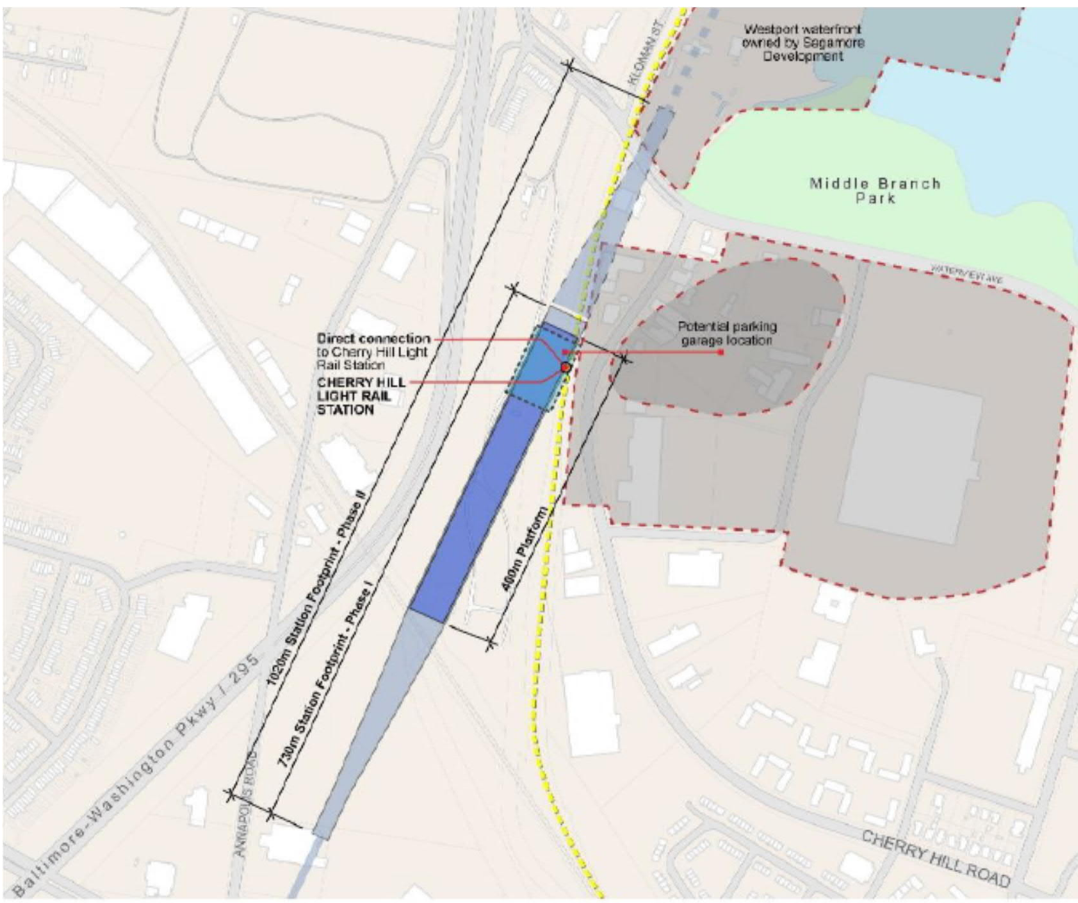


Cherry Hill Light Rail (LR) SCMAGLEV Station Concept (Above Ground/Elevated)

The topography in the southern portion of the Baltimore Westport Zone provided an opportunity for the engineers to conceptually design an elevated maglev station over the MDOT MTA Cherry Hill LR Station. The Cherry Hill LR Station is approximately 2.5 miles from downtown Baltimore (Camden Yards). The Cherry Hill LR SCMAGLEV Station concept would span over the adjacent/existing CSX railroad tracks. The elevated station concept also allows for potential terminal facilities. Potential terminal facilities would be located on nearby property and property just east of the Kloman Street between Waterview Avenue and I-95. The additional facilities could consist of tail tracks, a Maintenance of Way (MOW) facility, and other support facilities. The elevated Cherry Hill SCMAGLEV Station would provide vertical access to the LR Station directly below it, and would also to a proposed parking garage along Cherry Hill Road.

Please see Figure 11 below for an illustration of the elevated Cherry Hill LR SCMAGLEV Station concept.

Figure 11: Cherry Hill / Harbor West SCMAGLEV Elevated Station Concept



Westport Station Concept (Underground)

The Westport station would be adjacent to the Westport LRT station. The underground station cavern would be parallel to the LR tracks and extend from approximately Waterview Avenue to just north of Manokin Street, with the platform beginning around Maisel Street. There would be a new station building with a connection to the Westport LR Station platform. This station could potentially be constructed using cut and cover style top down method, assuming the station is built prior to any development (by others) on the site. This location would need to be coordinated and integrated with planned waterfront development.

Please see Figure 12 below for an illustration of the Westport Underground Station concept.

Figure 12: Westport SCMAGLEV Underground Station Concept

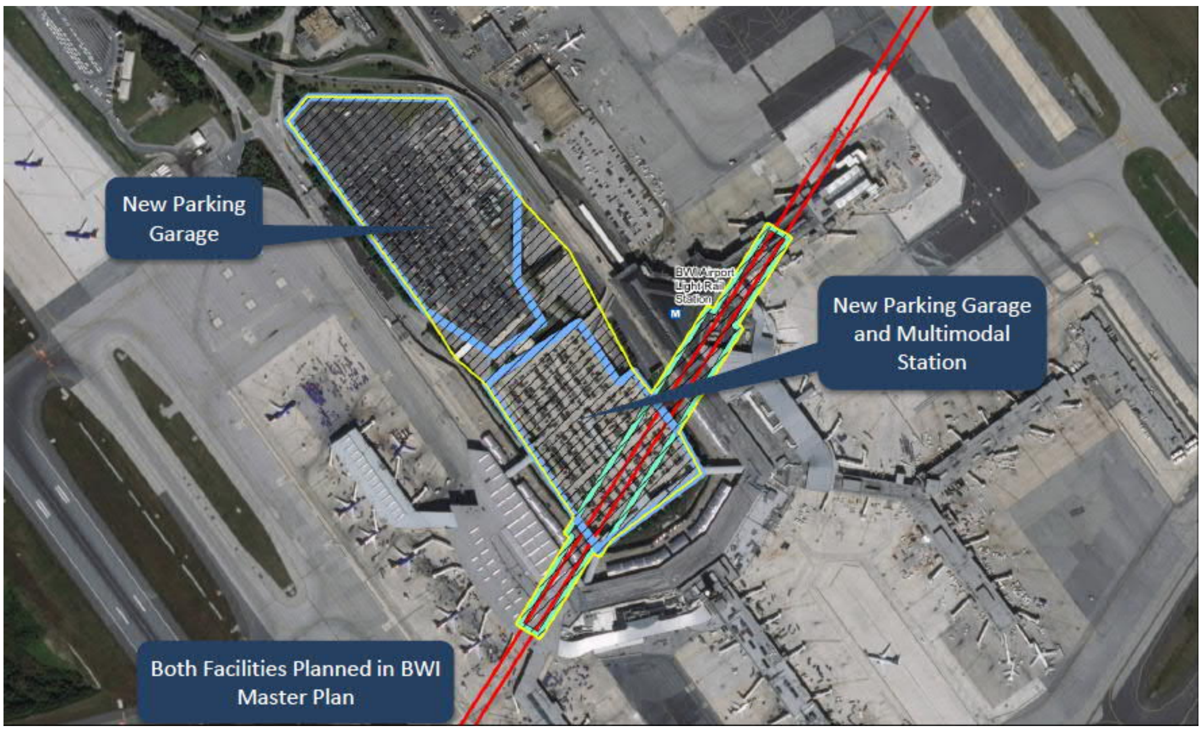
DESCRIPTION OF THE BWI MARSHALL STATION OPTION

SCMAGLEV Station Concept at BWI Marshall Airport (Underground)

Any SCMAGLEV Station concept at BWI Marshall Airport would be underground, and would be included in any build option as the intermediate station location. The station has been proposed in a revision to the Airport Layout Plan. The SCMAGLEV station location under BWI Marshall Airport would focus on simple and direct passenger intermodal connectivity to maintain adequate levels of customer service and minimize walking distances and the potential for wayfinding confusion. The underground cavern footprint for the SCMAGLEV Station at BWI Marshall Airport would be under the existing hourly parking garage and the airport terminals on either side.

Please see Figure 13 below, for an illustration of the SCMAGLEV Station concept at BWI Marshall Airport.

Figure 13: Underground SCMAGLEV Station Concept at BWI Marshall Airport



The BWI station would run underneath the terminal building towards the east end. The depth to the top of the station may be as deep as 98 feet, depending on results of the geotechnical boring program. The center portion of the station would be constructed under the existing hourly garage. The existing garage would first be demolished after constructing a new garage to the west. The center portion of the SCMAGLEV station would be constructed using top down methods, such as slurry walls and excavation, similar to deep foundations for a building. The portions of the station that fall under the terminal building would be constructed using mining methods (Sequential Excavation Method, SEM, or New Austrian Tunneling Method, NATM). After the station is constructed, a new multi-modal facility would be built above it, with convenient connections to the station and the airport terminal. A ventilation plant is proposed to be constructed 1.2 miles north of the BWI station. No separate ventilation facility would be planned for the BWI station, other than what is normally required for building HVAC.

DESCRIPTION OF THE WASHINGTON, DC STATION OPTIONS

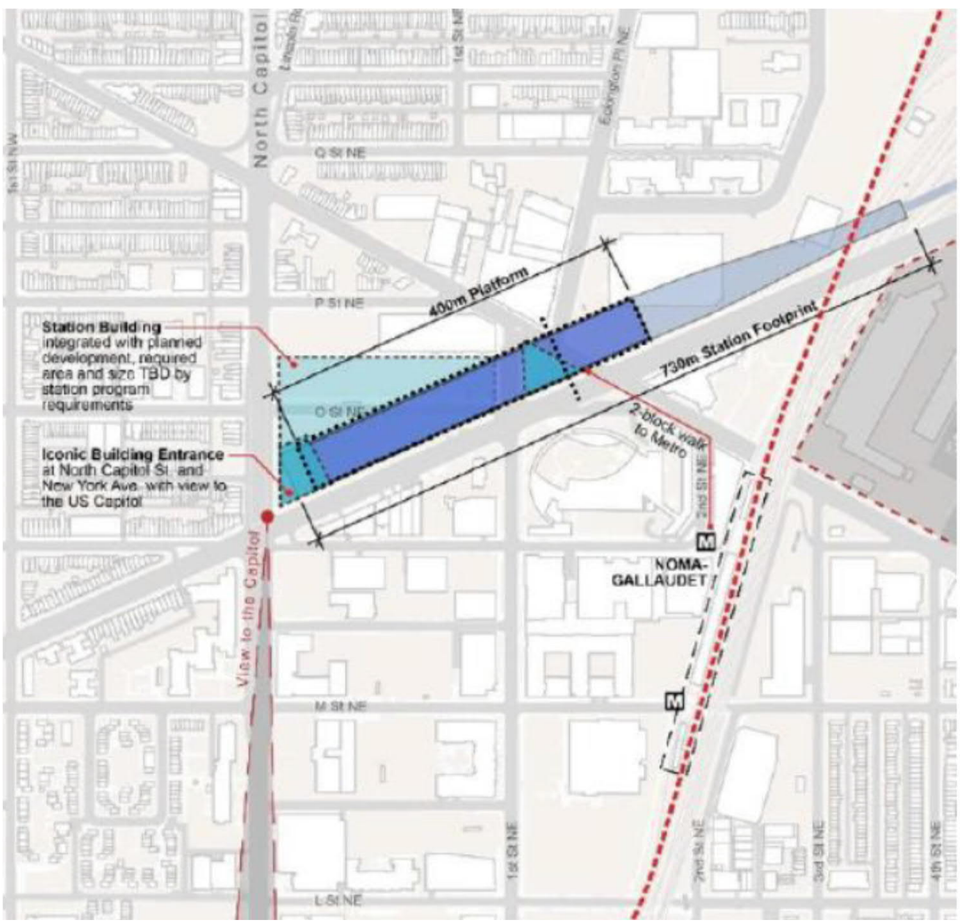
NoMa Elevated SCMAGLEV Station Concept (Above Ground/Elevated)

The topography in the Washington, DC NoMa-Gallaudet Station Zone provided an opportunity for the engineers to consider an elevated station concept adjacent to New York Avenue NE. The elevated station would extend from North Capital Street over First Street, Florida Avenue, Metropolitan Branch Trail, and the existing railroad tracks (between Union Station and the existing WMATA Brentwood Rail Yard and the Amtrak Ivy City Yard and Maintenance Facility). An elevated walkway could be provided between the SCMAGLEV station and the New York Avenue WMATA station. The walking distance would be approximately 1,300 feet. The elevated station concept would require a short mainline guideway viaduct section over the existing NEC railroad tracks to the north before transitioning into a tunnel portal structure (between the existing rail tracks and New York Avenue) to travel in/out of the District in deep tunnel.

Unlike the Cherry Hill LR SCMAGLEV Station option, there would be no additional potential terminal facilities proposed for the elevated NoMa SCMAGLEV Station option as they are not essential for operations and would only create additional impacts in the District.

Please see Figure 14 for the conceptual illustration of the elevated NoMa SCMAGLEV Station concept.

Figure 14: NoMa SCMAGLEV Station Concept (Illustration serves either Elevated or Underground)



NoMa Underground SCMAGLEV Station Concept (Underground)

Alternatively, the NoMa SCMAGLEV Station could be underground. The underground station concept would still extend from North Capital Street but it would stay in tunnel under First Street, Florida Avenue, Metropolitan Branch Trail, and the existing railroad tracks (between Union Station and the existing WMATA Brentwood Rail Yard and the Amtrak Ivy City Yard and Maintenance Facility). An elevated walkway could be provided between the SCMAGLEV station and the New York Avenue WMATA station. The walking distance would be approximately 1,300 feet horizontally, but as underground SCMAGLEV station at NoMa would also add the extra vertical travel to/from a depth of approximately 100 feet on either an elevator or escalator/stairs. The SCMAGLEV mainline would remain in tunnel under the existing NEC railroad tracks for travel in/out of the District in deep tunnel.

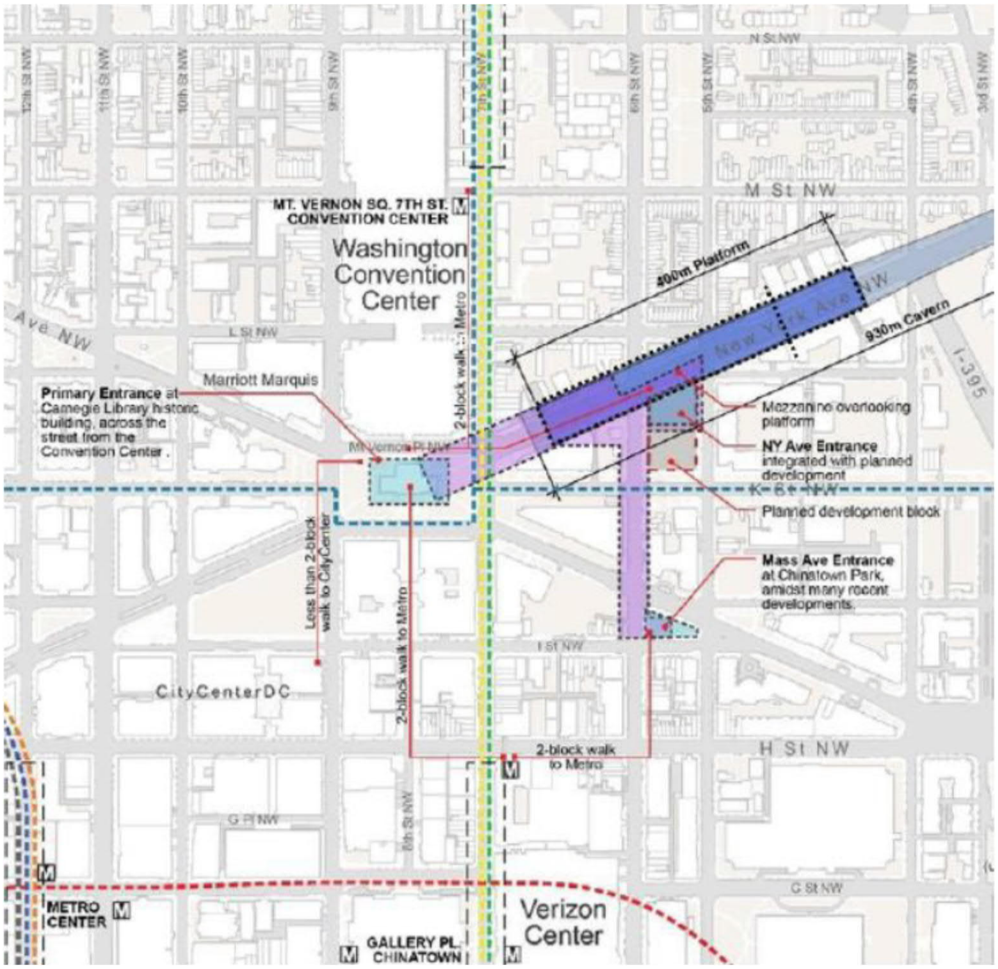
Please refer to Figure 15 for an illustration of the NoMa underground concept.

Mount Vernon Square East SCMAGLEV Station Concept (Underground)

This SCMAGLEV station would be underground below New York Avenue to the east of Mount Vernon Square. Potential station access from the surface would occur at the Carnegie Library historic building. Alternatively, there could be secondary access from a Massachusetts Avenue entrance at Chinatown Park, or potentially integrated with planned development on NY Avenue. The Mount Vernon Square East SCMAGLEV Station cavern would extend from approximately Massachusetts Avenue/Mount Vernon Square to just north of First Street.

Please see Figure 15 below, for an illustration of the underground Mount Vernon Square East SCMAGLEV Station concept.

Figure 15: Mount Vernon Square East SCMAGLEV Underground Station Concept

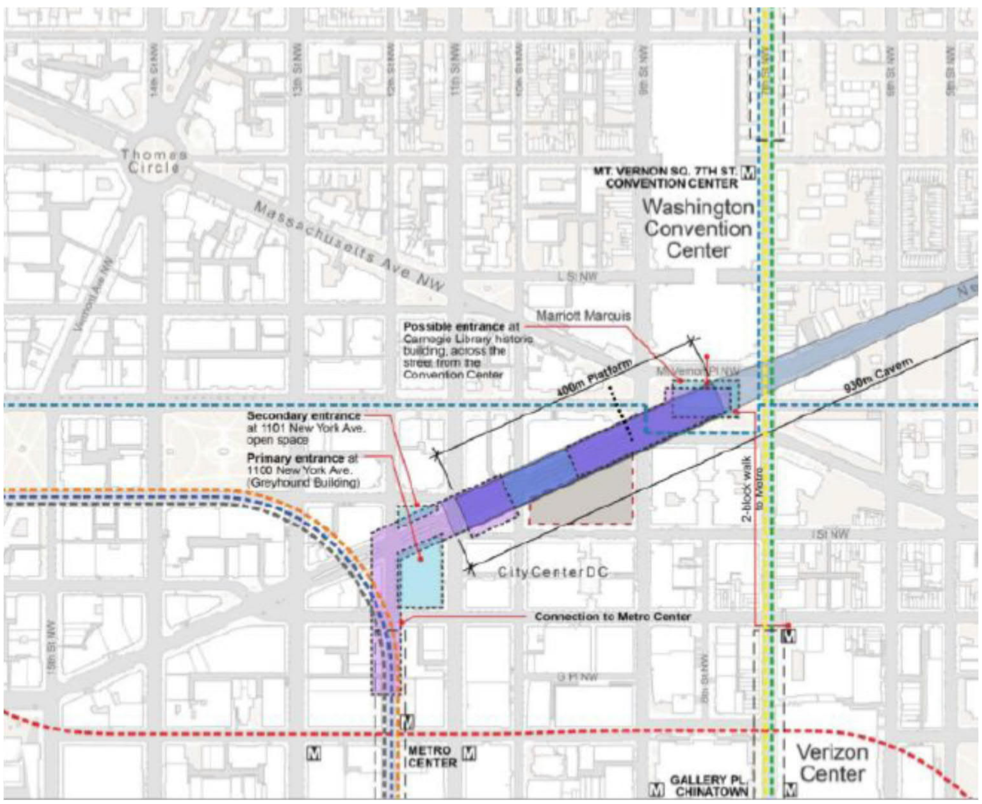


Mount Vernon Square West SCMAGLEV Station Concept (Underground)

This SCMAGLEV station would be underground below New York Avenue to the west of Mount Vernon Square. The Mount Vernon Square SCMAGLEV Station cavern would extend underground from approximately 12th Street to just north of 5th Street, but the station platform would approximately end at Mount Vernon Square. Potential station access from the surface would occur between 11th Street and 12th Street (Greyhound Building at 1100 New York Avenue). Alternatively, there could be secondary access from the northwest quadrant of the K Street and 7th Street intersection. An entrance as far as 14th Street could potentially be explored. A pedestrian tunnel access to the WMATA Metro Center Station could potentially be explored.

Please see Figure 16 for an illustration of the underground Mount Vernon Square West SCMAGLEV Station.

Figure 16: Mount Vernon Square West SCMAGLEV Underground Station Concept



3. Description of Ancillary Facilities

The engineering team provided footprints for the ancillary facilities for each alternative. In general, the ancillary facilities are interchangeable; however, the exact locations will depend on the final guideway alignment and further environmental review. The entire LOD footprint was assumed to be part of the surface LOD for the quantification of resources that fall within the surface LOD for each alternative.

ROLLING STOCK DEPOT (RSD)

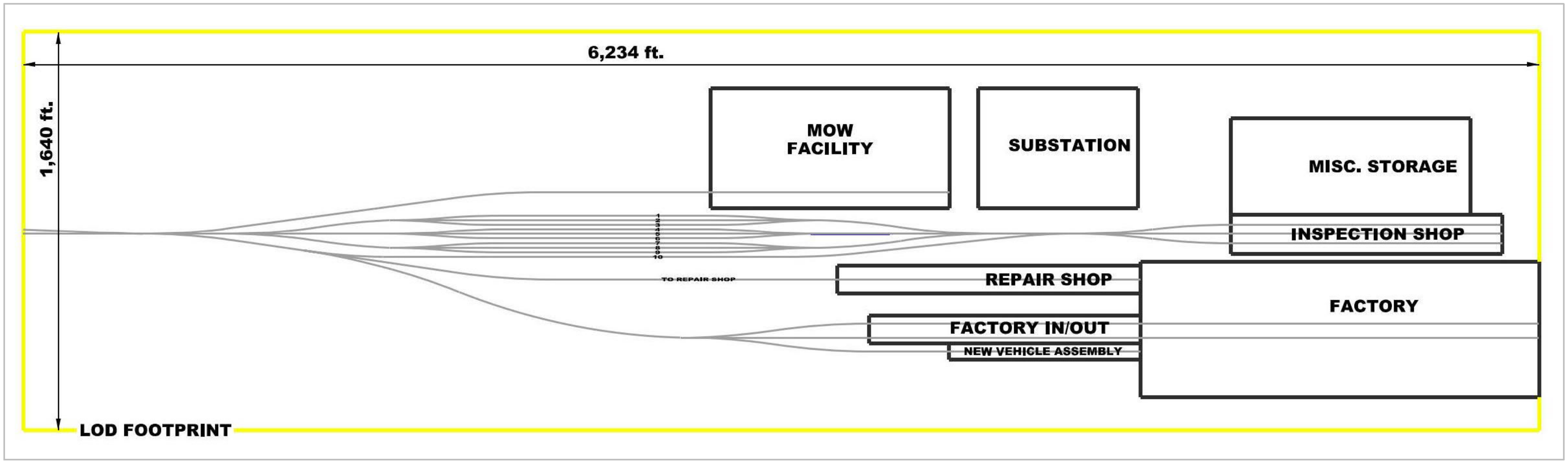
BWRR presented two conceptual options of potential RSD sites for the NEPA team to study. The RSD sites are interchangeable and apply to either alternative; however, only one RSD site would be required for the project. The southernmost site lies east of the Baltimore-Washington Parkway on BARC property, between Beaver Dam Road and Powder Mill Road. The northern site is also to the east of the Baltimore-Washington Parkway, north of MD 198.

See Figure 17 for a conceptual layout and typical dimensions of an RSD site. The potential RSD site footprints are also illustrated on sheet 5 (BARC) and sheet 7 (MD 198) of the project drawings in Appendix E.

The RSD facility would have active 24/7 operations for maintaining, repairing, cleaning and all other aspects of rolling stock maintenance. The RSD also stores the trains at night and during off-peak periods. The site will have several buildings, the largest being the maintenance facility where a rigorous maintenance and repair program is implemented. The approximate height of the tallest building/feature on the RSD facility is anticipated to be 60 feet tall. The facility will employ engineers, technicians, and other personnel (300 or more workers across three shifts). The major elements in the RSD site are:

- Storage yard for trains
- Maintenance building with approximately six bays for inspection, factory and repair shops
- Miscellaneous storage building
- Rail/Operations Control Center (RCC) [to be co-located with one of the other buildings],
- Offices
- Parking

Figure 17: Conceptual RSD Layout



Alternative layouts, possibly separating some of the components out of a co-located facility (such as the power substation and/or the MOW facility) would also make the RSD footprint smaller; however, the components would still need to be located elsewhere in the corridor. Changes would be documented in the DEIS if alternative RSD layouts are used.

BARC RSD Option

The BARC RSD footprint LOD would be approximately 257 acres, including access ramps. The conceptual layout of the RSD includes a power substation, a maintenance of way (MOW) facility, assembly facilities, repair and inspection shop facilities, a miscellaneous storage building, a Rail Control Center (RCC) co-located with one of the other buildings, as well as the multiple train storage guideways. Although not shown in the typical layout, stormwater management features would be incorporated within the footprint, as needed. The entire footprint is currently assumed as a potential surface impact for the purposes of this report. See Figures 18 and 19 for the conceptual layout of the RSD site evaluated on BARC (yellow LOD footprint is the same, the layout within the footprint changes between Alternative J and J1) for this report.

Figure 18: Conceptual Layout for BARC RSD option (Alt. J)

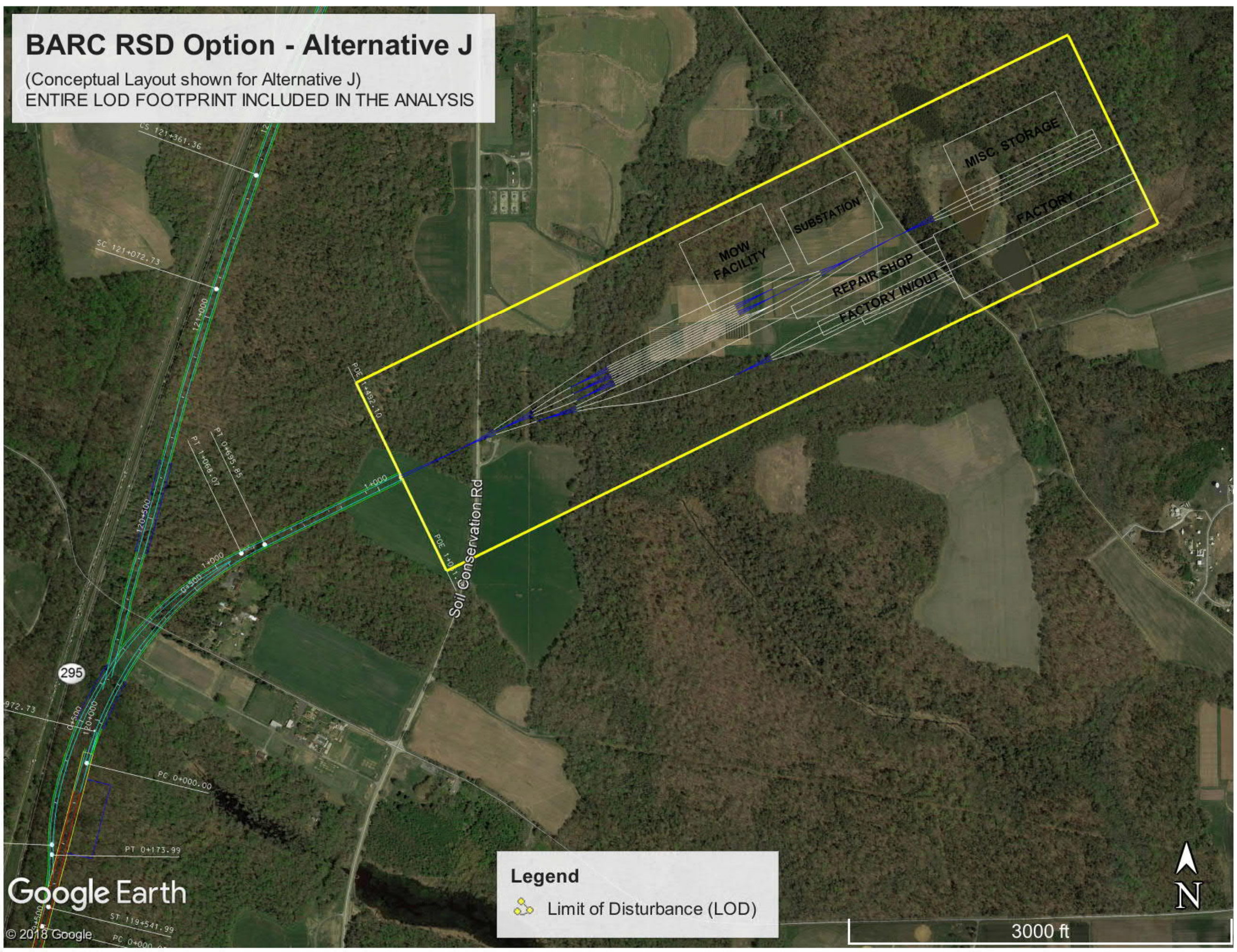
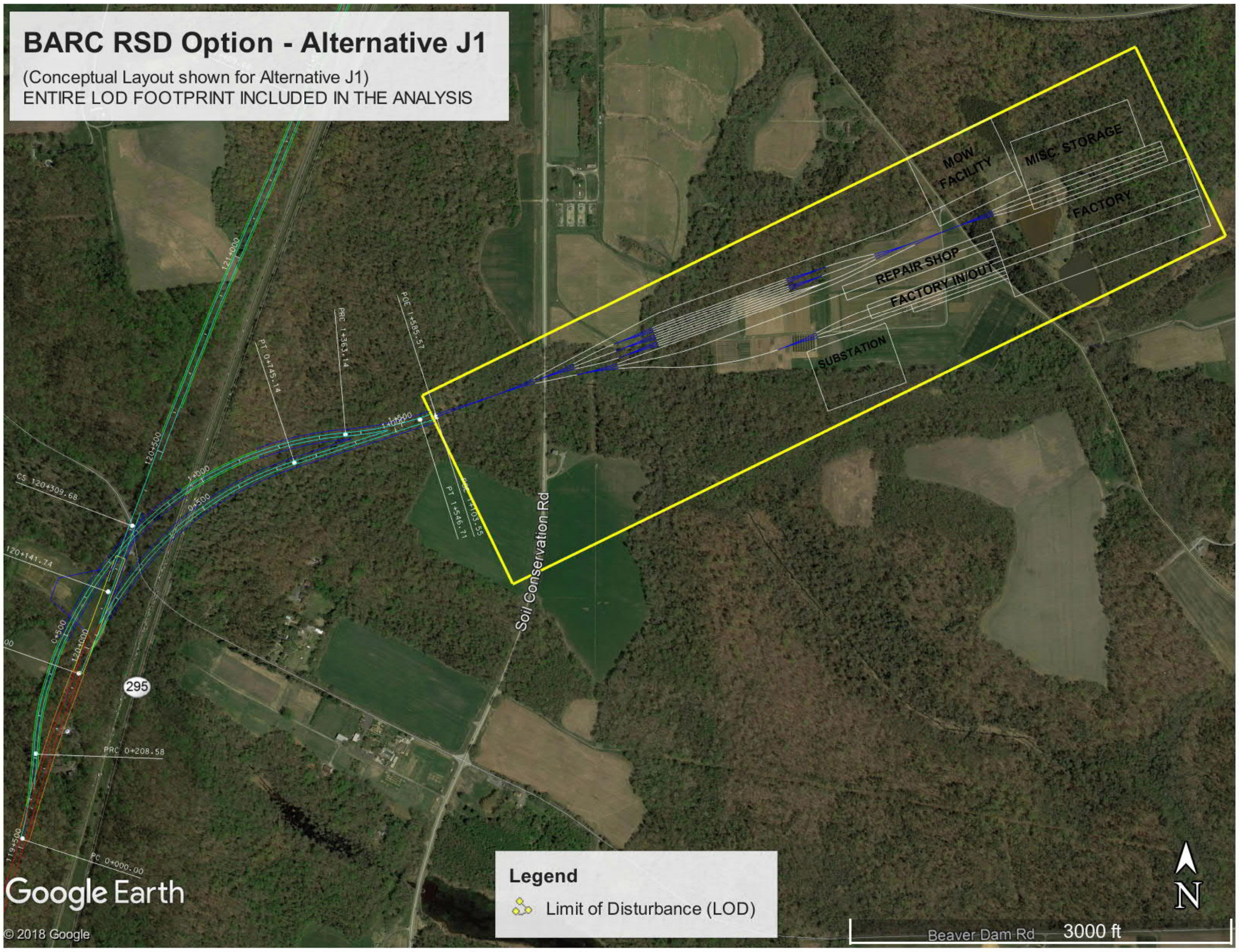


Figure 19: Conceptual Layout for BARC RSD option (Alt. J1)



Through multiple agency coordination meetings and information exchanges, the project team learned the following regarding the BARC property:

- U.S. Department of Agriculture (USDA) currently utilizes BARC for Federal, state, and industry funded research.
- There are federally required stewardship and sustainability regulatory requirements for BARC's mission.
- Long-term research conducted on BARC involve watersheds that the Agricultural Research Service (ARS) scientists have carefully sampled and studied for the past two decades. There are also studies relating to localized microclimates and there are sampling stations in the streams that focus on flows, water quality, and sediment.
- The location of the BARC RSD is at the headwaters of the Beaverdam Creek where an unnamed tributary of the Beaverdam Creek forms. These headwaters are supported by a rare, natural bog, mapped as the Beltsville Bog, within the RSD. Just below the named bog, two stormwater management ponds were installed in the late 1990's as part of a mitigation require for the WMATA Greenbelt Repair Facility located next to Indian Creek.
- Beaverdam Creek is a Maryland Department of Environment (MDE) and Maryland Department of Natural Resources (MDNR) Tier II reference stream used for water quality comparisons in the Anacostia Watershed.

- BARC also includes globally rare, endangered forest communities, the Pine Barrens Pine – Oak community. This upland pine community has apparently been unrecognized and unreported in the watershed until examples were discovered in a 2005 survey by the nonprofit NatureServe. This community is an unusual wetland type characterized by pitch pine and deciduous hardwoods in the canopy.
- BARC contains the Upper Beaverdam Creek subwatershed, which also supports a high number of wetlands of special state concern.
- NASA-GSFC has also noted that the proposed BARC RSD is in close proximity to the Goddard Geophysical and Astronomical Observatory (GGAO), which is very sensitive to vibration, artificial lighting, and electromagnetic interference.

Based on the information above, as well as agency comments and concerns (presented further in Chapter 4-Section C), the BARC RSD location has been dropped from further consideration..

MD 198 RSD Option

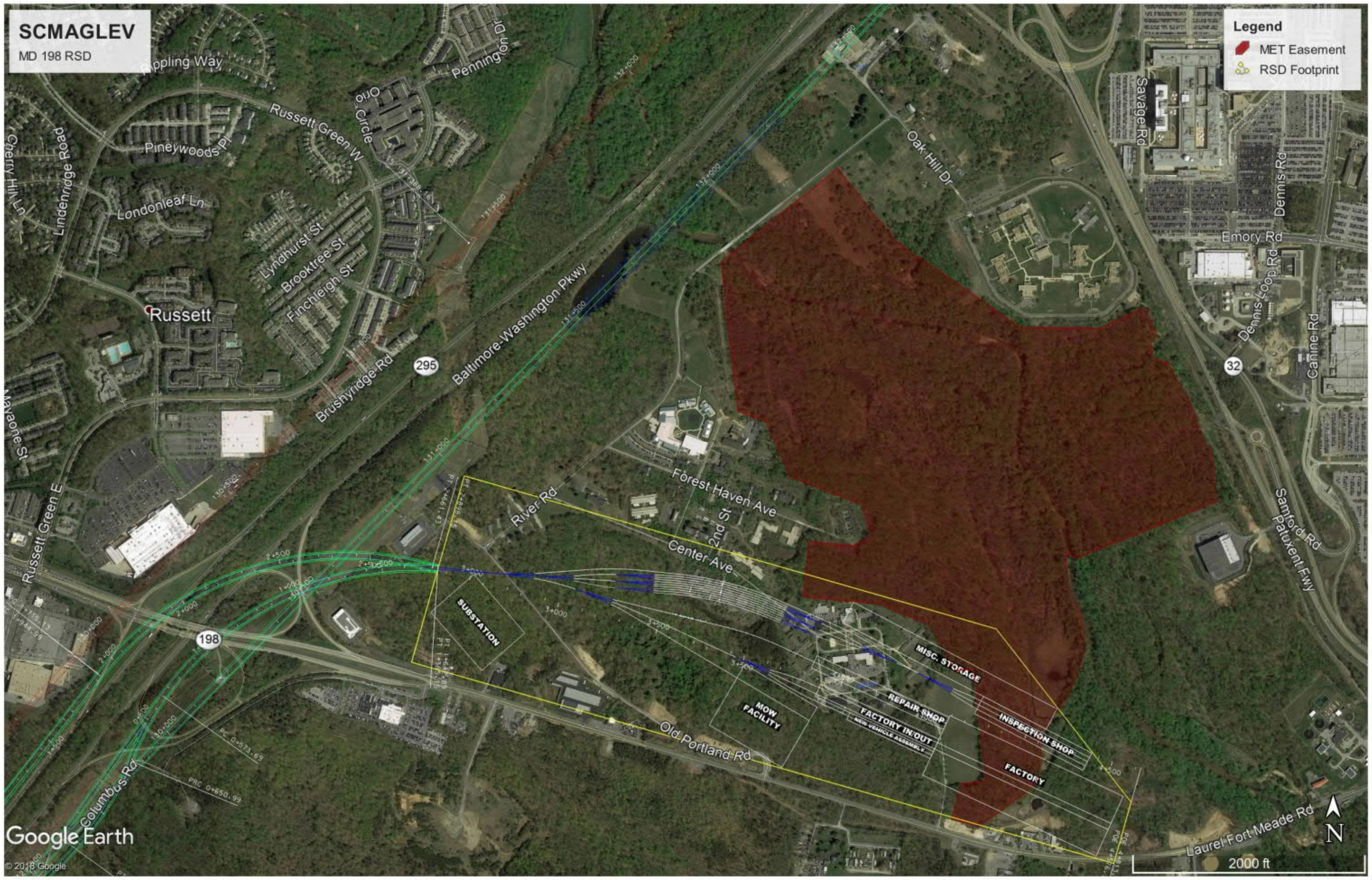
The MD 198 RSD footprint would be approximately 241 acres, including access ramps. The project team reduced the upper corner of the MD 198 RSD footprint in an effort to minimize the impact on a Maryland Environmental Trust (MET) conservation easement. The project team assumed that the entire footprint is a potential surface impact for the purposes of this report. Inside the LOD footprint box, the building would be the same as in the conceptual layout shown above for the BARC site, but ramp lengths would vary for the MD 198 RSD site. See Figure 20 for the conceptual layout of the RSD site adjacent to MD 198 (yellow LOD footprint and the layout within the footprint is the same for both Alternative J and J1).

Even though this site is physically located in Maryland, the US Government owns the property. Legislative actions subsequently regulated the jurisdiction to the District of Columbia. In addition to the MET conservation easement the subject property shares multiple existing uses and operations, including the following:

- New Beginnings Youth Development Center;
- Environmental conservation easement surrounding Little Patuxent River;
- DC National Guard Youth Challenge Academy;
- Central Administration Building, which is used by the District of Columbia Department of Youth and Rehabilitation Services and the District of Columbia Office of Contracts and Procurement Surplus Property Division;
- District of Columbia Department of Public Works Fuel Point and Vehicle Repair Shop Building;
- Wings over America Raptor Sanctuary;
- Forest Haven Hospital – closed hospital building(s) – class action legal action under purview of the Department of Disability Services has not concluded;
- Forest Haven Cemetery;
- Department of Labor (DOL) Woodland Job Corps Program;
- BG&E subterranean power conduits along Old Portland and River Roads to cross US 32 that support the NSA;
- Anne Arundel County proposal for new 3-million-gallon above-ground water storage tank and shift of utility provider

All of these uses are not within the MD 198 RSD footprint, but they are adjacent or the existing roadway access may be affected.

Figure 20: Conceptual Layout for MD 198 RSD option (Both Alt. J and J1)



The engineering team will continue to study the RSD sites during preliminary engineering to determine if they can be optimized to further reduce potential impacts to existing uses/operations and environmental impacts, including the siting of various RSD components, e.g. MOW facility into separate parcels in close proximity to ROW. As with the BARC RSD option, an RCC would be co-located with one of the other buildings and does not need additional footprint as shown in the current layout of the MD 198 RSD above.

RSD Flyover/ Elevated Connector Ramp Spur Tracks

For Alternative J1, the RSD flyover ramp spur tracks would need to cross over the BW Parkway (near Beaver Dam Road for the southern RSD location in BARC, or near MD 198 for the northern RSD site). Neither northern nor southern RSD locations require elevated ramp spur tracks to cross over BW Parkway with Alternative J. The potential RSD site footprints with ramp connectors are illustrated below in Figure 21 and Figure 22; and are also shown on sheet 5 (BARC) and sheet 6/7 (MD 198) of the project drawings in Appendix E.

Figure 21: BARC RSD Ramp Connectors/Flyovers

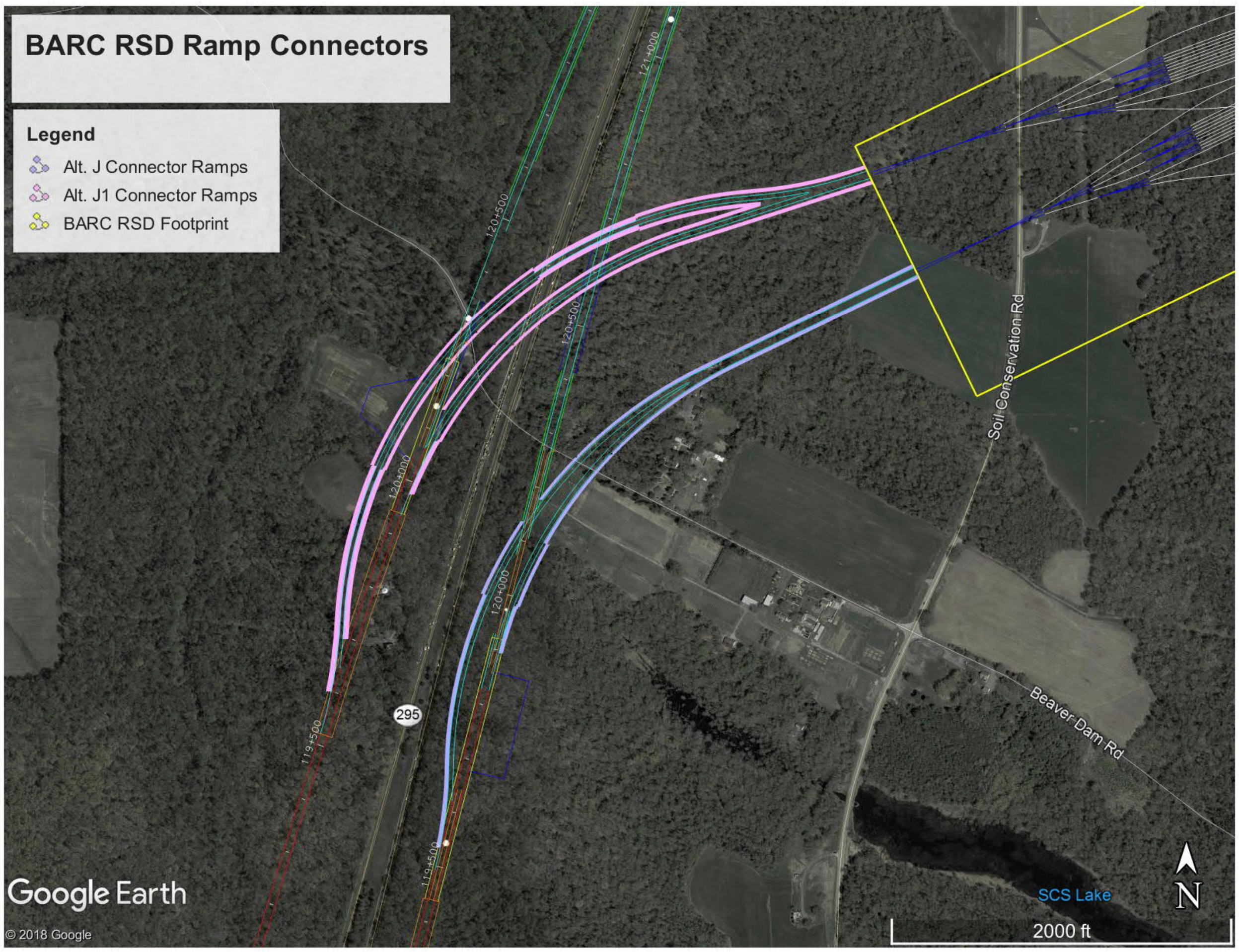
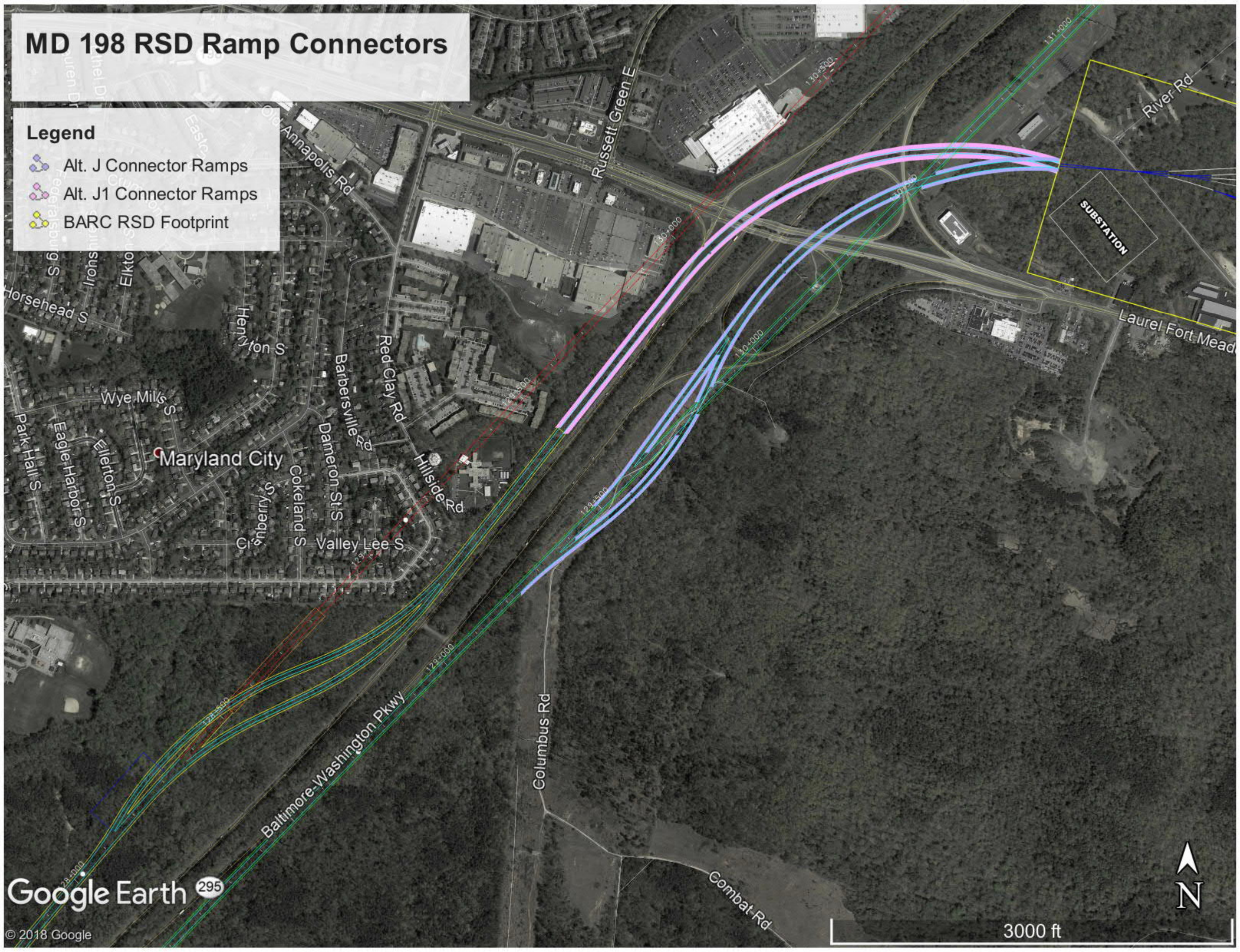


Figure 22: MD 198 RSD Ramp Connectors/Flyovers



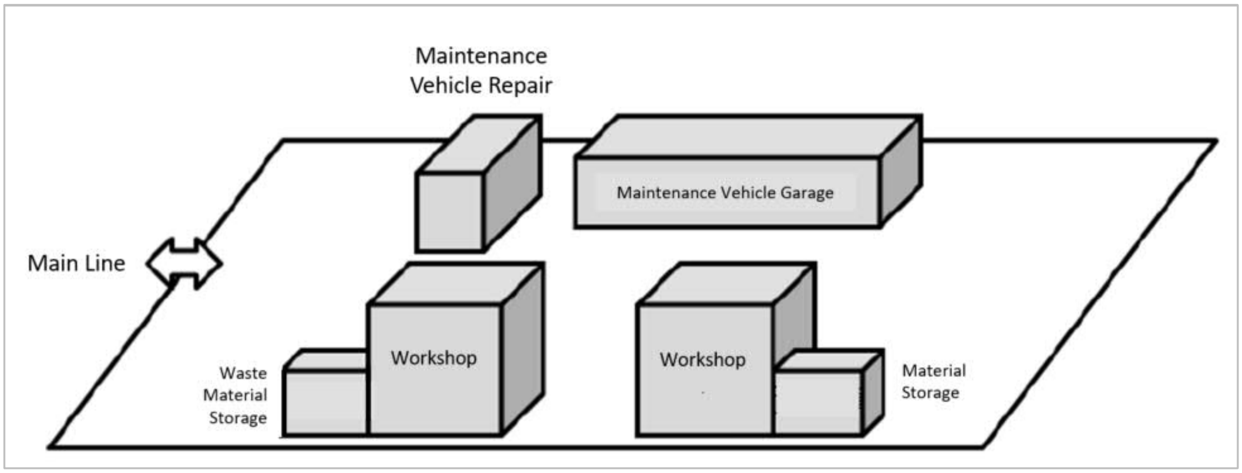
The elevated spur tracks for Alternative J1 do not cross Patuxent Research Refuge (PRR), regardless of the RSD option. However, Alternative J elevated ramp spur tracks would cross PRR for the MD 198 RSD option.

MAINTENANCE OF WAY (MOW) FACILITY

The SCMAGLEV system requires one MOW facility for storage of various types of equipment such as pickup trucks, inspection equipment, and tools. The MOW Facility would house workers who maintain the guideway, linear infrastructure (tunnels and viaducts), systems (magnets and communications), and facilities (ventilation plants and substations). Work on the guideway would be restricted to nighttime hours when there are no trains operating. The workers travel the guideway with a rubber tired fleet of special purpose vehicles that access the guideways using turnouts or other specially designed connections, and not SCMAGLEV vehicles. The MOW facility sites are interchangeable and apply to either alternative.

The MOW facility may be co-located on the RSD site footprint and thus is included in the acreage estimates and conceptual layout illustrations for both RSD sites above. However, if this co-location could not be accomplished, a 7.4 acre (+/-) MOW facility would be required elsewhere in the corridor (in proximity to the guideway to facilitate access) and the change would be analyzed and documented in the DEIS, if necessary. Both alternative RSD facilities would accommodate an MOW facility as currently assumed for this document. See Figures 18, 19, and 20 above for conceptual layout of the MOW facility if located within the respective RSD sites. See Figure 23 below for a typical illustration of the MOW facility layout. The approximate height of the tallest building/feature on the MOW facility is anticipated to be 40 feet tall.

Figure 23: Typical MOW Facility Layout



VENTILATION PLANTS (VENT PLANTS) AND EMERGENCY EGRESS

Vent Plants

Vent plants would be required for the tunnel portions of the alternatives. Each vent plant location would be spaced three to four miles apart and the footprint would be 1.24 to 2.47 acres (+/-) in size. Ventilation structures, also known as fan plants, would be located along underground sections of the alignment to provide smoke extraction from tunnels in the event of a fire or other incident. The location and size of the ventilation plants would be in accordance with National Fire Protection Association (NFPA)-130 and the research and experience of JR Central. Locations will be finalized in discussions with FRA Office of Safety and local emergency rescue authorities.

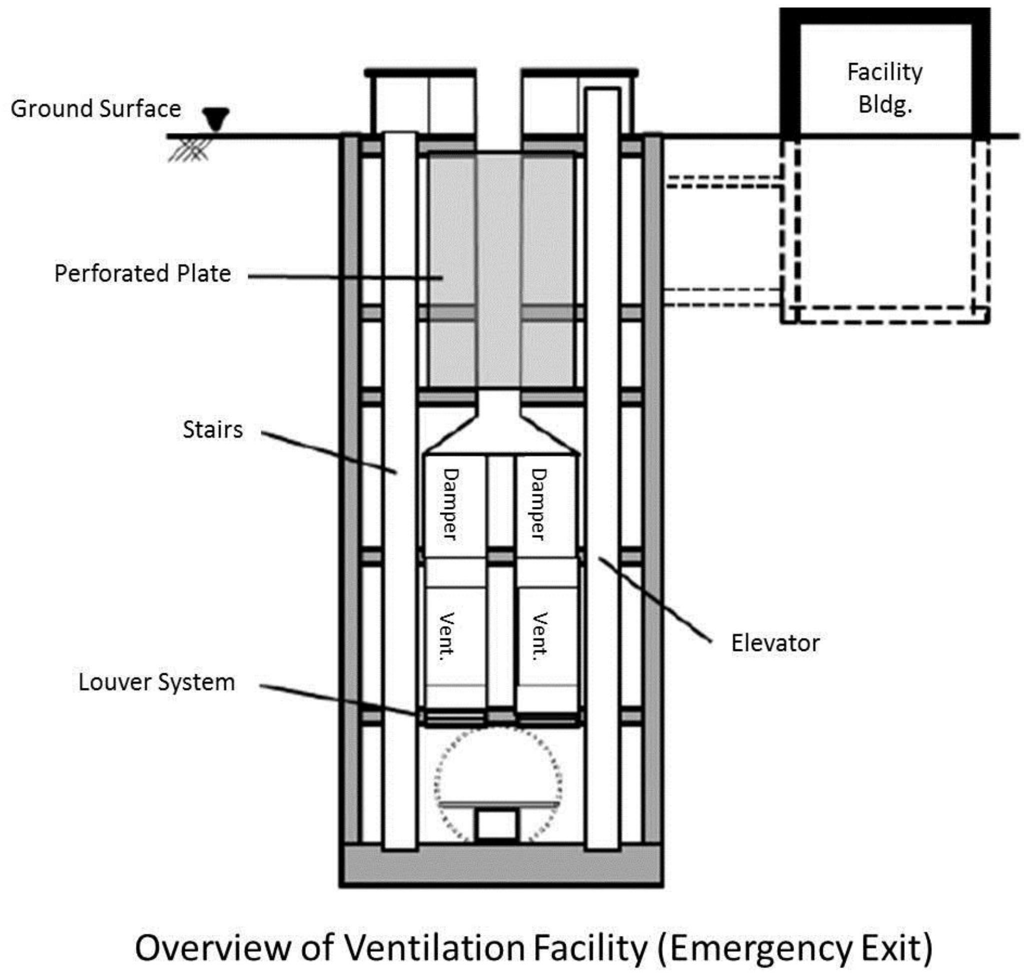
Although the primary purpose of the ventilation structures would be to remove smoke and supply fresh air in the tunnel in the event of a fire or other disaster, the fan system could also be operated in a low speed mode during warmer periods to maintain comfortable temperatures inside the tunnel for the benefit of maintenance workers.

The ventilation structures would be co-located with emergency exits to be used by train passengers and emergency response teams in the event of a fire or other condition that causes trains to stop in the tunnel. An independent ventilation system would be incorporated into the ventilation facility to maintain tenable conditions in the emergency evacuation passage that would be constructed below the guideways.

In addition to fan equipment, air shafts, and emergency exits, the ventilation structures would house control facilities and emergency response equipment. Approximately 3 acres would be needed for each facility, preferably sited directly over the tunnel. The spacing along the alignment, air shaft positioning over the tunnel, and size are compatible and result in an efficient design. The vent plant control rooms may be approximately 50 feet tall (anticipated height ranges from 1 to 5 stories), but exact dimensions and site specific details for the actual vent plant structures will not be available until preliminary engineering is completed, and will be included in the DEIS. For the Phase II analysis included in this alternatives report the entire footprint is assumed as a potential surface LOD, as reported in the quantitative results table in Chapter 4. See project drawings in Appendix E.

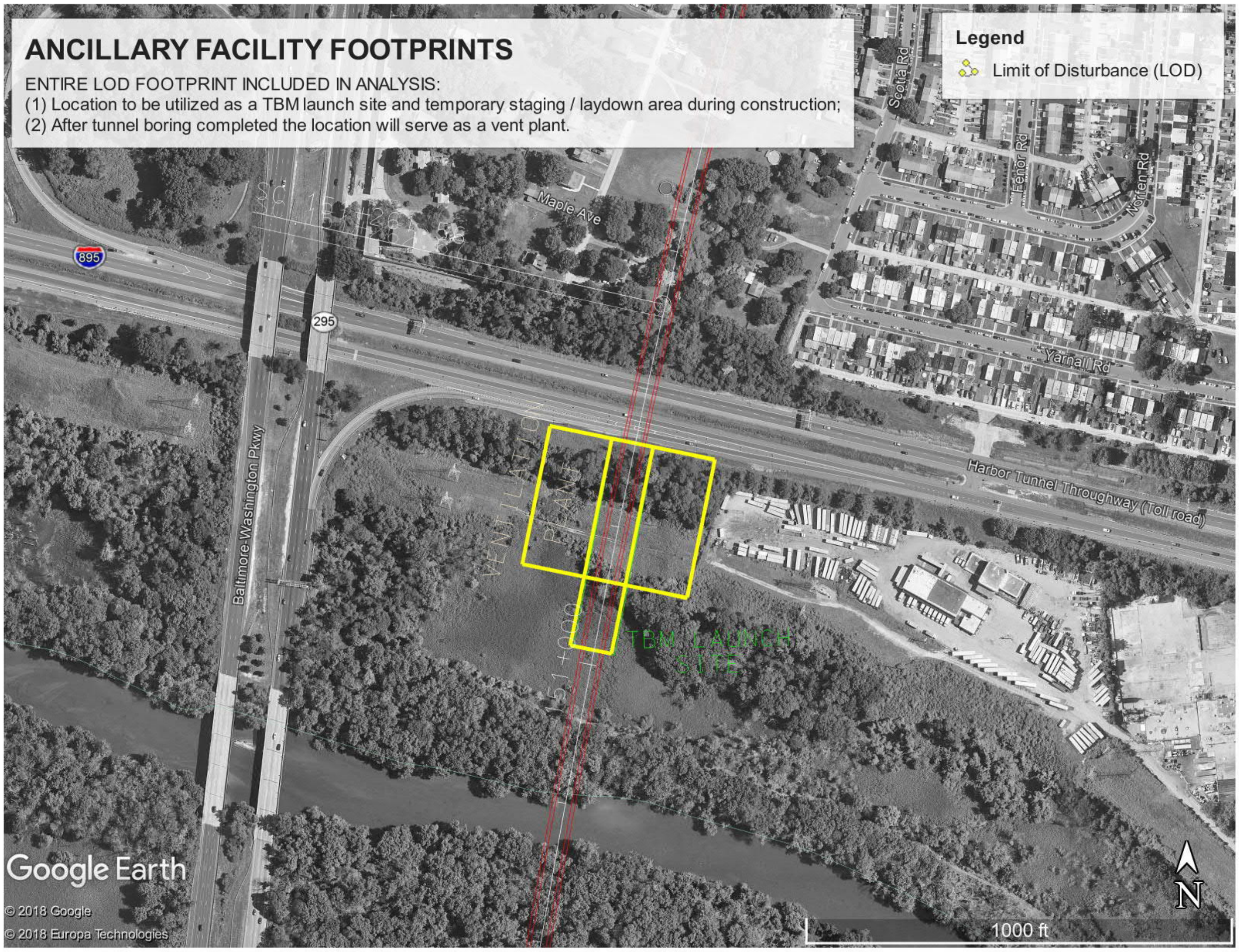
Given the compatibility of spacing, airshaft positioning over the tunnel, and size, the ventilation structure sites would serve as launch and retrieval sites for tunnel boring machines (TBMs) during construction. The vent shafts would have an approximate diameter of 100 feet, including air path of tunnel ventilation, air path of emergency evacuation passage ventilation, fans (separate fans for tunnel and evacuation passage), emergency exit stairs, and elevators. This dimension would be sufficient for launching and retrieving a 49 foot diameter TBM. TBM launch pits would be constructed first, which have approximate dimensions of 100 feet wide by 250-500 feet long (length may vary depending on site conditions), then the permanent vent plant would be constructed after the boring process and TBM retrieval is completed.

Figure 24: Conceptual Typical Section of SCMAGLEV Emergency Egress at Vent Plants



Source: Conceptual Illustration provided by BWRR.
(Actual Design TBD, Not to Scale)

Figure 25: Example Plan View of TBM Launch site and Vent Plant LOD Footprint



Emergency Egress

Emergency egress for passengers in tunnel sections of the route to a point of safety will be provided through an emergency evacuation passage inside the tunnel envelope. The tunnel cross section allots the space below the guideways as an emergency evacuation chamber. In the event of an emergency requiring evacuation, passengers will exit the train and use stairways (or slides) spaced periodically between the two guideways to access the emergency evacuation passage below. The passage will be ventilated independently of the upper portion of the tunnel to ensure clean air in the event of a smoky condition. Passengers will walk along the passage to the emergency exits, which will be co-located with the ventilation plants (Figure 24). The emergency exits and evacuation passage will also be used by local emergency rescue workers to enter the tunnel and access the incident area. See Figure B-3 in Appendix B for an illustration of how the emergency evacuation would work in deep tunnel.

Emergency egress and access for elevated viaduct structures would be provided via walkways along each side of the viaduct, which will include access stairways spaced along the route. Refer to the 12 map sheets in Appendix E for the vent plants/emergency egress locations along the corridor based on conceptual engineering.

In the event of a power failure, the wheels on the undercarriage will automatically descend. In most cases, the train will be able to coast into the next station. Emergency egress will be provided all along the route in the event people need to evacuate the train.

Site-specific details for emergency access for the viaduct portions will not be available until preliminary engineering is completed; however, the emergency egress locations for the tunnel portions would coincide with the vent plants. See Figure 25 above for an example plan view of the LOD footprint assumed for vent plant locations, which are also illustrated on project drawings in Appendix E.

SUBSTATIONS

Power substations energize stations and facilities, support linear infrastructure such as lighting and drainage pumps, and provide current to the coils in the guideway sidewalls to propel and levitate the trains.

Each substation can energize two sections of guideway at a time: one in the northbound direction and one in the southbound direction. A single substation cannot energize two sections of guideway in the same direction. Instead, a train is handed off from one substation to the next as it travels along the route. Consequently, one substation is required for every train traveling along the guideway in the same direction at the same time. For example, if the operating plan envisions three trains moving along the northbound guideway at the same time, three substations are required. Those same substations can simultaneously power three trains in the southbound direction. The power requirement for a 16-car SCMAGLEV train cruising at top speed is approximately 35MW.

The operating plan will dictate the number of substations required. Consideration will be given to planned future service to New York City in the design and location of the substations. Power redundancy will also be factored into the design.

The SCMAGLEV system requires approximately four substations based on conceptual-level engineering. Each substation would require an approximately 7 acres. The actual size will be confirmed following the development of the operating plan during preliminary engineering.. Different configurations that reduce the substation footprint may be feasible if required. For example, a stacked facility with dimensions of under 1.5 acres can be built in constrained areas. See Figure 26 below for a typical illustration of a substation. The approximate height of the tallest building/feature on the substation facility is anticipated to be 40 feet tall. Please see Figure 27 for a plan view example footprint of a substation location. Potential substation locations are shown on the alternatives drawings in Appendix E. To minimize impacts, substations would be collocated with SCMAGLEV vent plants and with the RSD site.

Figure 26: Typical Substation Layout

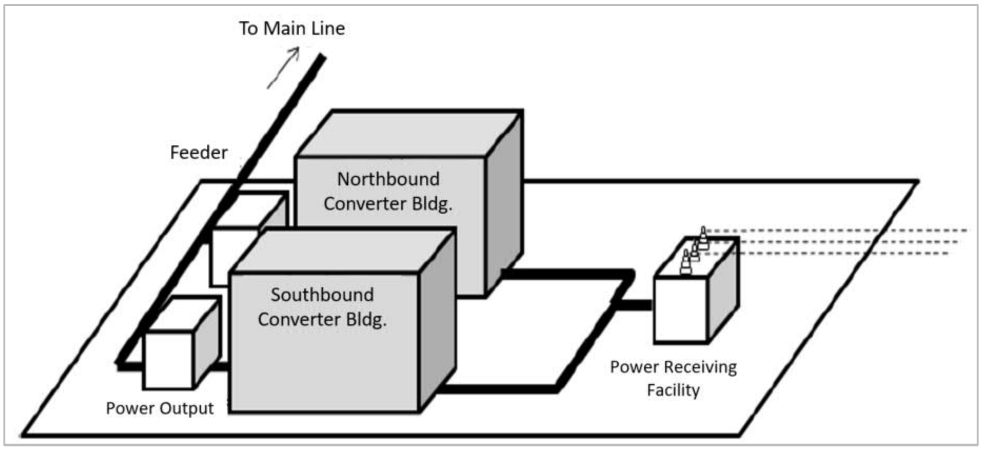
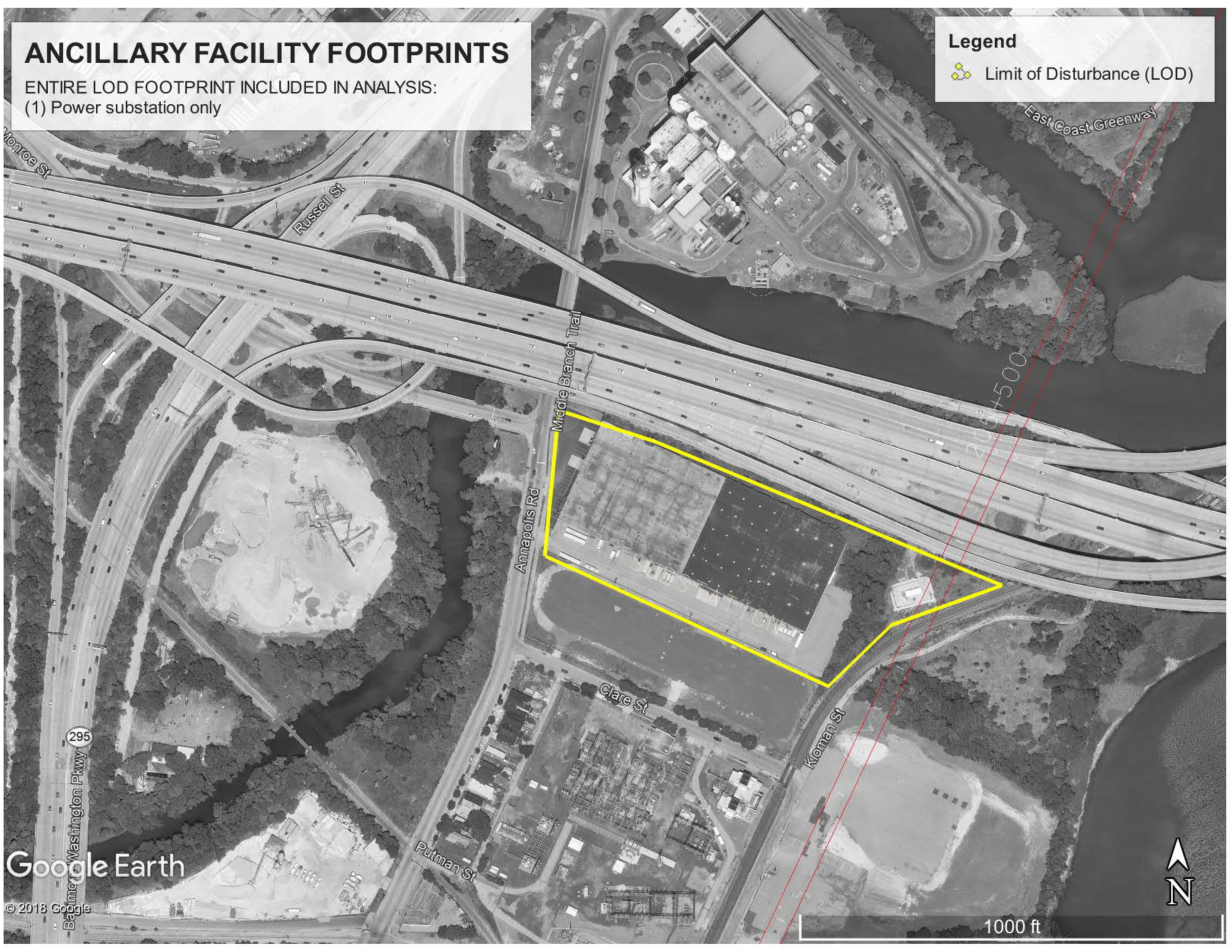


Figure 27: Example Plan View of Power Substation LOD Footprint



STATION PARKING

Parking garages would be required near the Cherry Hill LR SCMAGLEV and BWI Marshall Airport SCMAGLEV stations. See project drawings in Appendix E. Since the downtown areas are currently built out and have existing garages, new parking garages are not included in Washington, DC or Baltimore City at this time. During preliminary engineering, detailed ridership studies will identify the need and size of the parking garages. Local traffic impacts will be studied as part of the DEIS.

For the BWI Marshall station, parking needs would be coordinated with MAA. Based on coordination to date, the existing hourly garage at BWI Marshall Airport would be replaced by a new parking structure on the surface lot immediately to the north of the current location. Then, the BWI Master Plan includes the demolition of the existing hourly garage, which would provide BWRR an opportunity to construct the underground SCMAGLEV station cavern by top down methods, then a new parking garage and multimodal station would be built. Please refer back to Figure 13 in the station description section for an illustration.

For the Cherry Hill LR station, a new parking garage would be included near the station at Waterview Avenue and Cherry Hill Road. A conceptual LOD area for the new parking garage is illustrated on sheet 11 of 12 in Appendix E. Depending on potential transit oriented development (TOD) in the vicinity, parking may be incorporated as joint development or expanded with future developments. The parking needs will be reviewed during PE and updated as needed for the DEIS.

4. Description of Anticipated Construction Methods

Construction of the SCMAGLEV Project is anticipated to be accomplished through the award of one or more major construction contracts. The work would be largely linear, approximately 40 miles in length, and would be divided into multiple work fronts. As many as eight tunnel boring machines (TBMs) could be employed for this effort. The viaduct section in the center of each alignment alternative could also be constructed using two or more work fronts.

SCMAGLEV GUIDEWAY

Viaduct Construction

A single viaduct structure, approximately 46-feet wide, would carry two guideways. The structure would be built with precast concrete superstructure elements supported on concrete piers with pile foundations. The typical span of the viaduct structure would be approximately 120 feet. Longer spans would be used at locations where the alignment would cross waterway features, sensitive resources or existing infrastructure. A temporary work zone width of approximately 72 feet would be required under the viaduct during construction. Best management practices would be utilized to minimize surface impacts in park or natural environments. BWRR will develop more details during preliminary engineering based on the specific site conditions that require mitigation measures, which will be documented in the DEIS. Methods may include changing span lengths to allow flexibility of pier placements, limiting construction zones, or other options as negotiated with specific resource managers.

One or more contractors would be responsible for building the viaduct structure. Two or more work fronts would be anticipated, each with a laydown yard of approximately 0.7 acres. Laydown yard locations will be determined at a later date, potentially utilizing the space designated as permanent stormwater management during construction. Precast bridge deck segments would be delivered to the laydown areas on flatbed trucks from one or more precasting plants that could be located inside or outside of Maryland or Washington. Precast elements would be transported from the laydown yard to the active work front for installation using trucks or launching gantries mounted on completed viaduct sections.

The foundations for the elevated structures are expected to consist of deep foundations to limit the settlement potential, as required, to meet the guideway design requirements. The deep foundations could therefore consist of either pipe piles or H-piles with pile cap footings or drilled shafts depending on the subsurface conditions.

The superstructure for the elevated structures can be constructed using segmental concrete box beams or precast, prestressed concrete I-beams with concrete decking to support the guideways. Alternatively, structural girders may also be considered depending on the restrictions due to the electro-magnetic field from the SCMAGLEV system. The general constructability issues related to this type of construction involve the location of the casting beds for the precast elements to facilitate delivery to the bridge site as well as the erection system. For segmental box beam construction, it may be more economical to consider a gantry launching system versus a crane erected method depending on the available work zones along the alignment ROW.

Elevated viaduct construction, as required for the SCMAGLEV system, is conventionally used for highway and transit systems in the U.S. There are many contractors with the experience required for this kind of work, and sourcing the project will not be a problem. The work can be subdivided into separate construction contracts for each viaduct structure, and work can proceed simultaneously at multiple points along the alignment. The construction will involve the use of excavation equipment, pile drivers and large cranes. A construction zone ROW running the full length of the work area approximately 20 feet wide is desirable on at least one side of the alignment. Access to roadway network, access points to EMS (with system to update construction access to various locations) and railroad maintenance is required.

Access Roads

During construction, the contractor would install temporary access roads along viaduct structures for the delivery of materials. Best Management Practices would be employed, particularly for sensitive areas such as wetlands, to minimize surface disruption during viaduct construction. No permanent access road is required along the viaduct structure. Access for maintenance can be provided from the guideway level using equipment that reaches over the side of the viaduct.

FRA and MDOT would require permanent access roads to access emergency egress stairs from the viaducts. The spacing and locations of emergency stairs will be coordinated with the FRA Office of Safety and local emergency response providers. Stairs would be located adjacent to existing roadways, or in otherwise accessible areas, to avoid construction of new roadways. Further detail on access roads will be provided in the DEIS.

Tunnel Construction

Tunneling would be performed using Tunnel Boring Machine (TBM) construction, with minimal surface impacts except at TBM launch sites. The term Deep Tunnel has been used to indicate a tunnel that is constructed using a TBM. The minimum depth of a TBM is typically one tunnel diameter, or in this case 49 feet. The depth to the top of the tunnel varies from about 80 to 260 feet, with the variation resulting primarily from the ground contours above. Given the prevalence of soft soils in the corridor and anticipated groundwater conditions, tunneling is expected to be undertaken with Earth Pressure Balance Machines (EPBMs). EPBMs provide active face support to control the soil and water pressure as the cutterhead advances. A soil stabilizing agent, such as bentonite, foam or polymer, is injected into the ground as the machine advances. Information acquired from the soil boring program will be used to evaluate and select the TBM type and refine specifications.

The SCMAGLEV tunnels require a bore diameter of 49 feet, which is considered large by U.S. standards, although large-bore TBM tunneling has become common practice in the tunnel industry. The U.S. has recently deployed large-diameter EPBMs for two highway projects. The Alaskan Way project in Seattle deployed the largest EPBM machine built to date to construct a 57 foot bore diameter tunnel in soft ground conditions similar to those found in the Baltimore-Washington project corridor. The Port of Miami tunnel project utilized a 42 foot diameter EPBM machine. Although smaller in diameter, the twin WMATA Green Line tunnels beneath the Anacostia River were constructed using an EPBM in the mid-1980's that tunneled through saturated sands/alluvial deposits and the occasional boulder, and with about 1,500 feet of each tunnel constructed under the water table.

The TBMs can be expected to advance approximately 30 feet per day. With total bored tunnel lengths of 20 to 30 miles, depending on the alignment, multiple machines will need to be deployed concurrently for timely completion of construction. Hence, there will need to be a major investment in the procurement of EPBMs. These machines will be designed specifically for the project, taking into consideration tunnel diameter and the anticipated subsurface soil conditions to be encountered based on geotechnical soil boring results. A TBM with positive face control (an EPBM or even a Slurry Shield (SS) machine) would be utilized to reduce the risk of surface disturbance and voids.

The launch point of a tunnel bore will require a large staging area with a sizeable hole excavated to the depth of the tunnel invert. The EPBM will be partially assembled on the surface and lowered into the hole for complete assembly prior to launch. In addition to the cutterhead, an EPBM system includes substantial trailing equipment to support the operation of the machine, including building of the tunnel lining with precast segments and conveyance of the spoils (waste/excavated material – also referred to as muck) out of the tunnel. The muck is brought to the surface in the staging area, and then removed from the site using trucks or possibly rail cars. The required size of the launch point, coupled with the need for easy access for muck removal, will limit the potential starting point locations for tunnel boring contracts.

A significant effort will be required to manage muck removal for a tunnel of this size. At an estimated advance rate of 30 feet per day, soil removal totaling over 62,000 cubic feet per day would be anticipated for each TBM, weighing over 3,100 U.S. tons. This amount of muck would require removal by more than 250 dump trucks per day. The conceptual development of J and J1, specifically, the locations of proposed ventilation facilities and TBM launch sites near truck and freight rail routes, accounted for construction equipment and materials access, staging and storage, and spoils hauling.

The tunnel alignment will have to consider the proximity of WMATA's metro lines which cross over and under New York Avenue. WMATA requires a clearance of one tunnel diameter between its tunnels and the proposed SCMAGLEV tunnel. Similarly, the DC Water CSO line under construction under New York Avenue will have to be avoided in the design.

Tunneling under BWI Airport will be designed to be adequately deep to avoid adversely impacting the airport facilities, including the terminals and runways, and its operations.

A single-bore TBM tunnel with an outside diameter of approximately 50 feet would provide optimal aerodynamic and speed performance. Technology and capabilities of present-day TBMs allow for unimpeded tunneling and enhanced risk management. The alignment would be designed such that TBM tunneling would be performed under at least one tunnel diameter of ground cover to minimize surface impact. Sections of cut-and-cover tunneling would be used for the stations and the transitions between the viaduct and TBM tunnel sections, including portals and TBM launch locations. A waterproofing system would be installed to prevent groundwater inflow into the tunnel in the final permanent stage.

Generally, construction-staging locations for sections of the alignment in tunnel will be at the proposed ventilation plant locations, and staging locations for construction of transition, portal, and viaduct sections will generally be within areas within the proposed limits of disturbance defined in this report. Construction staging will be evaluated further during preliminary engineering in support of the detailed analyses in the DEIS.

Vent plant sites would be used as launch sites for the TBMs to minimize cost and streamline construction. With multiple launch sites and the slow TBM speed (approximately 30 feet per day), contractors should be able to manage the stockpiles of materials removed from the tunneling operation on a regular basis, during off peak travel times to the extent possible, to minimize the disruption to daily traffic. The engineering team provided footprints for TBM launch site/vent plants/laydown yards, based on conceptual engineering, as shown on the project drawings in Appendix E. BWRR will develop a plan and construction specifications for soil removal from the tunnel segments (spoils) during preliminary engineering; the NEPA team will review and discuss this further in the DEIS.

TBM tunnels in soft ground are typically supported by precast segments, which are installed behind the cutter head as the excavation progresses, producing a continuous lining along the tunnel length with a circular, uniform geometry. Each excavation round is followed by installation of segmental lining for the excavated length and therefore no ground is left unsupported. The excavated round is supported by the shield of the TBM until precast segment installation (installed inside the shield). The annulus between the installed lining segments and excavated ground is then grouted. Segmental linings are also equipped with gasket joints to inhibit groundwater inflow into the tunnel. The lining segments will be cast remotely (pre-fabricated) and shipped to the site, with sufficient segments stored on-site at all times for a pre-determined period of excavation progress.

TBM Laydown Yards

TBM machinery requires a portal/launch shaft, muck processing areas, and precast tunnel segment lining storage areas. The muck processing locations, where excavated materials would be sorted for alternative use or disposal, have not been identified, but these areas would not have to be located along the alignment. Muck could be transported by truck or rail to remote processing areas. Based on previous experiences with large-bore TBMs, a typical muck processing area would be approximately 1.7 acres.

Muck removal operations would generate construction-related traffic. The Alaskan Way Viaduct Replacement Program, for example, removed muck via barge to avoid the estimated 300 heavy truckloads per day. Similar magnitude truck traffic would be required for each TBM in operation for the project. Certain roadways in the project area could have truck traffic restrictions, which would require coordination with local authorities. A few of the proposed TBM launch sites would be adjacent to rail lines, which would potentially offer another means of removal. Potential sites for the permanent disposal or use of excavated materials would be identified during preliminary engineering. Associated environmental impacts, such as traffic impacts and noise, will be assessed in the DEIS.

Precast tunnel lining segment storage would be required for the TBM operations, with a typical size of approximately 1.2 acres. The segment linings would be cast remotely and shipped to the site. Storage yards could be located at the TBM launch sites or distant storage yards. For example, the Hampton Roads, VA, tunnel project had tunnel lining segments cast in Baltimore and shipped to the construction site by barge.

SCMAGLEV STATIONS

The J and J1 alignment alternatives include underground station alternatives in Washington, D.C., an underground station at BWI Airport, and underground and above ground station alternatives in Baltimore, MD. For underground stations, the preferred method of construction uses top-down methods, where surface access would be available. Top-town construction was used for stations in the Washington Metro system. Support of excavation is installed around the perimeter of the station footprint, typically using slurry walls or sheetpiles, the station area is excavated to the required depth, and the station box is constructed. The top of the hole is backfilled and the surface is restored. Top-down construction can be phased to minimize daytime lane closures to one or two lanes. Excavated material will need to be removed from the site by trucks. Underpinning could be required for buildings in proximity to the station, depending on existing foundations. If the station box traverses under a building or other infrastructure, such as a metro tunnel, mining techniques will be used such as New Austrian Tunneling Methods (NATM) or Sequential Excavation Methods (SEM) tunneling. NATM and SEM involve incremental support and advancement of excavation under monitored conditions. Some amount of NATM/SEM construction is envisioned at each of the three underground station options. A waterproofing system would be installed to seal the stations on all sides.

The above ground station alternatives would be constructed using conventional building construction methods, with deep pile foundations and steel or concrete framing. In both Baltimore and Washington station alternatives, some portion of the station and/or its approaches could be built on elevated structure to cross over existing roadways and railway lines. Contractors may utilize Precast structural elements (pieces built offsite, transported to the construction site, and then lifted/slid into place) to minimize disruptions in spanning over the active transportation infrastructure.

For underground station alternatives, a separate vent draft relief shaft would at most add 1,080 square feet to the station footprint if not incorporated into the station footprint. The vent shaft could be incorporated into a headhouse building/entrance, can rise to street level to release air through street grates, or be shunted to an adjacent site or building. Waterproofing methods have been developed for the construction of underground stations. Details would be provided in the preliminary engineering drawings. Entry points to the station would be raised above the 100-year flood level. Drainage and pumping systems would also be provided.

INTERFACE WITH OTHER INFRASTRUCTURE (ROADS/BRIDGES/RAIL SYSTEMS/STRUCTURES)

Constructing the required tunnels and viaducts along either alignment would interface with existing infrastructure. Continuous permanent access roads along the viaduct or portal sections would not be required; however, access roads would be provided to points of emergency evacuation. Any new access roadway or impacts to existing roadways and/or roadway reconstruction will be coordinated with the corresponding agency regarding design characteristics, including bicycle and pedestrian facilities as appropriate. These details will be developed in the preliminary engineering stage and discussed in the DEIS. Based on coordination to date, the SCMAGLEV project would not preclude other projects.

Viaduct portions of Alternatives J and J1 alignments would cross over several existing roadways. The SCMAGLEV viaduct would span over the roadways with a minimum of 18 ft. of vertical clearance below. In addition to roadway clearances, the viaduct height is controlled by the need to maintain a minimum distance of 20 feet between the magnets along the guideway and people traversing below. Impacts to the roadways by the viaduct would be limited to piers in the median of divided roadways and temporary disruptions or lane closures during construction.

Deep tunnel sections of the alignments would have no surface impacts beyond typically expected micro settlement (a slight depression that could possibly form in the existing ground above the tunnel) or heave (a slight mound/hump that could possibly form in the existing ground above the tunnel). The results from geotechnical test borings along the corridor allow the project sponsor to utilize TBMs specifically designed for this corridor to reduce the risk of surface disturbance and voids, as discussed previously in tunnel construction section. Investigation and study of similar tunneling projects around the world (and in Washington DC currently in progress) evidences that the tunnel boring process is imperceptible at surface level for deep tunnels. The potential impacts to residences, impacts to businesses and critical infrastructure, including the roadway network and the Anacostia River Flood Control System, will be evaluated in the DEIS as appropriate.

The RSD location proposed on the BARC property would require realignment of Springfield Road in Laurel, Maryland. Soil Conservation Road could also require an adjustment. The alternative RSD site north of MD 198 would require modifications to local roads. In addition, the project team may consider terminal support facilities near Baltimore depending on space availability and zoning.

Construction of the Washington, DC underground station options at Mount Vernon Square would temporarily impact New York Avenue from 6th Street NW to 12th Street NW. The location would be proximate to three Washington Metro stations: Gallery Place, Metro Center, and MVS/7th St/Convention Center. Underground connections to one or more Metro stations could be provided. The Mount Vernon Square SCMAGLEV station would also be convenient to the proposed expansion of the DC Streetcar network.

The NoMa SCMAGLEV station options would be either above or below Florida Avenue NE and 1st Avenue NE. They would be accessible to the Washington Metro Red Line New York Avenue Station. Amtrak Union Station and the Washington Greyhound Bus station would be approximately 0.6 miles from NoMa, along with connections to the proposed DC Streetcar system.

For the NoMa elevated station option, the existing 9th Street Bridge over Amtrak/NY Avenue would require reconstruction. In order to construct a cut-and-cover tunnel at this location, two of the bridge spans would have to be temporarily removed and reconstructed and one bridge pier would need to be shifted closer New York Avenue in order to fit the new SCMAGLEV transition portal between the existing rail tracks and the roadway.

The underground BWI Marshall Airport station would have temporary impacts to the airport terminal circulation road during construction. The station would connect to the airport terminal and provide access to the BWI Marshall Airport stop on the MDOT-MTA light rail system, as well as bus lines that serve the airport.

Two options are under consideration for the Baltimore station. The elevated Cherry Hill LR SCMAGLEV station would have direct connections to the MDOT MTA Cherry Hill LR station and local roadway system. The station could require modifications to the roadway network that would pose temporary traffic disruptions during construction. The elevated Cherry Hill Station would potentially temporarily disrupt light rail and CSX operations during construction as well, but this may be minimized by coordinating the construction and respective operating schedules. For the Cherry Hill LR elevated station option, the transition portal could require Patapsco Avenue/Annapolis Road intersection to be raised approximately three feet. This will be confirmed during preliminary engineering and discussed in the DEIS.

The underground Camden Yards SCMAGLEV station option in downtown Baltimore would be convenient to MARC, light rail, subway and buses. The construction could temporarily disrupt traffic on streets over or around the station footprint. The Alternatives Report considered surface impacts relating to the potential entrance points for the Camden Yards station assuming the underground station would be constructed by TBM and mining the cavern and underpinning the buildings above, if needed. However, approximately three city blocks would need to be analyzed in the DEIS if top down construction methods were utilized for the Camden Yards station option.

INTERFACE WITH UTILITIES

The viaduct portions of Alternatives J and J1 would impact aerial transmission lines, including some high-tension lines owned and operated by Baltimore Gas & Electric (BGE) and the Potomac Electric Power Company (Pepco). Both public utilities are owned by Exelon. Alternative J would parallel a BGE high-tension transmission line corridor for approximately 1.1 miles in the vicinity of MD 198. BWRR is in coordination with both utility companies. Transmission line mitigation measures to be addressed during preliminary engineering will include options to raise, lower or bury the lines near SCMAGLEV infrastructure. The alignment alternatives would not cross any major substations. Other aerial utility impacts will also be identified and addressed during preliminary engineering.

The SCMAGLEV underground stations would typically be 100 feet to 130 feet deep. In addition, minimum SCMAGLEV tunnel depths of approximately 50 feet would avoid impacts to most underground utilities. An exception is the DC Water Combined Sewer Overflow (CSO) Northeast Boundary tunnel (under construction in 2018) that crosses New York Avenue south of Montana Avenue NE at a depth of approximately 90 feet. The SCMAGLEV tunnel would be designed to avoid the CSO tunnel. Other major existing underground utilities, if any, would be avoided, where possible.

Transition portals, TBM launch sites, and underground station alternatives would be constructed using “top down” methods to the extent possible. Station excavation would impact utilities buried near the surface, such as water, sewer, power, and communications systems. As an initial phase of the construction work, utilities would be relocated, replaced, or, in some cases, supported in place, to allow station excavation to proceed. Once the station footprints are defined, impacted utilities will be identified and designs will be undertaken to address temporary and permanent solutions.

Elevated station alternatives would also require some utility relocation work, in particular at locations of building foundations. Bridge pier locations for above ground stations and viaduct would be designed to avoid impacts to underground utilities, where possible.

Ultimately, the construction contractors would address utility impacts by one of several measures: removal, relocation, re-routing, vertical adjustments, or modification. Proactive coordination and meetings with utility providers will be undertaken to address and mitigate each impact. Mitigation measures (such as burying overhead transmission lines or realigning underground pipes) could impact existing travel ways during construction, and would be coordinated with the affected government entity, accordingly. Construction would coincide with an extensive monitoring program of utilities. The utilities would be evaluated for sensitivity to ground settlement and monitored to ensure they would not be adversely impacted.

STORMWATER MANAGEMENT (SWM)

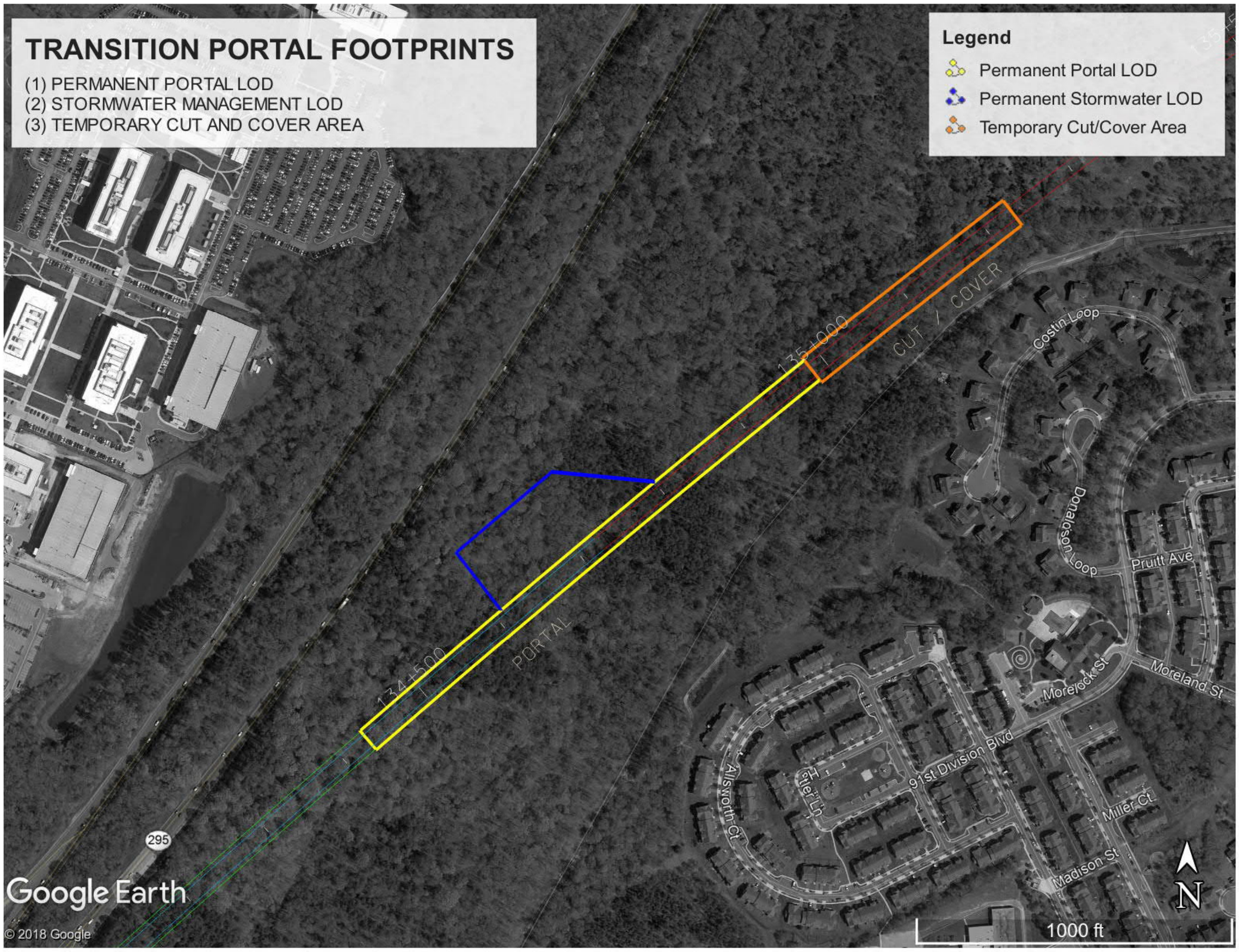
As the SCMAGLEV will operate interstate, its construction and operation will be regulated preemptively by the Surface Transportation Board (STB). The STB's preemption extends to environmental reviews of the construction and operation of railroads that are subject to its jurisdiction..

Stormwater for the viaduct portion would be collected in the bottom of the guideway and piped down the piers to outlets on the ground below. Stone aprons at outlets would be constructed to minimize erosion and disperse flows. Where necessary, the runoff would be detained and/or treated through Best Management Practices (BMPs) such as bio-retention areas, treatment swales, or linear ponds. The goals would be to detain and treat as much runoff as possible within the right-of-way (ROW). The contractor would restore the land underneath viaducts to natural ground cover with the exception of pier areas. The tunnel portals, stations, vent shafts and other potential points of water ingress will be designed to withstand the 100 year flood. SWM will be documented in the DEIS based on preliminary design.

The RSD would comprise of buildings, guideways, and paved parking lots that would create impervious surfaces. The runoff from these surfaces would require treatment and detention. The RSD location would connect to the main line via guideways ramps that would be elevated. The RSD final layout and dimensions are dependent on the size of the proposed fleet, and will be determined following the development of the operating plan. For this report, Stormwater retention areas are assumed to be contained within the RSD footprint. SWM will be documented in the DEIS based on preliminary design.

SWM will need to occur where the alignment would transition from tunnel to viaduct at the portal structures. Runoff would be collected at the “low” end of the portal, prior to the guideway entering into deep tunnel. Runoff would be pumped or drained to the SWM area adjacent to the portal structure. See Figure 28 below and drawings 5, 6, and 7 in Appendix E for the potential stormwater management surface footprints for tunnel portals, based on conceptual engineering. The DEIS will document any change to the currently assumed SWM area based on the ongoing preliminary engineering.

Figure 28: Plan View of Example Transition Portal Footprint



Chapter 4. Evaluation of Alternatives

Phase II consists of the evaluation of alternatives and is based on the conceptual engineering LOD, which includes: the footprint for the viaduct sections of guideway, the footprint for stations (either underground or elevated, as applicable), the footprint of each respective RSD site, the proposed station elements surface LOD (entrance points, temporary construction, and potential parking), and the footprints for the proposed ancillary facilities (vent plants/substations/TBM launch sites). The LOD for the mainline guideway is typically 72 feet wide when on viaduct. The LOD footprints for the ancillary facilities vary by each component and are sized to capture minor changes to site element locations during alternative refinements.

The body of the report focuses on the total number of occurrences and/or acreages of resources within in the surface LOD footprint for each alternative. However, the study team computed the quantities for tunnel LOD footprint as well, which can be found in Appendix C and Appendix D.

A. Evaluation Criteria

The potential station locations developed by BWRR needed to be assessed to determine which were to be retained and paired with the retained build alignments for inclusion in the quantitative GIS desktop analysis as a component option of the two alternatives. Key criteria used by FRA to evaluate stations were ROW, land use, transportation, environmental, cost, constructability and operations. See Table 1 for the qualitative criteria used by the project team during the station assessment.

The refined alignments for the build Alternatives J and J1 must continue to meet the acceptable geometric design criteria listed in Appendix B. Based on conceptual design, both the horizontal and vertical geometry for the refined J and J1 alignments continue to meet the design criteria. The vertical profiles are subject to change during preliminary engineering based on data from the soil boring program. BWRR contractors have completed the soil boring field work and their engineering team is compiling the draft results report. Based on early review of data gathered to date, the engineering team does not anticipate major changes required to portal locations or other facilities, just tunnel depth. Therefore, any future refinements should have minimal variance from the findings of this Alternatives Report, but any changes will be documented in the subsequent DEIS.

See Table 2 on the following page for the quantitative evaluation criteria utilized in the Phase II evaluation on the alternatives (now composed of the alignments, the station options retained during the station assessment, the RSD options, and the footprints for the respective ancillary components). FRA and MDOT based this GIS analysis primarily on desktop level research of available resource inventories found in the study area. Although this analysis does not include field surveys, the study team conducted site verifications of some resources to validate this analysis. Fieldwork, modeling and detailed technical evaluations will be completed as part of the DEIS.

Table 3 presents the qualitative station assessment results. Table 4 summarizes the quantitative results from the evaluation performed on the surface LOD footprint for mainline viaduct sections, cut and cover portals, ancillary support facilities, and construction areas. For instance, the quantities reflect the potential number of occurrences where parcels located in the surface LOD footprint for the viaduct sections and/or the acreages of resources in the LOD designated as a surface footprint only.

The study team also tabulated the resulting quantities for the underground/tunnel LOD. Appendix C presents the total project summary table that includes both the potential impacts from the surface LOD footprints plus the associated tabulation of parcels ore resources above the underground/tunnel LOD footprints. Appendix D contains the result tables broken down by the various station and RSD combinations.

This methodology does not make an impact determination with respect to the potential displacement of properties; its purpose is to compare potential impacts between Alternatives J and J1 using the evaluation criteria in Table 2. For example, the number of residential properties in the LOD represents a combination of properties that would have potential sliver/partial impacts to potential impacts affecting more than a sliver of each respective property. The study team will conduct a more detailed analysis in the DEIS to assess the extent of the impact and provide a plan for avoidance, minimization, or mitigation.

Table 1: Qualitative Station Assessment Criteria

Criteria		Description
ROW	Property Acquisition	Potential Number of Residential Displacements;
		Potential Number of Commercial Displacements
Land Use	Station-Oriented Land Use in Vicinity	Proximity to existing or planned activity centers
		Potential for Development-oriented zoning or policies
	Development/ Redevelopment Potential of Surrounding Parcels	Potential for Suitable, available land or re-developable buildings for joint station development
Transportation	Connectivity and Accessibility	Walking proximity to fixed guideway transit/rail station
		Driving time proximity to regional highway system
		Capacity of roadway system to accommodate increased auto-taxi trips
	Parking	Potential Number of parking facilities within a 1/4 mile or space to construct adequate parking
Environmental	Environmental Impacts (Station or Approach)	Potentially Requires use of parkland
		Potential Adverse effect on historic property
		Potential adverse effects on environmental justice community
Cost	Magnitude of Cost	Estimated Cost differential relative to NoMa for DC Stations and Cherry Hill for Baltimore stations
Constructability	Interface with other infrastructure or complex conditions (Station or Approach)	Potential for Building underpinning or other infrastructure supportive requirement
		Potential for Construction over/under active roadway/rail
		Potential for Permanent impacts on other infrastructure
		Potential that Alignment impacts utility or other land use that is not movable
Operations	Alignment Compatibility	Satisfies the 15-minute trip time for Baltimore-Washington
Notes:	BWRR developed station locations within the retained PASR station zones. Some zones had more than one station concept to assess during Phase II.	

Table 2: Quantitative Evaluation Criteria

Criteria	Description
Residential Parcels	Number of residential parcels in the surface Limit of Disturbance (LOD). The amount of each respective property in the LOD varies from small slivers to larger portions. Some parcels include HOA common space or undeveloped parts of the parcels, not houses. A more detailed assessment of specific property impacts and type of impact (for example direct or indirect) will be made in the DEIS.
Commercial Parcels	Number of commercial parcels in the surface LOD (includes office buildings, retail stores, warehouses, & heavy commercial / industrial uses). The amount of each respective property in the LOD varies from small slivers to larger portions. A more detailed assessment of specific property impacts and type of impact will be made in the DEIS.
Low Income Census Block Groups	Number of low income census bock groups in the surface LOD. A low-income area is defined as those with a median household income at or below the Department of Health and Human Services or Census Bureau poverty guidelines.
Minority Census Block Groups	Number of minority census block groups in the surface LOD. Minority populations are defined as those where the minority (Black, Hispanic, Asian-American, or American Indian and Alaskan Native) population of the affected area exceeds 50-percent or is meaningfully greater (10 percent) than the minority population percentage in comparison to the respective county average.
Community Resources	Number of community resources (churches, schools, cemeteries, health care/emergency facilities, etc.) in the surface LOD.
Historic Sites and Landmarks	Number of Historic Landmarks and Eligible National Register Sites & Districts in the surface LOD, including properties potentially subject to the Section 4(f) and/or Section 106 process. [Note: Federal Parkland is addressed individually].
Non-Federal Parks	Number and acreage of State/County/Local Parks in the surface LOD, including properties potentially subject to Section 4(f).
NPS Property	Acreage of properties noted as NPS Land in the surface LOD, including the Baltimore-Washington Parkway (BWP).
PRR	Acreage of property noted as Patuxent Research Reserve (PRR) Land in the surface LOD.
Fort Meade	Acreage of properties noted as Fort George G. Meade Land in the surface LOD.
BARC	Acreage of properties noted as Beltsville Agricultural Research Center (BARC) Land in the surface LOD.
NASA-GSFC	Acreage of properties noted as Federal Land in the surface LOD, Specifically NASA - Goddard Space Flight Center (GSFC).
Ecological Resources	Acreage of ecological resources in the surface LOD. Ecological resources consider a wide range of natural areas and species including forests; migration corridors; rare, threatened and endangered species; critical habitat and sensitive species protection areas; wildlife refuges; and conservation easements. The Maryland Department of Natural Resources (MDNR) datasets include Forest Interior Dwelling Species (FIDS), Forest Conservation Easements (FCE), and Sensitive Species Project Review Areas (SSPRA).
Natural Resources	Acreage of Wooded/Forest Areas, Wetlands, Wetlands of Special State Concern (WSSC), and 100-Year floodplains in the surface LOD.
Notes:	1. The quantitative desktop screening applies the criteria in this table to the LOD for each alternative as provided by the BWRR engineering team as of May 22, 2018. Any component or features not provided will be evaluated during the DEIS as engineering is refined. 2. The quantities in Table 5 summarize the total number of occurrences and/or acreages of resources in the surface LOD for each alternative, which includes: • the surface footprint for the viaduct sections of guideway, • the surface footprint for stations (as applicable), • the surface footprint of each respective RSD site, • the proposed station elements surface LOD (entrance points, temp. construction, and potential parking), and • the surface footprints for the proposed ancillary components (vent plants/substations/TBM launch sites). 3. The study team also computed the quantities separately for tunnel LOD sections versus surface LOD footprint sections. The Total Project Summary Table (Surface + Tunnel Results) is located in Appendix C. 4. The detailed evaluation results tables (by station terminus combinations) are located in Appendix D.

B. Qualitative Station Assessment

The project team used objective qualitative criteria to determine the advantages and disadvantages of alternative station locations, as shown in Table 1. The station assessment narrowed down the station locations to be included in the quantitative desktop analysis as components of the alternatives, as shown in Table 3.

BWRR coordinated with WMATA about several potential SCMAGLEV station locations in the District, specifically, NoMa, Mount Vernon Square, Farragut Square. WMATA clearly favored an SCMAGLEV Station in the Mount Vernon Square area over the other two areas. NoMa was the least favorite of the three locations discussed given the agency's interest in not adding more passengers to the already overcrowded Red Line, the only metro line serving NoMa. Further details regarding the qualitative station assessment follow below:

Camden Yards Station (Underground)

A station location in Camden Yards is in an area with heavy traffic and would require temporary traffic disruptions during construction. The proposed station alignment does not follow the street grid; therefore if top-down construction were selected, then several buildings (over the span of approximately three blocks) would be demolished. There is the potential for approximately three downtown buildings needing underpinning, plus the potential need to support active rail lines and roads. Buildings and elevated roadways directly impacted by the construction of the deep underground station and its approach tunnel that would require temporary or permanent underpinning support include the M&T Bank Stadium, MLK Boulevard viaduct, Federal Reserve Bank of Richmond, Baltimore Convention Center, and the historic Otterbein Church.

There is a potential adverse effect on one historic property, the Old Otterbain Church. However, the downtown Baltimore location is pedestrian oriented, has multiple fixed guideway transit options (approx. 1,100 feet to Camden Yards LRT and MARC Station), is within a mostly built out area with many existing parking garages, and is located closest to the regional highway system. As noted in Table 3, the estimated cost differential relative to the Cherry Hill SCMAGLEV Station (Baltimore Station Base Case) is an additional $1.4 Billion to construct the underground Camden Yards SCMAGLEV Station.

FRA and MDOT retained this station location for the DEIS. See Sheet 12 of Appendix E for the project drawing illustrating the Camden Yards Station.

Calvert / Light Street Station (Underground)

This location would not provide a direct connection to an intermodal facility, and would require passengers to walk approximately 2,100 feet to the Camden Yards LRT and MARC Station. This station would require easements and underpinning (for approximately seven downtown buildings, plus the potential need to support road infrastructure) or the demolition of existing buildings (over the span of approximately three blocks) since the station cavern is on a diagonal and does not align with the existing street grid. An underground station located near Calvert/Light Street in the Baltimore Inner Harbor Station Zone is also in an area with heavy traffic. There is a potential adverse effect on one historic property, the Old Otterbain Church. The Calvert/Light Street station is in close proximity to the Inner Harbor waterway, which would require a Department of the Army permit for any proposed impacts to aquatic resources to the inner Harbor. The location would potentially require the use of McKeldin Fountain for station access and is a longer walk for pedestrians to access other fixed guideway transit options. As noted in Table 3, the estimated cost differential relative to the Cherry Hill SCMAGLEV Station

(Baltimore Station Base Case) is also an additional $1.4 Billion to construct the underground Calvert / Light Street SCMAGLEV Station.

Based on this assessment, FRA and MDOT dropped this station location from consideration.

Port Covington Station (Underground)

A potential station at Port Covington was eliminated by the project team because: (1) lack of connectivity to other rail/transit (no existing light rail); and (2) constructability issues should the Port Covington development be constructed with deep building foundations as proposed, prior to the SCMAGLEV construction (potential Port Covington Station does not line up with existing or planned street layout). As opposed to the other Baltimore station location options under consideration, there is no fixed guideway transit service at Port Covington. The developer is considering a light rail extension to the property. However, that light rail extension is not reasonably foreseeable as it has not advanced to consideration under NEPA nor is it in the financially constrained long-range transportation plan. Without meaningful connectivity to a reasonably foreseeable fixed guideway transit service, a Port Covington station location would not provide a logical terminus for SCMAGLEV as access to the station would be limited. As proposed, the Port Covington development would be constructed prior to the construction of SCMAGLEV. The deep foundations of the Port Covington buildings would essentially prevent construction of the station box and approach tracks.

It is possible to orient a Port Covington station to align for potential future through service. However, such a station orientation on Port Covington would almost entirely transect planned future development, including buildings with deep foundations, under the approved Port Covington Master Plan (avoiding the foundations of future buildings would require that the station box be aligned with the street grid which results in a station orientation that could not accommodate potential future through service). Based on discussions between BWRR and the Port Covington developer, the developer has stated that the only way for a station to be accommodated in a way to account for the planned development would be for the station box to be constructed prior to the development's construction (similar to the box that was constructed in New York's west side in anticipation of Amtrak's Gateway Tunnel project so that private development over the alignment could proceed without precluding the proposed gateway Tunnel). The Port Covington developer announced in April 2018 that it is commencing the next phase of development on the site in 2018 with occupancy expected by 2020. Given the developer's timeline, a Port Covington station location is not reasonable as it could not be constructed in advance of the developer's constructing buildings that would preclude locating a station on the site.

The location would provide good access from I-95 for auto travelers. However, the lack of a fixed guideway transit connection substantially diminishes this location as a logical terminus for SCMAGLEV, especially relative to the other locations under consideration that have such connectivity. It was understood during preparation of the PASR that the developer was studying a light rail extension. However, in the time since the PASR publication, the concept of a light rail extension has not advanced to the degree to be considered reasonably foreseeable. As noted in Table 3, the estimated cost differential relative to the Cherry Hill SCMAGLEV Station (Baltimore Station Base Case) is an additional $1.1 Billion to construct the underground Port Covington SCMAGLEV Station. The Port Covington location is dropped from consideration.

SCMAGLEV Cherry Hill LR Station (Elevated)

The Cherry Hill site was initially considered in large part because the ground contours allowed for construction of an above ground station, with cost savings over the other Baltimore concepts. Even though it is approximately 2.5 miles from downtown Baltimore (Camden Yards), Cherry Hill is the only site near the downtown area that could accommodate an above ground station. An underground station was not developed for Cherry Hill. The last mile access to downtown can be accomplished by a number of means: auto or shuttle bus: 8 - 18 minutes via multiple routes by auto; or by light rail: the LRT is located under the SCMAGLEV station (7-8 minutes travel time with LR trains approximately every 15 minutes) from Cherry Hill. The trip from Cherry Hill to Camden Yards would take approximately 16 to 22 minutes by bicycle, depending on the route

Constructing a station over the CSX, LRT and local roadways is far less disruptive and complex then constructing an underground station below them. An underground station would require installing temporary and permanent support systems under the existing transportation lines. The temporary support system of piles and beams would have to carry the rail lines and roadways during excavation and construction of the station cavern. Given the great width of the station cavern (approximately 148 feet), the temporary support structures to carry a freight train would be enormous. The temporary supports would then have to be transferred to permanent substructures founded on the roof of the station box. The box would have to be designed to support the freight rail loads for Cherry Hill.

Construction over the LRT will have to be coordinated during nighttime hours or limited shutdowns, and is not viewed as a significant challenge. The proposed Cherry Hill Station does not involve a crossing of the Amtrak NEC. CSX uses the tracks crossed by the Cherry Hill Station option for two trips per day. Construction of the Cherry Hill station over a CSX track used twice per day is not comparable to the NoMa station challenges of construction over an active Amtrak railyard. The proximity to CSX tracks, in this case, is less of an issue with respect to intrusion protection because of the slow speeds of the CSX trains over these tracks. The Cherry Hill LR station option would need to address potential impacts to CSX. BWRR is actively coordinating with CSX on this potential crossing and any effect of the crossing is expected to be mitigated.

The elevated station concept also allows for potential terminal facilities (tail tracks, a Maintenance of Way (MOW) facility, and other support facilities). The benefit of tail tracks at this location reduce costs of deadheading (running empty) trains back and forth to the proposed RSD during off-peak periods. It would also benefit operations by maintaining ready standby trains at the station in the event of an equipment failure. However, having tail tracks would not be a requirement for the system. The Cherry Hill area has the potential for transit oriented development (TOD) and space is available to construct an adequate parking facility adjacent to the station.

By applying the station evaluative criteria, a station at Cherry Hill satisfies all the station evaluation criteria because of (1) location in an area of streets having good traffic flow; (2) construction obstacles (CSX tracks) can be addressed with relative ease and efficiency; (3) provides a direct connection to the Cherry Hill LRT Station; and (4) is relatively cost effective. As noted in Table 3, the estimated cost to construct the Cherry Hill SCMAGLEV Station (Baltimore Station Base Case) is $1.4 Billion less than what would be required to build either the Camden Yards or the Calvert / Light Street SCMAGLEV Station; the Cherry Hill SCMAGLEV Station would be $1.1 Billion less than Port Covington and $900 Million less than the Westport Station.

This location is retained for the DEIS. Please see Sheet 11 of Appendix E for the project drawing illustrating the elevated Cherry Hill LR SCMAGLEV Station.

Westport Station (Underground)

An underground station option was considered in Westport adjacent to the Westport LRT station. There would be direct pedestrian connection to the Westport LRT Station with available space to construct adequate parking adjacent to the station. The Westport site did not allow an above ground station due to vertical geometry constraints. Similar to the Calvert/Light Street station, the Westport Station option is also in close proximity to potential waterfront development, which would require a Department of the Army permit for any proposed impacts to aquatic resources as well. The underutilized adjacent industrial area provides an opportunity for redevelopment, but unclear soil conditions may require remediation or special removal/hauling/disposal. A potential underground station in the Baltimore Westport Station Zone was dismissed because (1) a future alignment beyond Westport would cross and impact the large BGE gas tank complex immediately north of I-95 and (2) the station at Westport would need to be underground to accommodate future development plans of the site's owner, which would add approximately $900M in capital cost vs. the above ground station at Cherry Hill. This location is dropped from consideration.

BWI Marshall Station (Underground)

The BWI Marshall underground station is the only intermediate station, also specified in the notice of intent to prepare and Environmental Impact Statement, and is required for either alternative. The SCMAGLEV Station at BWI Marshall would provide a direct intermodal connection to the airport terminal and also to the LRT Airport Station. It is in good proximity to highway access that experiences minor airport terminal queuing during peak travel times. Potential impacts to the airport operations are being coordinated with MAA and FAA.

The BWI Marshall station is retained for the DEIS. Please see Sheet 9 of Appendix E for the project drawing illustrating the SCMAGLEV Station at BWI Marshall Airport.

NoMa Station (Elevated)

The elevated station option at NoMa would be at the edge of the scenic viewshed and L'Enfant Plan restrictions are possible at this site. The existing 9th Street Bridge over Amtrak/New York Avenue would have to be reconstructed in the area as a result of the cut-and-cover tunnel construction to complete the SCMAGLEV transition portal. Although not currently planned, any future SCMAGLEV extension south from an elevated NoMa station would have visual and property acquisition impacts.

The approach tracks for a potential aboveground DC station located at NoMa would require crossing ten active rail tracks, eight of which are used by Amtrak, MARC, VRE, and CSX and two by WMATA Metrorail. There are several differences between this potential rail track crossing and the crossing of the NEC rail tracks evaluated in the PASR, which led to the elimination of PASR Alignment Alternatives H and I1. Specifically, the NoMa approach crossing length would be approximately 0.2 KM (0.125 mile), or approximately 80 percent shorter length than that of the NEC crossing of the eliminated Alignment Alternatives H and I1. In addition, the NoMa approach crossing of tracks would be a roughly perpendicular crossing of rail tracks than the skewed angle NEC crossing of H and I1. The tracks crossed by NoMa carry trains that operate at slower speeds than the NEC tracks that would have been crossed by H and I1 because the train operational speeds on tracks near NoMa consist of either station approach decelerating and station departure accelerating speeds, or slower-speed yard movements. The combination of a shorter, relatively perpendicular crossing and slower train speeds translates into a less-costly crash protection design at the potential NoMa approach crossing than the H or I1 crossing of NEC tracks. Finally, the potential NoMa approach guideway viaduct crossing of rail tracks would be parallel to the existing US Route 50 (New York Avenue) crossing of the rail tracks. It may be possible to have the piers of the approach viaduct align adjacent to the New York Avenue bridge piers so as to avoid or minimize the need to realign rail tracks or interfere with future rail expansion. Conversely, PASR H and I1 were found to potentially interfere with plans to expand the NEC. The foregoing assessment notwithstanding, even though it is technically possible to cross the rail track with an approach viaduct to an aboveground NoMa station location, the fatal flaw PASR criteria precedent of crossing the NEC would still be a constructability issue. Although less complex structurally that the H or I1 crossing of the NEC tracks, such a crossing would require addressing the individual operational needs of five rail operators both during construction of the crossing and in the future.

Even if proved ultimately feasible, a station at NoMa, whether above ground or underground does not fully satisfy the station evaluation criteria (see Table 2). Specifically, a NoMa location is in an area with chronic street traffic congestion, would connect with only one Metro line - Red - which is the most overburdened line in the Metro system, and is not cost effective.

For consistency with the Phase I PASR criteria, FRA and MDOT dropped the NoMa elevated station option from further consideration since it would cross Amtrak, which was a fatal flaw.

NoMa Station (Underground)

While an underground station option at NoMa would address the fatal flaw constructability criteria of crossing Amtrak, the underground location would add nearly $950M in capital cost to the project as compared to an above ground station, thereby, making a station at NoMa even less cost-effective. An underground NOMA station would be less convenient than an elevated station in terms of connectivity, including the additional time required for an elevator or escalator ride from a 100 foot deep station. Note that the WMATA New York Avenue Station is elevated, and would be more easily accessed from an elevated SCMAGLEV station. Just like the elevated NoMa option, an underground NoMa location is in an area with chronic street traffic congestion, would connect with only one Metro line - Red - which is the most overburdened line in the Metro system, and is not cost effective.

An underground station at NoMa was dropped from further consideration for the following reasons: (1) the station would have poor interconnectivity with the nearest fixed-guideway transit station: the Metro NoMa-Gallaudet Station because of both the relatively long horizontal distance between an SCMAGEV station and the Metro station, as well as the vertical distance between an underground SCMAGLEV station and the elevated Metro station; (2) WMATA indicated in meetings with BWRR that additional passenger loads on the Red line, which serves NoMa-Gallaudet and is the most congested of the Metro lines, would be unacceptable because the SCMAGLEV passenger loads would further exacerbate the Red line's overloading issues; (3) a NoMa SCMAGLEV station would likely provide insufficient ridership and operating revenue because it is served by only one Metro line and has insufficient development density as it abuts a relatively low density residential area to the north and west (by contrast, a Mount Vernon Square Station connects with all Metro lines and is in the most densely developed area of the District; and (4) despite efforts to address traffic flow issues in NoMa, New York Avenue in NoMa remains heavily congested due to being a gateway to the District (in contrast, a station west of Mount Vernon Square is in a relatively uncongested stretch of New York Avenue). Further coordination on SCMAGLEV station planning in the District with DCOP, DDOT, and others will occur during the DEIS. Based on these deficiencies, FRA and MDOT dropped the underground NoMa underground location from further consideration.

Mount Vernon Square East Station (Underground)

The Mount Vernon Square East station would be underground, but easements would likely be needed for station entrances. The location has intermodal connectivity as it would be approximately 1,500 feet from the WMATA Mt. Vernon Square Station and also the future DC Streetcar station; but it is approximately 2,200 feet to the WMATA Gallery Place Station. The Mount Vernon Square East location would experience heavier roadway congestion and has less parking facilities as compared to the Mount Vernon Square West option, but is still a short walking distance to two Metro lines (Green and

Yellow). As noted in Table 3, the estimated cost differential relative to the elevated NoMa SCMAGLEV Station (DC Station Base Case) is an additional $1.2 Billion to construct the underground Mount Vernon Square East SCMAGLEV Station. However, the Mount Vernon Square Station connects with two Metro lines and is in the most densely developed area of the District.

This location is retained for study in the DEIS. Please see Sheet 1 of 12 in Appendix E for the project drawing illustrating the underground Mount Vernon Square East SCMAGLEV Station.

Mount Vernon Square West Station (Underground)

The Mount Vernon Square West station would be underground, but easements would likely be needed for station entrances. The location has intermodal connectivity as it would be approximately 1,500 feet from the WMATA Metro Center Station; approximately 750 feet to the future DC Streetcar station; approximately 1,800 feet to the WMATA Gallery Place Station; approximately 2,000 feet to McPherson Square; and about 2,100 feet to WMATA Mt. Vernon Square Station. By applying the station evaluation criteria, a station at Mount Vernon Square West satisfies all the station evaluation criteria because of (1) relatively good location for street access given good traffic flow along New York Avenue west of Mount Vernon Square; (2) station-generated trips to/from fixed guideway transit would be dispersed among six Metro lines (Red, Green, Yellow, Blue, Orange, and Silver); and (3) construction obstacles (e.g., 7th Street Metro tunnel and Carnegie Library)can be addressed with relative ease and efficiency. As noted in Table 3, the estimated cost differential relative to the elevated NoMa SCMAGLEV Station (DC Station Base Case) is an additional $1.3 Billion to construct the underground Mount Vernon Square West SCMAGLEV Station. However, the Mount Vernon Square Station connects with all six Metro lines and is in the most densely developed area of the District.

This location is retained for the DEIS. Please see Sheet 1 of 12 in Appendix E for the project drawing illustrating the underground Mount Vernon Square East SCMAGLEV Station.

C. Evaluation Results Table and Summary

FRA and MDOT evaluated a total of 16 combinations of alignment, station, and RSD options under Alternatives J and J1 as displayed in Table 4. Each alternative consists of eight options comprised of the various combinations of alignments with each of the Baltimore and Washington station options and each of the RSD options. The BWI Marshall station is common to all combinations and included in each of the alternatives. This breakout was necessary for FRA and MDOT to accurately evaluate the potential impacts of the individual options.

Alternative J (BWP East)

- Potentially impacts environmentally sensitive federal lands (PRR, USDA/BARC, NPS/Baltimore-Washington Parkway and tunnel under Anacostia Park) and federal properties (NASA-GSFC and a potential tunnel portal on Fort Meade).
- Potentially impacts facilities and operations of BWI Marshall Airport, NSA, and USSS.
- Would impact more Wetland of Special State Concern (WSSC) acreage, BARC property, and areas adjacent to the Patuxent River compared to Alternative J1.
- Potentially impacts to long term BARC research related to the disruption of current, micro weather patterns.
- Would impact more Baltimore-Washington Parkway property and adjacent ecological resources than Alternative J1.
- Would impact fewer residential parcels with the viaduct portion of the alignment. For example, six to ten residential parcels are in the surface LOD footprint depending on the Washington, DC terminus option (the Mount Vernon

Square West station or the Mount Vernon Square East station). The LOD footprint for tunnel sections of the alignment pass under more residential parcels as compared to Alternative J1.

Alternative J1 (BWP West)

- Potentially impacts environmentally sensitive federal lands (USDA/BARC, NPS/Baltimore-Washington Parkway and tunnel under Anacostia Park) and federal property (tunnel under but potential surface impact with vent plant on Fort Meade).
- Potentially impacts to long term BARC research related to the disruption of current, micro meteorological weather patterns.
- Potentially passing through two Superfund Areas of Concern under active investigation.
- Potentially impacts facilities and operations of BWI Marshall Airport.
- Would not have a direct impact to property occupied by NSA and USSS (it would be on the opposite side of the Baltimore-Washington Parkway), these agencies expressed concern with the SCMAGLEV viaduct in proximity to their facilities.
- Would not impact PRR or NASA-GSFS properties as it would be on the opposite side of the Baltimore-Washington Parkway.
- Would be closer to residential communities as compared to Alternative J. There would be approximately 12 to 18 residential parcels in the surface LOD footprint for Alternative J1, regardless of the terminus station option. These impacts could range from a small sliver to a larger portion of the parcel, or potentially require a total take of the property. A more detailed assessment will be made in the DEIS.
- Would affect a greater number of local parks.

RSD Options

- The BARC RSD would impact more environmental resources (especially floodplains, Wetlands of Special State Concern, and Sensitive Species Project Review Areas (SSPRA)) as compared to the MD 198 RSD option.
- Other BARC factors include:
    - The BARC RSD would impinge on the mission of the USDA-ARS, and would destroy parts of the watersheds that ARS scientists have carefully sampled and studied for the past two decades. The cost of losing these historical watershed research plots is incalculable as there is no way to mitigate this loss of research opportunities.
    - The headwaters feeding the rare, natural Beltsville Bog, as well as the loss of forest, wetland, streams of concern to the USDA-ARS.
    - The BARC RSD would have potential impacts to long term research related to disruption of current, micro meteorological weather patterns.
    - MDE requires that mitigations are performed within the same watershed, but there is no land left for mitigation on BARC and limited land for mitigation in Prince Georges County.
    - NASA-GSFC has also noted that the close proximity of the proposed BARC RSD to the Goddard Geophysical and Astronomical Observatory (GGAO), which is very sensitive to vibration, artificial lighting, and electromagnetic interference, has the potential for severely negatively impacting the operations of these systems and could jeopardize the quality of the research and measurements that satellite missions rely on for the past 50 years.
    - In addition to USDA and NASA-GSFC, concerns regarding the BARC RSD location have been expressed by NCPC, USACE, and M-NCPPC and Prince George's County.
    - Given the information and concerns raised, the difficulty in mitigating the potential impacts, the lack of potential replacement property, and the challenges associated with locating a minimally disruptive RSD facility on the BARC site, the BARC location is dropped from further consideration for a RSD facility.

- Existing facilities owned by the federal government (Particularly the Department of Labor Woodland Job Corps Center facility site);the entry checkpoint/access roads to the New Beginnings Youth Development Center and the National Guard's Capital Guardian Youth Challenge Academy; and natural resources (MET conservation easement) are challenges at the MD 198 RSD option.
- With the elimination of the BARC RSD location and the challenges still facing the MD 198 RSD site; BWRR has coordinated with the developer of SCMAGLEV technology, the Central Japan Railway Company (JRC), on the operational feasibility of splitting up the RSD facility. JRC recently confirmed the ability to have alternate RSD layouts that allow for flexibility while meeting SCMAGLEV design criteria. Applying this updated information allowed BWRR to reexamine the corridors abutting the J and J1 alignments to explore and identify other options for a RSD site. Locations that currently contain a mix of commercial, industrial, and transportation land uses would be preferable. Any alternative RSD site will need to be explored by the NEPA team and presented to local officials and the community before the site is factored into the DEIS for comparison.

Stations

- The Mount Vernon Square station options are both in downtown Washington, DC (zone promoting high density uses). Both locations are in proximity to two or more WMATA Metro lines. Consequently, both Mount Vernon Square underground station options are retained for the DEIS.
- NoMa elevated station would require the guideway to cross the NEC tracks, which was a fatal flaw condition established in the PASR and therefore is dropped from consideration as it violates the criteria.
- An underground station at NoMa is not a reasonable alternative under NEPA and, therefore, was dropped from further consideration for the following reasons:
    - (1) the station would have poor interconnectivity with the nearest fixed-guideway transit station: the Metro NoMa-Gallaudet Station because of both the 1,200 foot long horizontal distance between an SCMAGEV station and the Metro station, as well as the 100+/- foot vertical distance between an underground SCMAGLEV station and the elevated Metro station;
    - (2) WMATA indicated in meetings with BWRR that additional passenger loads on the Red line, which serves NoMa-Gallaudet and is the most congested of the Metro lines, would be unacceptable because the SCMAGLEV passenger loads would further exacerbate the Red line's overloading issues;
    - (3) a NoMa SCMAGLEV station would likely provide insufficient ridership and operating revenue because it is served by only one Metro line and has insufficient development density as it abuts a relatively low density residential area to the north and west (by contrast, a Mount Vernon Square Station connects with all Metro lines and is in the most densely developed area of the District; and
    - (4) despite efforts to address traffic flow issues in NoMa, New York Avenue in NoMa remains heavily congested due to being a gateway to the District (in contrast, a station west of Mount Vernon Square is in a relatively uncongested stretch of New York Avenue).
    - Consequently, FRA and MDOT dropped the NoMa station options from consideration.
- The intermediate station at BWI Marshall Airport configuration will be developed in coordination with the BWI Marshall Airport master plan. The underground station is interchangeable for either alternative and is retained for the DEIS.
- As discussed above, FRA and MDOT evaluated and eliminated the underground Baltimore station options in Westport, Port Covington, and Calvert/Light Street.
- The Cherry Hill LR Station option is in a TOD zone with redevelopment potential, located above the existing light rail station, and is accessible to the regional highway system. Cherry Hill access to downtown (approximately 2.5 mile +/-) can be accomplished by a number of means: auto or shuttle bus: 8 - 18 minutes via multiple routes by auto; or by light rail: the LRT is located under the SCMAGLEV station (7-8 minutes travel time with LR trains approximately every 15 minutes). The station option would require the alignment to cross over and run adjacent to the existing

CSX track. Consequently, ongoing discussions are required with CSX and MDOT MTA, but the elevated Cherry Hill LR station option is retained for the DEIS.

- The Camden Yards station option is in proximity to multiple transit connections, the location is in downtown Baltimore, and is accessible to the regional highway system. Consequently, the underground Camden Yards station option is retained for the DEIS.

See Table 3 for the summary of the qualitative station assessment and see Table 4 for the summary of the quantitative results focusing on the surface LOD footprint. Please see the detailed tables in Appendix C and Appendix D for the full results of the desktop analysis that include both the surface LOD footprint plus the underground/tunnel LOD footprints as well.

Table 3: Station Assessment Table

Retained Station Zones (Phase I: PASR)		Potential Station Location (Phase II: Alternatives Report)	ROW		Land Use			Transportation				Environmental			Cost	Constructability				Operations	Comment	Recommendation
			Property Acquisition		Station-Oriented Land Use in Vicinity		Development/ Redevelopment Potential of Surrounding	Connectivity and Accessibility			Parking	Environmental Impacts (Station or Approach)			Magnitude of Cost	Interface with other infrastructure or complex conditions (Station or Approach)				Alignment Compatibility		
			Potential Number of Residential Displacements	Potential Number of Commercial Displacements	Proximity to existing or planned activity centers	Potential for Development-oriented zoning or policies	Potential for Suitable, available land or re-developable buildings for joint station development	Walking proximity to fixed guideway transit/rail station	Driving time proximity to regional highway system	Capacity of roadway system to accommodate increased auto-taxi trips	Potential Number of parking facilities within a 1/4 mile or space to construct adequate parking	Potentially Requires use of parkland	Potential Adverse effect on historic property	Potential adverse effects on environmental justice community	Estimated Cost differential relative to NoMa for DC Stations and Cherry Hill for Baltimore stations	Potential for Building underpinning or other infrastructure supportive requirement	Potential for Construction over/under active roadway/rail	Potential for Permanent impacts on other infrastructure	Potential that Alignment impacts utility or other land use that is not movable	Satisfies the 15-minute trip time for Baltimore-Washington		
Baltimore	Inner Harbor Zone	**Camden Yards (Underground station)**	None	Easements needed for station entrances	< 1/4 mile	Pedestrian-orientated intense development for downtown core area	Area mostly built out	1,100-foot walk to Camden Yards LRT and MARC Station	3-5 mins. to I-95 via I-395	Heavy traffic along Howard, Conway, and Pratt Streets	26 garages/lots	No	Old Otterbain Church (1771)	No	+$1.4 B	Three downtown buildings plus need to support active rail lines and roads	No impact	None	No Impact	Yes	Built-out downtown Baltimore location with direct connection to multiple fixed-guideway transit options, located closest to the regional highway system.	**Retained For DEIS**
Baltimore	Inner Harbor Zone	Calvert/ Light Street (Underground station)	None	Easements needed for station entrances	< 1/4 mile	Pedestrian-orientated intense development for downtown core area	Area mostly built out	2,100-foot walk to Camden Yards LRT and Marc Station	5-10 mins. to I-95 via W Conway Street and I-395	Heavy traffic along Conway, Light and Pratt Streets	38 garages/lots	McKeldin Fountain (Baltimore City)	Old Otterbain Church (1771)	No	+$1.4 B	Seven downtown buildings plus need to support active roads	No impact	None	No Impact	Yes	Built-out downtown Baltimore location requiring a walk to connect to multiple fixed-guideway transit options, located further from the regional highway system than Camden Yards.	**Dropped from Consideration**
Baltimore	Port Covington Zone	Port Covington (Underground station)	None	Unknown depending on Port Covington Master Plan	< 1/4 mile	Planned redevelopment area following Port Covington Master Plan	Limited opportunities - Port Covington Master Plan already provides development plan	Unknown - no fixed transit available	3-5 mins. to I-95 via E McComas Street	Future conditions unknown once Port Covington is built out	No public lots currently available	No	None	No	+$1.1 B	To avoid major underpinning, station shell needs to be constructed before new buildings are constructed	Station under existing and proposed active roadways	None	No Impact	Yes	Major planned new city location composed of existing industrial-use parcels that does not have an existing fixed-guideway transit option, located close to the regional highway system. New station box would need to be funded and constructed before planned development by others.	**Dropped from Consideration**
Baltimore	Westport - Cherry Hill Zone	**Cherry Hill (Elevated over LRT Station)**	None	15 parcels (includes tail tracks in Westport)	Located on southern tip of future Westport TOD; Approx. 2.5 miles to Camden Yards	South Baltimore Gateway Master Plan recommends mixed use development and latest zoning indicates TOD for adjacent industrial land	Older industrial adjacent land provides good opportunity for redevelopment	Direct connection to Cherry Hill LRT Station	3-5 mins. to BWP via Waterview Avenue	Heavy traffic along BWP NB during the AM commute	Space available to construct adequate parking facility adjacent to station	No	None	Yes	Baltimore Station Base Case	No	Viaduct over LRT and CSX	Requires W. Patapsco Avenue to be raised 1-2 Meters	BGE Power Lines parallel to LRT tracks	Yes. Provision of tail tracks provides greater flexibility for operations	Zoned TOD location providing opportunity to redevelop around station, existing fixed-guideway transit option, located close to the regional highway system.	**Retained For DEIS**
Baltimore	Westport - Cherry Hill Zone	Westport (Underground station East of Kloman Street)	None	6 parcels	Adjacent to future Westport TOD; Approx. 2.3 miles to Camden Yards	South Baltimore Gateway Master Plan recommends and latest zoning indicates TOD waterfront development	Underutilized adjacent industrial use provides good opportunity for redevelopment; unclear soil conditions may require special removal handling	Direct connection to Westport LRT Station	3-5 mins. to BWP via local roads	Heavy traffic along BWP NB during the AM commute	Space available to construct adequate parking facility adjacent to station	No	None	Yes	+$900 M	No	Adjacent to CSX and LRT	None	None	Yes	Zoned TOD location providing opportunity to redevelop around station, existing fixed-guideway transit option, located close to the regional highway system.	**Dropped from Consideration**
BWI Marshall	BWI Marshall Airport	**BWI Airport (Underground station)**	None	None	Under BWI terminal	Airport Master Plan expecting growth	Limited to station area	Direct connection to airport terminal and LRT Airport Station	3-5 mins. to I-195 via BWI Airport ramps	Minor airport terminal queuing during peak travel times	Multiple airport short/long-term facilities and space to construct additional parking facility	No	None	No	BWI Station Base Case	Airport terminals	Hourly garage would need to be demolished and replaced; tunnel construction under airport loop road	Possible impacts to airport operations that will need to be worked out	No Impact	Yes	BWI station configuration will be developed in coordination with BWI Airport master plan.	**Retain For DEIS**

Table 3: Station Assessment Table (Continued)

	Retained Station Zones (Phase I: PASR)	Potential Station Location (Phase II: Alternatives Report)	ROW		Land Use			Transportation				Environmental			Cost	Constructability				Operations	Comment	Recommendation
			Property Acquisition		Station-Oriented Land Use in Vicinity		Development/ Redevelopment Potential of Surrounding	Connectivity and Accessibility			Parking	Environmental Impacts (Station or Approach)			Magnitude of Cost	Interface with other infrastructure or complex conditions (Station or Approach)				Alignment Compatibility		
			Potential Number of Residential Displacements	Potential Number of Commercial Displacements	Proximity to existing or planned activity centers	Potential for Development-oriented zoning or policies	Potential for Suitable, available land or re-developable buildings for joint station development	Walking proximity to fixed guideway transit/rail station	Driving time proximity to regional highway system	Capacity of roadway system to accommodate increased auto-taxi trips	Potential Number of parking facilities within a 1/4 mile or space to construct adequate parking	Potentially Requires use of parkland	Potential Adverse effect on historic property	Potential adverse effects on environmental justice community	Estimated Cost differential relative to NoMa for DC Stations and Cherry Hill for Baltimore stations	Potential for Building underpinning or other infrastructure supportive requirement	Potential for Construction over/under active roadway/rail	Potential for Permanent impacts on other infrastructure	Potential that Alignment impacts utility or other land use that is not movable	Satisfies the 15-minute trip time for Baltimore-Washington		
Washington, DC	NoMa-Gallaudet Zone	New York Avenue west of Florida Avenue (Elevated station)	None	3 parcels plus 65 subdivided parcels	Northern tip of NoMa development area	Downtown Zone that promotes high density commercial and mixed uses	Potential redevelopment of adjacent parcels north of NY Avenue	1,200-foot walk to the NoMa Metro Station	3-5 mins. to NY Avenue gateway bridge and 5-10 mins. to I-395 via NY Avenue	New York Avenue heavily congested during commute times	9 garages/lots & room to construct a new facility	No	None	No	DC Station Base Case	No	Bridge over Metro/Amtrak/ VRE/ MARC	9th St Bridge	Pepco substation on west side of Amtrak Bridge	Yes	High density mixed use zoning provides good opportunity to redevelop around station including new parking structure, adjacent to existing Environmental Justice community, two-block walk to one Metro line, located close to the regional highway system. Crossing Amtrak NEC would violate the Phase I PASR criteria.	**Dropped from Consideration**
Washington, DC	NoMa-Gallaudet Zone	New York Avenue west of Florida Avenue (Underground station)	None	Easements needed for station entrances	Northern tip of NoMa development area	Downtown Zone that promotes high density commercial and mixed uses	Potential redevelopment of adjacent parcels north of NY Avenue	1,200-foot walk to the NoMa Metro Station	3-5 mins. to NY Avenue gateway bridge and 5-10 mins. to I-395 via NY Avenue	New York Avenue heavily congested during commute times	9 garages/lots & room to construct a new facility	No	None	No	+$950 M	Seven commercial buildings plus need to support active roads	Construction under Metro/Amtrak/ VRE/ MARC	None	Construction under Pepco substation on west side of Amtrak Bridge	Yes	Poor interconnectivity with the Metro w/ both horizontal & vertical distance from underground SCMAGLEV to elevated Metro; WMATA noted additional passenger loads on overloaded Red line unacceptable; would likely provide insufficient ridership & operating revenue as served by only one Metro line & abutting a relatively low density EJ residential area; heavily congested traffic area	**Dropped from Consideration**
Washington, DC	**Mt. Vernon Square Zone**	**New York Avenue East of Mount Vernon Square (Underground station)**	None	Easements needed for station entrances	East of downtown DC	Downtown Zone that promotes high density residential and mixed use commercial uses	Area nearly built out	1,500-foot walk to the Mt. Vernon Square Station; 2,200-foot walk to the Gallery Place Station; 1,550-foot walk to future DC Streetcar station	5 min. drive to I-395; 5-10 min. drive to NY Avenue Gateway bridge to U.S. 50	New York Avenue heavily congested during commute times	16 garages/lots	Mt Vernon Square (DC) and Milian Park (NPS)	Carnegie Library	No	+$1.2 B	No	Construction under NY Avenue between 7th and 1st Streets NW	None	No Impact	Yes	High density mixed use residential zoning does not provide good opportunity to redevelop around station, limited off-street parking options, short walk to two Metro lines, located further from regional highway system than other alternatives, and integrates with alignment to provide full speed service.	**Retained For DEIS**
Washington, DC	**Mt. Vernon Square Zone**	**New York Avenue West of Mount Vernon Square (Underground station)**	None	Easements needed for station entrances	In downtown DC	Downtown Zone that promotes high density commercial and mixed uses	Area mostly built out	1,500-foot walk to Metro Center; 1,800-foot walk to Gallery Place; 2,000-foot walk to McPherson Square; 2,100-foot walk to Mount Vernon Square; 750-foot walk to future DC Streetcar station	5-10 mins. to I-395 via 9/12th Street tunnels, 10-15 mins. to NY Avenue gateway bridge to U.S. 50; 15-20 mins. to I-66 via K Street	Minimal traffic delays on New York Avenue	56 garages/lots	Mt Vernon Square (DC) and Parklet @ 12th and I Streets NW (NPS)	Carnegie Library	No	+$1.3 B	Carnegie Library	Construction under NY Avenue from 6th to 12th Streets NW	None	No Impact	Yes	Built-out downtown DC location with numerous off-street parking options and short walk to six Metro lines, located close to regional highway system.	**Retained For DEIS**

Table 4: Quantitative Surface Footprint LOD Evaluation Results Summary Table

Surface Footprint LOD Evaluation Results Summary	Alternative =	Alternative J (BWP East)								Alternative J1 (BWP West)							
	*Station Option =	MVS West to Cherry Hill LR		MVS West to Camden Yards		MVS East to Cherry Hill LR		MVS East to Camden Yards		MVS West to Cherry Hill LR		MVS West to Camden Yards		MVS East to Cherry Hill LR		MVS East to Camden Yards	
	**RSD Option =	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC
Number of Residential Parcels in LOD (Count)		7	6	7	6	10	9	10	9	15	12	15	12	18	15	18	15
Number of Commercial Parcels in LOD (Count)		50	36	26	12	63	49	39	25	52	37	31	16	65	50	44	29
Number of Low Income Census Block Groups in LOD (Count)		1	1	0	0	2	2	1	1	1	1	0	0	2	2	1	1
Number of Minority Census Block Groups in LOD (Count)		13	13	11	11	17	17	15	15	12	10	10	8	16	14	14	12
Number of Community Resources in LOD (Count)		2	1	0	0	2	1	0	0	2	1	2	1	2	1	2	1
Number of Historic Landmarks and/or Eligible National Register Sites & Districts in LOD (Count)	Maryland	20	19	21	20	20	19	21	20	17	15	19	17	17	15	19	17
	Washington, DC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Parks (State, County, Local) in LOD	(Count)	3	3	3	3	3	3	3	3	5	5	5	5	5	5	5	5
	(Acres)	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	18.15	13.40	18.15	13.40	18.15	13.40	18.15	13.40
National Park Service (including B-W Pkwy) (Acres) in surface LOD		42.26	40.27	42.26	40.27	41.8	39.9	41.8	39.9	34.36	29.04	34.36	29.04	33.9	28.6	33.9	28.6
Patuxent Research Refuge (Acres) in surface LOD		19.27	17.28	19.27	17.28	19.27	17.28	19.27	17.28	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fort George G. Meade (Acres) in surface LOD		30.62	12.61	30.62	12.61	30.62	12.61	30.62	12.61	20.68	2.67	20.68	2.67	20.68	2.67	20.68	2.67
Beltsville Agricultural Research Center (Acres) in surface LOD		10.55	251.87	10.55	251.87	10.55	251.87	10.55	251.87	8.14	249.37	8.14	249.37	8.14	249.37	8.14	249.37
NASA - Goddard Space Flight Center (Acres)		0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ecological Resources (SSPRA, Critical Habitat, Forest Easements) in surface LOD	FIDS (Acres)	236.67	231.79	236.67	231.79	236.67	231.79	236.67	231.79	208.86	202.17	208.86	202.17	208.86	202.17	208.86	202.17
	NON-FIDS (Acres)	100.60	316.18	100.60	316.18	100.60	316.18	100.60	316.18	89.43	305.61	89.43	305.61	89.43	305.61	89.43	305.61
Wooded Areas / Forest (Acres) in surface LOD		249.68	278.12	247.46	275.90	249.68	278.12	247.46	275.90	228.73	249.97	226.52	247.75	228.73	249.97	226.52	247.75
Wetlands of Special State Concern (Acres) in surface LOD		7.47	37.02	7.47	37.02	7.47	37.02	7.47	37.02	1.04	36.01	1.04	36.01	1.04	36.01	1.04	36.01
Wetlands (Acres) in surface LOD		32.80	39.58	32.72	39.51	32.80	39.58	32.72	39.51	26.85	37.87	26.78	37.80	26.85	37.87	26.78	37.80
100 Year Floodplain (Acres) in surface LOD		49.01	67.61	46.68	65.28	49.01	67.61	46.68	65.28	42.80	67.16	40.47	64.83	42.80	67.16	40.47	64.83

*Station Options: MVS West= Underground below New York Avenue west of Mount Vernon Square; MVS East= Underground below New York Avenue east of Mount Vernon Square; Cherry Hill LR = Elevated at MDOT-MTA's Cherry Hill LR; Camden Yards = Underground Camden Yards/Convention Center.

** RSD Options: RSD MD 198 = Northern RSD between MD 198 and Fort Meade; RSD BARC = Southern RSD on BARC property.

Note: These results represent the surface footprint LOD only. See Appendix C for the total project summary results (surface + tunnel) and see Appendix D for the detailed option specific tables containing the breakdown of potential surface versus underground results. The NEPA team prepared this quantitative desktop screening utilizing the criteria in Table 2 as applied to the surface LOD for each alternative as provided by the BWRR engineering team. Any component or features not available in time for this Alternatives Report will be evaluated during the DEIS as engineering is refined.

D. Alternatives Eliminated from Further Consideration

Both Alternative J and Alternative J1 have potential impacts according to the desktop analysis. However, there were no engineering, operational, or environmental discriminators to eliminate either alternative at this time. However, the Phase II evaluation did eliminate some of the component options from further consideration, mainly with respect to the station locations. For example, the NEPA Team reviewed the potential station locations led to the dismissal of the Port Covington Station Zone. The lack of existing fixed transit options, the lack of existing public parking (no intermodal connectivity), and constructability issues were reasons for dismissal.

The NEPA Team assessed and dismissed other potential station locations within the remaining zones: a potential underground station located near Calvert/Light Street in the Baltimore Inner Harbor Zone; a potential underground station in the Baltimore Westport Zone; and, both the potential underground and elevated NoMa station options in the Washington, DC NoMa-Gallaudet Zone.

Based on agency comments and concerns noted in Section C above, the BARC RSD is not advancing into the DEIS.

BWRR did not develop a fully tunneled alternative concept as the alignments were refined to minimize environmental impacts to the extent practicable. The additional billions of cost from tunneling to go beyond minimization of impact to complete avoidance of impact along the BWP is a substantial amount of capital expenditure that would severely jeopardize the financial viability of the project. In addition, some extent of above-ground operation is needed to demonstrate the feasibility of Maglev technology to the public, other than riders, consistent with the Maglev Deployment Program as authorized in TEA-21 and to provide riders the experience of above-ground travel. With the BWP already being in transportation use, the section along the BWP is the logical location to provide the above-ground demonstration of Maglev (above ground running in any other section of J or J1 would result in substantial residential or business impacts). In addition to being not prudent or feasible, placing the entire project in tunnel would be unreasonable. The Section 4(f) Evaluation of the recent B&P Tunnel Project in Baltimore, that was extensively in tunnel, concluded it was not prudent or feasible to avoid the use of nine Section 4(f) properties. The DEIS will expand further on the Section 4(f) analysis for this SCMAGLEV project, including a full tunnel option(s) for comparison.

E. Alternatives to Advance for Detailed Study in DEIS

FRA and MDOT recommend that both Alternatives J and J1 advance as alternatives in the DEIS. FRA and MDOT will coordinate with BWRR regarding preliminary engineering and further refinement to the MD 198 RSD location and continue to pursue options that would further minimize or avoid resources as components of the alternatives for the DEIS.

BWRR has coordinated with the developer of SCMAGLEV technology, the Central Japan Railway Company (JRC), on the operational feasibility of splitting up the RSD facility. JRC recently confirmed the ability to have alternate RSD layouts that allow for flexibility while meeting SCMAGLEV design criteria. Applying this updated information allowed BWRR to reexamine the corridors abutting the J and J1 alignments to explore and identify other options for a RSD site. Locations that currently contain a mix of commercial, industrial, and transportation land uses would be preferable. Any alternative RSD site will need to be explored by the NEPA team and presented to local officials and the community before the site is factored into the DEIS for comparison..

F. Infrastructure Ownership and Operation Considerations

The project sponsor BWRR holds a railroad franchise from the Maryland Public Service Commission[6] to operate the SCMAGLEV system if the forthcoming Record of Decision concludes with a Build Alternative outcome. Private and public properties would be affected by an ultimate Build Alternative decision regardless of required deep tunnel or surface infrastructure.

Alternatives J and J1 would require property owned by private owners, state, city, and county properties, NPS and USDA (BARC). In addition, Alternative J would also require property owned by the USFWS (PRR), as well as crossings of USSS and the Fort George G. Meade property (property also utilized by the NSA). BWRR will own the SCMAGLEV infrastructure. BWRR may also seek fee simple ownership of property in some cases, but BWRR anticipates that easements would be satisfactory for most of the property impacts.

Representatives from some federal landowners have expressed concern regarding their authority to dispose of property, or grant easements, to BWRR for the SCMAGLEV project. In light of these concerns, FRA and the study team will address these issues in further detail, including legal reviews, in the DEIS.

[6] Source: The Northeast Maglev LLC (TNEM) Nov 17, 2015 regarding Public Service Commission (PSC) of Maryland Case No. 9363. BWRR's ability to use eminent domain in Maryland as granted by the Maryland PSC railroad license is a process that may be employed subject to a host of conditions not dissimilar to a government agency's and certain other railroad's and pipeline and transmission line company's ability to exercise eminent domain.

Chapter 5. Agency Coordination and Public Involvement Summary

FRA and MDOT encouraged agency and public input throughout the alternatives development process. FRA and MDOT facilitated interagency meetings, numerous agency-specific meetings, several public meetings, and maintained a Project website and Project e-mail account.

A. Agency Coordination

FRA and MDOT engaged federal, state, and local agencies in the preliminary alignments development phase of the SCMAGLEV Project through two interagency meetings in March 2017 (one in Baltimore and one in Washington, DC) followed by the presentation of the Draft PASR results at the October 3, 2017 interagency meeting in Greenbelt, MD. Agency field meetings occurred on July 19, 2017 and July 26, 2017 to provide agencies with an overview of the potential above ground portions of the preliminary alignments. FRA and MDOT also held an interagency webinar meeting on December 7, 2017 to provide an update on the PASR status.

Agency coordination has occurred since the PASR; in addition to individual agency meeting (see Table 5), the NEPA team held monthly Interagency Review Webinars (on April 17, 2018; May 15, 2018; June 19, 2018; July 17, 2018; August 21, 2018; September 18, 2018; and October 16, 2018). The NEPA team attended DC Interagency Meetings on April 3, 2018 and June 27, 2018. The NEPA team also attended a Joint Evaluation (JE) Meeting on April 25, 2018. See Appendix G for meeting summaries of the NEPA meetings. The Project Sponsor is meeting separately with certain agencies to advance PE as needed.

The National Historic Preservation Act (NHPA) Section 106 coordination has also begun with consulting party meetings on March 14, 2018 and September 17, 2018. In addition, agency field meetings occurred on September 20, 2018 and September 25, 2018. There was also a USFW-PRR specific natural resources filed trip on October 29, 2018. Additional coordination with the District of Columbia Department of Transportation (DDOT)/District of Columbia Office of Planning (DCOP) and with Baltimore City Planning regarding the respective terminus station options is ongoing.

The NEPA team attended a number of individual agency meetings presented in the Table 5. Following this outreach, NASA-GSFC, USFWS, and NSA elevated their agency status to official Cooperating Agencies in this NEPA process.

The NEPA team also submitted a draft version of the Alternatives Report to the agencies for comment (see Appendix F for a summary of agency comments).

Table 5: Agency Meeting Log since the PASR

Title	Meeting Date
NPS/FRA Workshop	1/30/2018
MDOT-SHA Meeting	2/20/2018
NASA Meeting	2/27/2018
MD DNR Meeting	3/19/2018
Secret Service Meeting	3/20/2018
Baltimore City Planning Department	3/26/2018
MNCPPC - Prince George's County	3/27/2018
NPS, USDA/BARC, USFWS Meeting	3/29/2018
Anne Arundel County Planning	4/2/2018
DC DDOT, Planning, Energy and Environment	4/3/2018
NSA	4/10/2018
Fort George G. Meade	4/19/2018
MDOT-MAA	5/2/2018
USEPA	5/10/2018
USDA ARS/BARC	5/17/2018
DOI, NPS, USDA/BARC, USFWS Meeting	6/4/2018
FAA	6/18/2018
MDOT-MTA Engineering – Station Meeting	6/21/2018
DC DDOT, Planning, Energy and Environment	6/27/2018
Baltimore City Planning Department	7/09/2018
MNCPPC- Prince George's County	7/24/2018
MDOT-MTA Engineering – Follow up Meeting	8/20/2018
USDA ARS/BARC – Follow up Meeting	8/21/2018
NCPC, CFA, HPO, DDOT	9/11/2018
Fort George G. Meade	10/10/2018
FAA – Follow up Meeting	10/16/2018
DC Agencies – Follow up Meeting	10/22/2018
NPS Coordination / Section 4(f) Meeting	10/23/2018
Fort George G. Meade – Follow up Meeting	10/30/2018

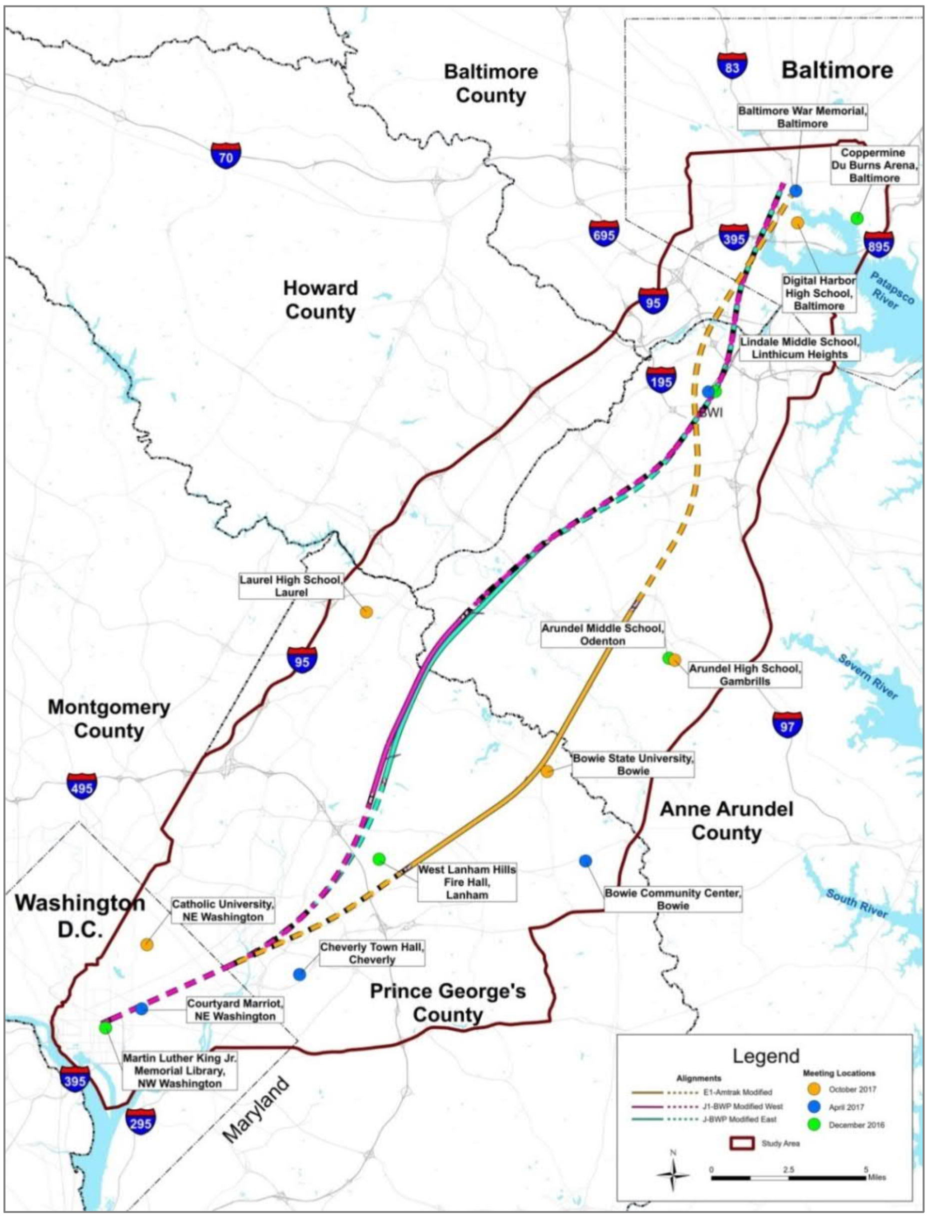
See Appendix G for agency coordination meeting summaries.

B. Public Involvement

1. Community Meetings

FRA and MDOT conducted three rounds (five meetings held during each round) of Public Open Houses in mid-December 2016 (Scoping Meeting), April 2017 (Purpose and Need/Initial Alignment Alternatives) and October 2017 (Preliminary Alternatives Screening). FRA and MDOT held the open houses at different locations throughout the project corridor as illustrated in Figure 29. The next round of public engagement will occur when the DEIS is published and FRA holds public hearings.

Figure 29: Public Open House Meeting Locations

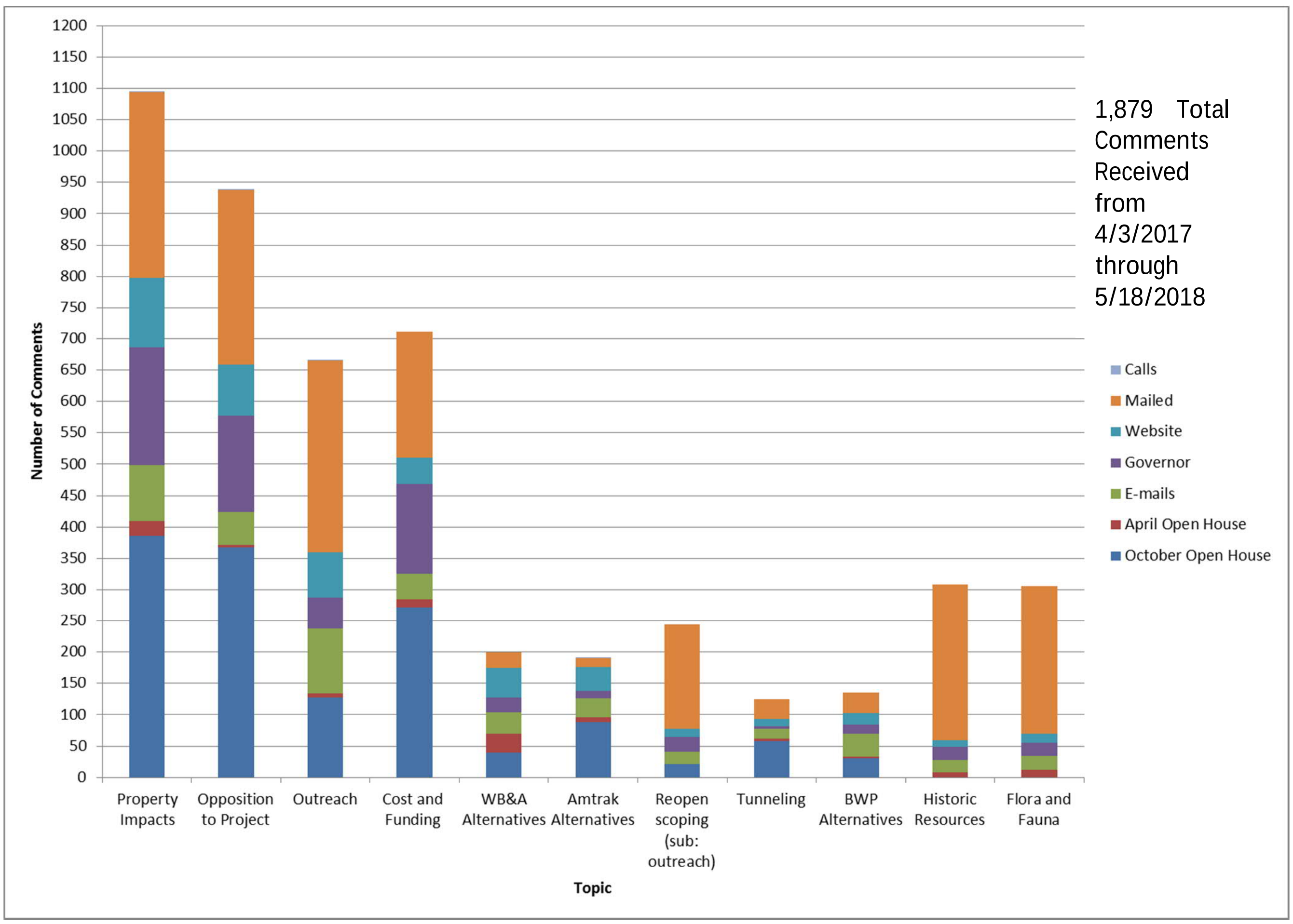


2. Summary of Comments Received

To date, the Project Team has received a total of 1,879 comments during the alternatives development process. The PASR documented the comments received as of November 2, 2017. Since then the Project Team has continued to accept and compile comments through the development of the Alternatives Report. As of May 18, 2018, the Project Team has received 268 comments via the Project website comment form, 250 comments via the Project e-mail account (info@bwmaglev.info) or e-mail accounts of individual Project Team members, 248 comments via the Governor's Office e-mail account, 348 comments via mail, four comments via calls, 52 comments at the April 2017 open houses, and 709 comments at the October 2017 open houses.

Table 6 provides a summary of public comments and topics.

Table 6: Summary of Public Comments



FRA and MDOT analyzed written comments up through May 18, 2018 for this report. This period included the public meetings in mid-April 2017 and the third round of public meetings in late October 2017. This period coincided with the development and screening of preliminary alignments, and the alternatives development. The top comment types are notes below:

1. Property Impacts – 1095 or 58% of comments addressed property impacts, including property devaluation and use of eminent domain.
2. Opposition to the Project – 939 or 50% of comments expressed direct opposition to the project (not just specific alternatives).
3. Outreach – 666 or 35% of comments addressed outreach, including re-opening the scoping process due to "insufficient notification." This percentage remained constant before and after the October open houses.
    - Reopen Scoping – 244 or 13% of comments requested that the scoping period be re-opened.
4. Cost and Funding – 711 or 38% of comments addressed project cost and funding, including ticket price, taxes, and overall cost.
5. WB&A Alternatives – 199 or 11% of comments addressed the WB&A Alternatives, including opposition to the alternatives and questions or comments about how resources (particularly homes) would be impacted by the alternative. The WB&A Alternative has been eliminated since the publication of the Preliminary Alternatives Screening Report.
6. Amtrak Alternatives – 191 or 10% of comments addressed the Amtrak Alternatives, with a mix of support and opposition for an alignment following the Amtrak route. The Amtrak Alternative has been eliminated since the publication of the Preliminary Alternatives Screening Report.
7. Tunneling – 125 or 7% of comments addressed tunneling, including potential impacts of construction and vibration.
8. BWP Alternatives – 135 or 7% of comments addressed the BWP Alternatives, including both support and opposition for the alternatives.
9. Historic Resources – 308 or 16% of comments addressed the historic resources, including potential impacts of construction.
10. Flora and Fauna – 306 or 16% of comments addressed the flora and fauna, including potential impacts of construction.

Comments not received or compiled in time for this report will continue to be accepted and recorded/considered for the DEIS. The project website (http://www.bwmaglev.info) includes responses to the most common questions under the Frequently Asked Questions (FAQs) page, as well as meeting materials, interactive maps and reports.

Chapter 6. Conclusions and Next Steps

FRA and MDOT recommend that both Alternatives J and J1 advance as alternatives in the DEIS. Alternatives J and J1 are reasonable alignments for a SCMAGLEV system with appropriate further avoidance, minimization, and mitigation measures and property transfer/easement agreements with Federal, state and local entities. Alternative J1 would have the longest tunnel section and would avoid PRR but is closer to residential communities on the west side of the Baltimore-Washington Parkway. Both Alternatives J and J1 would impact the NPS Baltimore-Washington Parkway property and would cross USDA/BARC property with the mainline guideway. Alternative J would also cross other federal lands or cross near federal facilities, including NASA-GSFC, USSS, NSA, Fort George G. Meade, and the PRR – but would be farther away from the residential communities as compared to Alternative J1.

The Alternative J surface LOD footprint would be in six to seven residential parcel boundaries if the Mount Vernon Square West terminus would be selected, but the surface LOD footprint would be in nine to ten residential parcel boundaries if the Mount Vernon Square East terminus station option would be selected (in combination with the intermediate station location at BWI Marshall Airport and with either the Cherry Hill LR or the Camden Yards potential terminus station options in Baltimore). The Alternative J1 surface LOD footprint would be in 12 to 15 residential parcel boundaries if the Mount Vernon Square West terminus would be selected, but the surface LOD footprint would be in 15 to 18 residential parcel boundaries if the Mount Vernon Square East terminus station option would be selected (in combination with the intermediate station location at BWI Marshall Airport and with either the Cherry Hill LR or the Camden Yards potential terminus station options in Baltimore). Please note that the parameters of the LOD and the desktop analysis indicate parcel boundaries and does not mean property displacements. The extent of impact for the specific parcel boundaries will be documented in the DEIS. Additionally, further coordination is needed with local officials and railroads regarding the potential station locations. Access roads and modifications to existing roadways, either temporary detours during construction or permanent reconstruction, will be included in the DEIS analysis.

Retained alternatives J and J1 are practical and feasible from a technical and economic standpoint. Even though J and J1 impact properties that are outside the legal jurisdiction of the lead agency, MDOT and FRA can continue to analyze the alternatives in the EIS. Alternatives that are outside the scope of what Congress has approved or funded must still be evaluated in the EIS if they are reasonable, because the EIS may serve as the basis for modifying the Congressional approval or funding in light of NEPA's goals and policies.

As the RSD facilities are currently positioned, the BARC RSD would have greater impacts to the USDA/BARC property and, potentially, more environmental resources as compared to the MD 198 RSD option. As a result of agency comments and concerns during the development of the Alternatives Report discussed in Chapter 4, FRA and MDOT subsequently dropped the BARC RSD option from further consideration. The BARC RSD option will not be included as a component in the DEIS.

The MD 198 RSD location will advance into the DEIS to further analyze the potential impacts to the MET conservation easement, other natural resources, and the Woodland Job Corps Center facility. Further downsizing/reconfiguring of the MD 198 RSD in the DEIS may avoid or minimize impacts as compared to the footprint analyzed in this Alternatives Report. However, even a reduced/reconfigured layout on the BARC property would not resolve the disruption of research and the lack of mitigation available for a BARC RSD.

With the elimination of the BARC RSD location and the issues regarding the MD 198 RSD location, the project team is continuing to seek ways to optimize the RSD facility - including the possibility of exploring alternative configurations and possibly new sites for the RSD components. The project team will document possible changes in the DEIS.

Please refer to Figure 30 for a revised overview map for the alternatives retained for detailed study.

The No Build Alternative will also be carried forward and serve as a baseline for comparison to the remaining Build Alternatives. It will also serve as a tool to evaluate feasibility, impacts, and cost, pursuant to NEPA and SAFETEA-LU. As the NEPA process continues, FRA and MDOT will work with BWRR to refine the alignments to minimize potential environmental impacts and/or avoid resources, where possible. Coordination with the public and resource agencies regarding the evaluation of alignments will continue throughout the Project and FRA and MDOT will document these efforts in the forthcoming DEIS. Additionally, the NEPA team intends to explore mitigation and minimization for all project components and will document the Section 4(f) and Section 106 evaluations in the DEIS.

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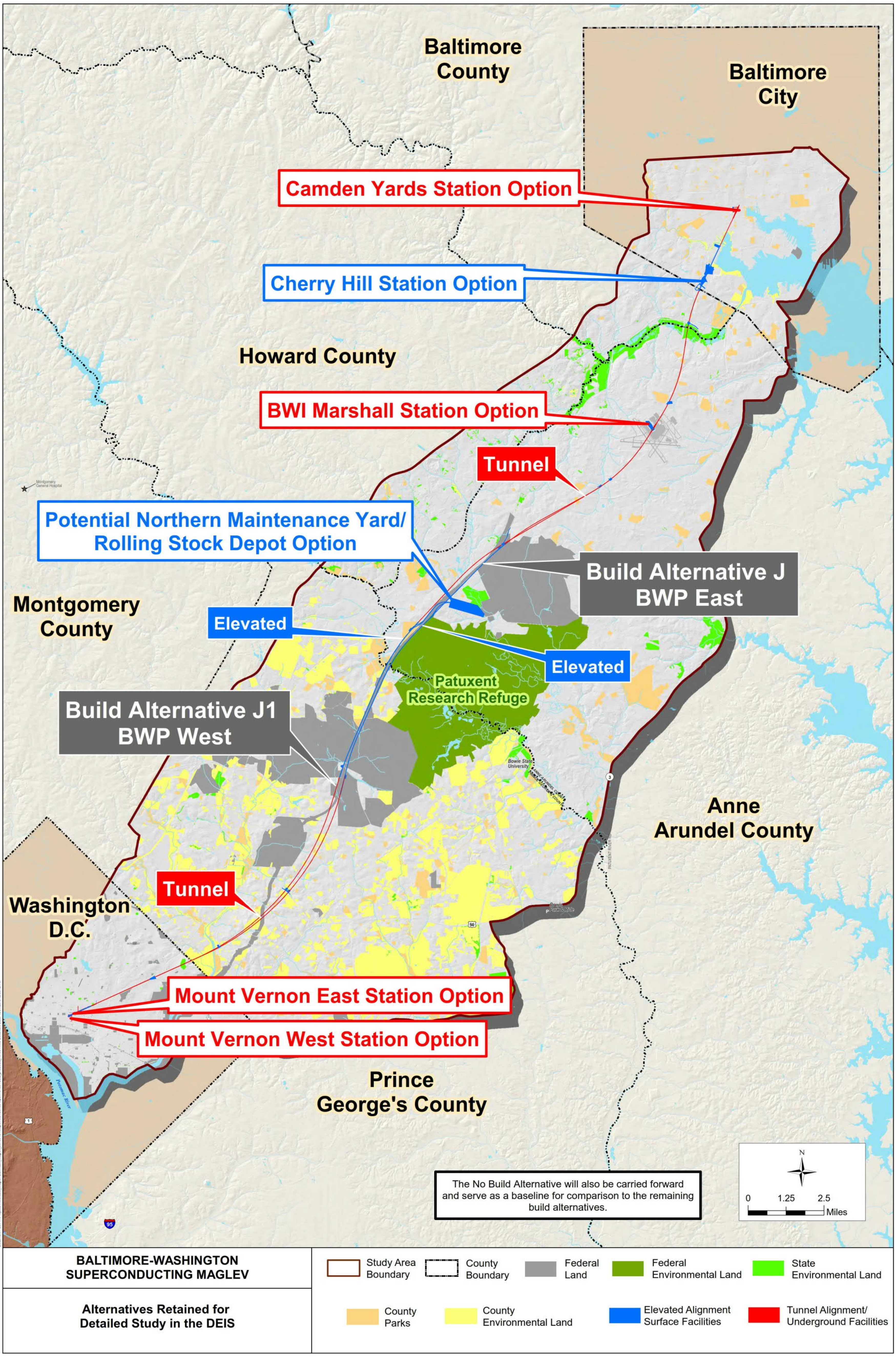
Figure 30: Alternatives Retained for Detailed Study in the DEIS



APPENDICES

A. Summary Description Table and Illustration of Initial PASR Alignments/Station Zone Illustrations

B. SCMAGLEV System Requirements and Components

C. Total Project Summary Table (Surface + Tunnel Results)

D. Detailed Evaluation Results Tables (by Station Terminus Combinations)

E. SCMEGLEV Alternatives Conceptual Plan and Profile Drawings

F. Agency Comments on the Draft Alternatives Report

G. Agency Coordination (Meeting Summaries)

Appendix A: Summary Description Table and Illustration of Initial PASR Alignments/Station Zone Illustrations

Table A-1: Summary Descriptions of Initial PASR Alignments

Alignment Name		Description from south to north (Washington, DC to Baltimore)
A	I-95 Parallel	Generally follows the Amtrak railroad right-of-way and CSXT Camden Line right-of-way out of Washington to I-495, then parallels the I-95 corridor before turning easterly for the BWI Marshall Airport station, and then approximately follows MD 295 to Baltimore.
B	Baltimore-Washington Parkway (BWP Parallel)	Generally follows the Amtrak railroad right-of-way and CSXT Camden Line right-of-way out of Washington to MD 193 where it turns northeasterly and crosses the Beltsville Agricultural Research Center (BARC) property to the Baltimore-Washington Parkway, then runs parallel to the west side of the Baltimore-Washington Parkway before veering east toward the BWI Marshall Airport station, and then approximately follows MD 295 to Baltimore.
C	Amtrak Parallel	Generally follows the Amtrak railroad right-of-way out of Washington and then continues north through portions of the Patuxent Research Refuge (PRR) and Fort George G. Meade to BWI Marshall Airport station, and then approximately follows MD 295 to Baltimore.
D	Linthicum/ City Options	Small segments that provide different options to connect the middle segments of any of the three previous alignments (A, B, and C above) between Baltimore, MD and BWI Marshall Airport and also a different option to the terminus in Washington.
E	Amtrak Corridor	Generally follows the Northeast Corridor/Amtrak railroad right-of-way out of Washington through Odenton, and then continues in tunnel to BWI Marshall Airport and beyond to Baltimore.
E1	Amtrak Modified	Extended tunnel out of Washington to a transition portal north of the Capital Beltway, and then joining the previous alignment E (which runs on elevated structure following the Northeast Corridor/Amtrak railroad right-of-way through Odenton, and then transitions back to tunnel toward BWI Marshall Airport and continues underground to Baltimore).
F	Baltimore-Washington Parkway Corridor	Generally follows WMATA and MARC out of Washington through College Park, then crosses eastward to the Baltimore-Washington Parkway corridor between the interchanges of MD 197 and MD 32, and then continues in tunnel to BWI Marshall Airport and continuing to Baltimore.
G	Washington Baltimore & Annapolis (WB&A) Corridor	Generally follows US 50 out of Washington in tunnel, transitions to elevated structure over the Anacostia River, then transitions back to tunnel under Landover Road before transitioning back to elevated structure over the Capital Beltway along MD 704, then continues elevated along the WB&A Trail and WB&A Road, then enters a tunnel towards BWI Marshall Airport and continues underground to Baltimore.
G1	WB&A Modified	Like G, G1 generally follows US 50 out of Washington, then transfers to MD 704, then continues along the WB&A Trail and WB&A Road, and then enters a tunnel to BWI Marshall Airport and continues to Baltimore. Slight horizontal refinements and an additional tunnel section under Odenton (from approximately Patuxent Road to just north of MD 32) were the added modifications to the WB&A corridor.
H	WB&A to Amtrak	This hybrid alignment follows the WB&A alignment (G) to Bowie and then transitions westward to run alongside Amtrak (E) through Odenton, before continuing in a tunnel to BWI Marshall Airport and beyond to Baltimore.
I	Amtrak to WB&A	This hybrid alignment utilizes the Amtrak alignment (E) in the south out of Washington, before shifting to the northeast near Bowie State University to then match the WB&A alignment (G) to the north of Odenton.
I1	Amtrak Modified to WB&A	This hybrid alignment utilizes the Amtrak Modified alignment (E1) to a transition portal north of the Capital Beltway, then turns eastward on elevated structure to the WB&A alignment (G) south of Odenton, then transitions into tunnel near Severn to continue to the BWI Marshall Airport and then Baltimore underground.
J	BWP Modified East	This modification to the Baltimore-Washington Parkway alignment includes an extended tunnel under Washington until after the Capital Beltway before transitioning to the elevated guideway. The modified alignment then generally follows the Baltimore-Washington Parkway on the east side through BARC, the PRR, and Fort George G. Meade before returning to tunnel towards BWI Marshall Airport station, then continuing in tunnel to Baltimore.
J1	BWP Modified West	This modification to the Baltimore-Washington Parkway alignment includes an extended tunnel under Washington until after the Capital Beltway before transitioning to the elevated guideway. The modified alignment then generally follows the Baltimore-Washington Parkway on the west side through BARC then turns to the east in tunnel to BWI Marshall Airport station, then continuing in tunnel to Baltimore. This alignment avoids Patuxent Research Refuge and would be in tunnel under Fort George G. Meade.
--	No Build	Continuation of existing transportation options between Baltimore, MD and Washington, DC, via I-95, US 1, US 29, MD 295, MARC service, and Amtrak service (including Acela service). The No Build Alternative would include transportation improvements adopted in the Regional Constrained Long-Range Plan for the Baltimore and Washington, DC areas. The No Build also includes selective planned major rail improvements identified in the NEC FUTURE ROD.

Notes:
1. Alignments A through D are based on the FRA/MDOT MTA Baltimore-Washington Maglev Project Draft EIS (2003).
2. Alignments E through J1 are based on stakeholder input and comments received during project scoping, including three routes based on 2012 studies by the private sponsor, BWRR.
3. The FRA/MDOT/ MTA NEPA team provides an independent and professional evaluation of the potential environmental impacts of the various alignments, and makes recommendations to BWRR's engineers regarding the alignments to avoid, minimize, and mitigate impacts so that the SCMAGLEV system, if built, does the least possible harm to the natural and human environment.

Figure A-1: Initial PASR Alignments

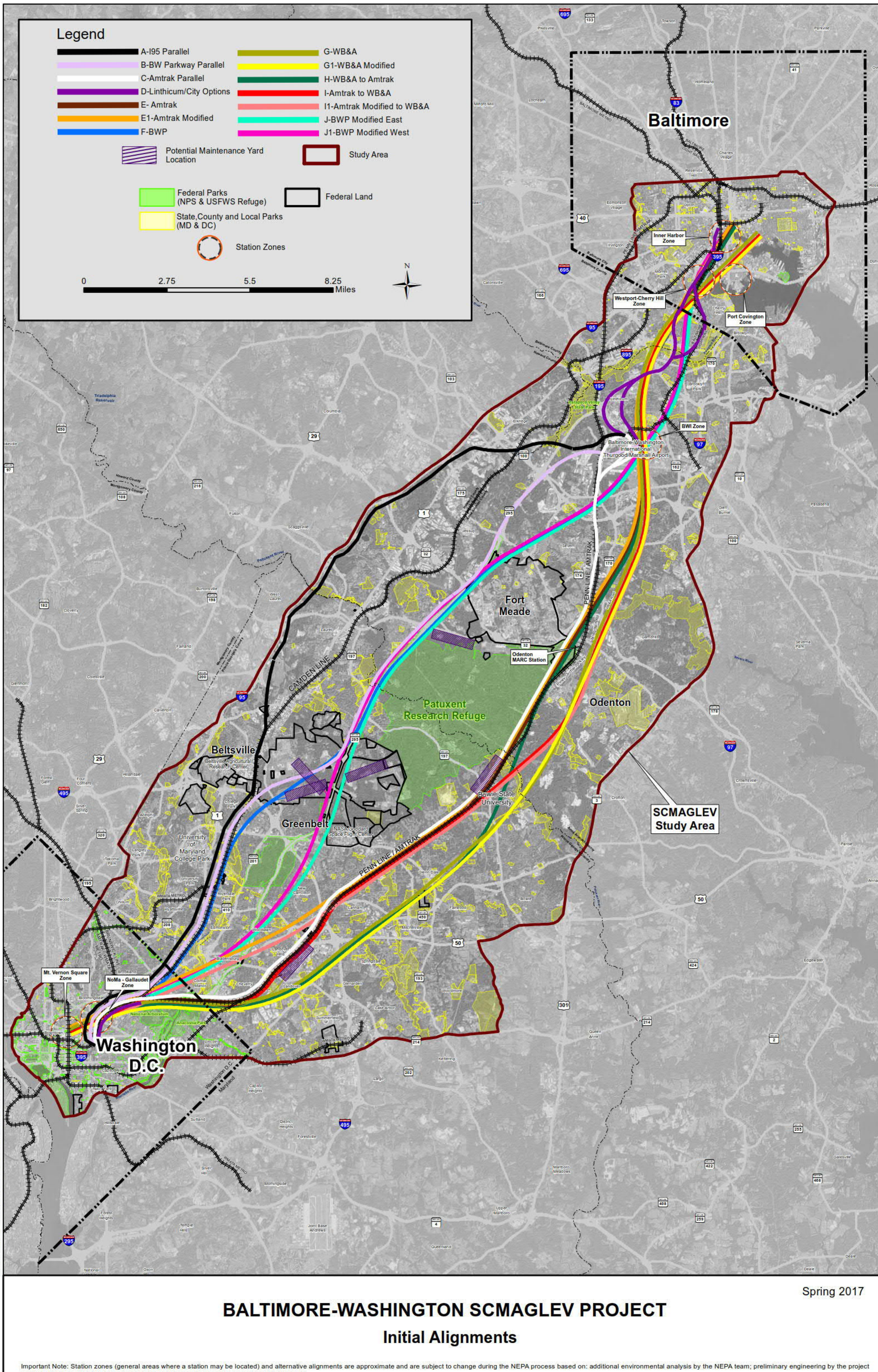


Figure A-2: Baltimore Station Zones (PASR)

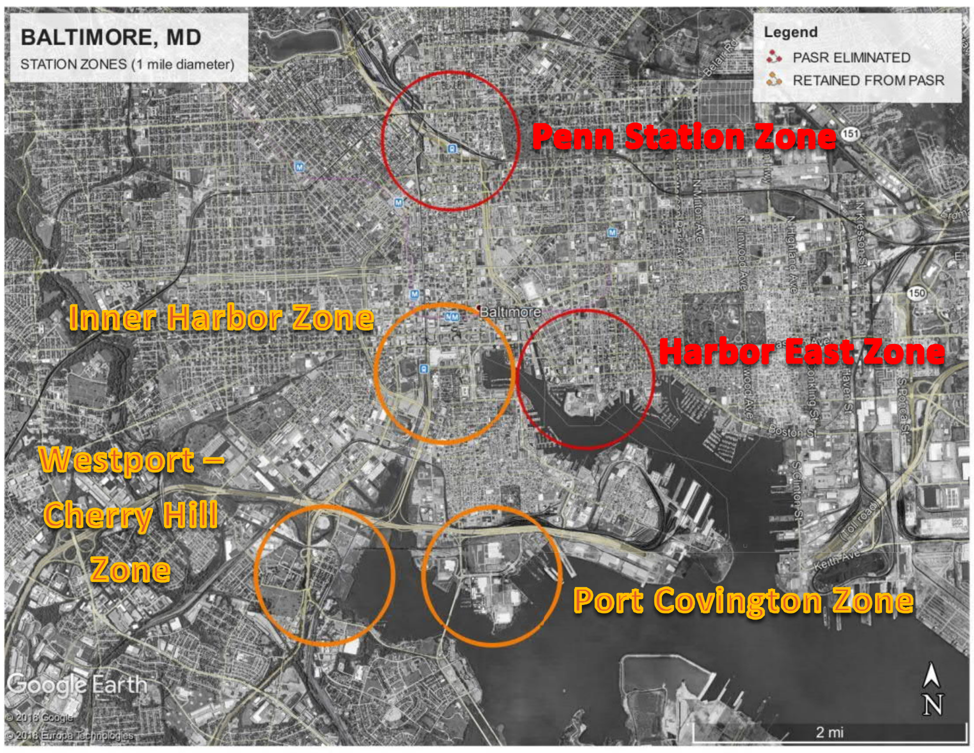


Figure A-3: BWI Marshall Airport Station Zone (PASR)

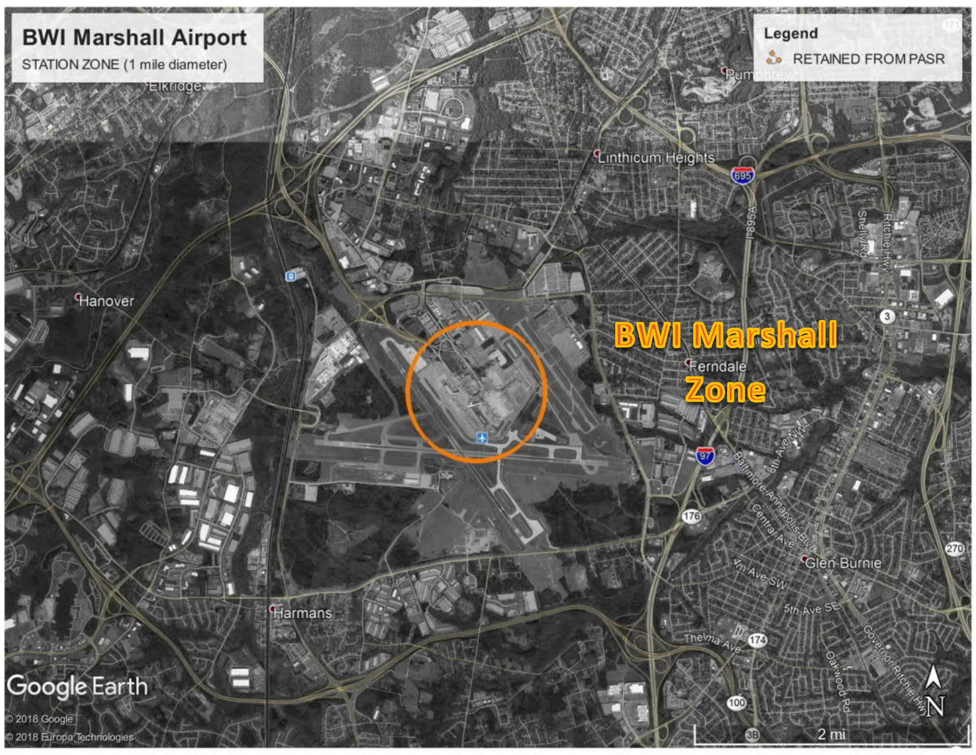
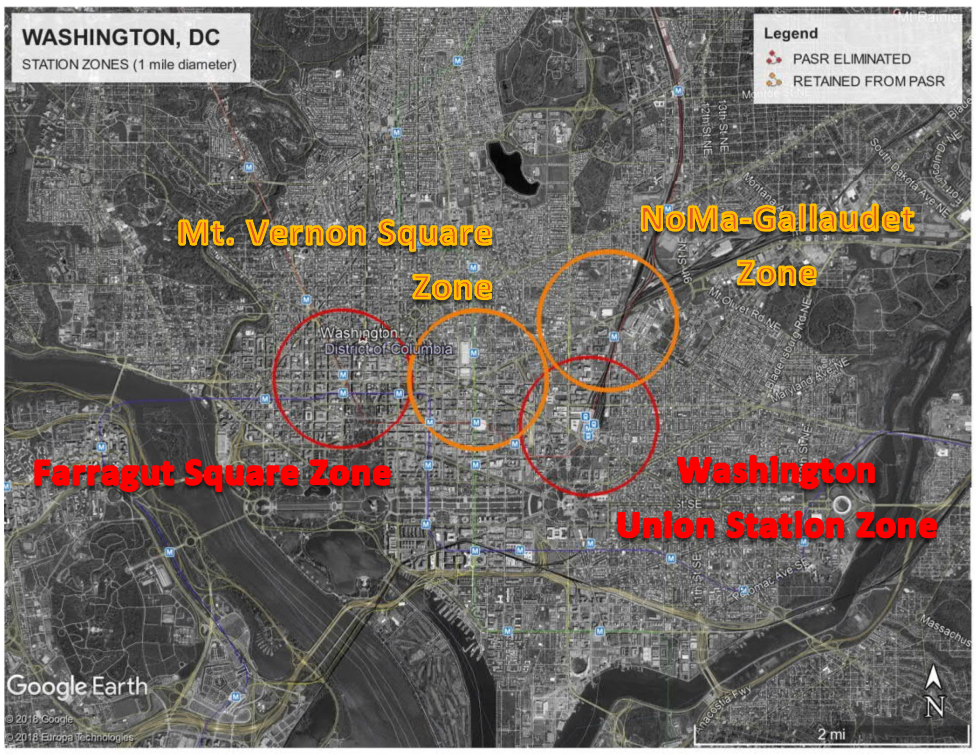


Figure A-4: Washington, DC Station Zones (PASR)



Appendix B: SCMAGLEV System Requirements and Components

SCMAGLEV SYSTEM REQUIREMENTS AND COMPONENTS

The SCMAGLEV design guidelines and general requirements are important to the alternative development process. Since the SCMAGLEV system would be a new technology to the United States, it is important that readers become familiar with its system elements that include horizontal and vertical geometry, design, operations and performance, and support components. These elements influence the footprint and LOD for evaluation of alternatives.

1. SCMAGLEV Alignment Criteria

The ability of an alignment to meet acceptable horizontal and vertical geometry was determined by geometric design criteria details listed in Table B-1.

Table B-1: Acceptable Geometric Design Criteria

Element	Design Criteria
Desired radius	10 miles (16,000 m)
Minimum radius for top speed operation	5 miles (8,000 m)
Minimum radius for slow speeds	2,600 feet (800 m)
Minimum tangent section length at stations	3,300 feet (1,000 m)
Maximum grade	4%
Desired grade (for energy efficiency)	3%
Minimum vertical curve radius for top speed operation	25 miles (40,000 m)
Minimum vertical curve radius at slow speeds	1.9 miles (3,000 m)
Maximum super elevation (angle of cant)	10 degrees
Station length, including turn-outs and cross-overs	3,280 feet (1,000 m)
Station – platform length (for 16 car train, subject to change)	1,312 feet (400 m)
Station – maximum grade of guideway	0.3%
Center-to-center spacing of guideways	19 feet (5.8 m)
Out-to-out dimension of elevated guideway (approximate)	46 feet (14 m)
Internal tunnel diameter for two guideways (approximate)	43 feet (13 m)
Minimum internal tunnel cross-sectional area (governed by aerodynamics)	800 square feet (74 m^2)
ROW limits for elevated structure	72 feet (22 m)

Source: Design Criteria (2017) provided by BWRR, the private project sponsor, are among the specifications for commercial deployment of SCMAGLEV developed from decades of research and testing by the Central Japan Railway Company (JR Central).

LENGTHS FOR ALTERNATIVE J AND J1 BY SECTION TYPE AND TERMINUS STATION OPTION

See Table B-2 for end-to-end lengths of the alternatives by the various terminus station options and by construction section type.

Table B-2: Lengths by Section Type for the Various Terminus Station Options

Alternatives J and J1 by Section Type (with the various Terminus Station Options)	Viaduct Length (miles)	Deep Tunnel Length (miles)	Cut & Cover Length (miles)	Transition Portal Length (miles)	Terminus Station Length (miles)	Total Length (miles)
Alternative J (Mount Vernon Square –West to Harbor West/Cherry Hill LR)	9.0	22.4	0.7	0.96	1.69	34.75
Alternative J (Mount Vernon Square – West to Camden Yards)	9.0	25.0	0.5	0.64	1.10	36.24
Alternative J1 (Mount Vernon Square - West to Harbor West/Cherry Hill LR)	4.5	26.9	0.57	1.13	1.69	34.79
Alternative J1 (Mount Vernon Square - West to Camden Yards)	4.5	29.5	0.45	0.81	1.10	36.36

Note that MVS-East Station option would reduce the deep tunnel length by approximately 0.37 miles (600 meters).

2. SCMAGLEV Station Elements

The SCMAGLEV system would consist of both underground tunnel segments and above ground segments on viaduct. Likewise, the potential station scenarios would include both underground and above ground options. The ultimate build alternative would have three stations. One station would be located in Washington DC, one at BWI Marshall Airport, and one in Baltimore, Maryland.

Stations include four primary elements: the Head House, Ticketing Concourse, Mezzanine, and Platforms.

- The head house structure for Washington or Baltimore would be the interface to the surrounding community. It could be highly visible and architecturally significant or integrated into neighboring structures. The head house could include customer service space, operational offices, retail activity, and other features. Passengers would enter the head house and proceed to the ticketing concourse. Secondary entrances could be provided to handle increased passenger flow and increase accessibility.

- The ticketing concourse would comprise a large passenger circulation space for the purchase of tickets, trip planning, and potential additional retail space. The ticketing concourse would be approximately 0.44 acres and would be oriented to accommodate the geometry of the mezzanine and platforms. A secondary ticketing concourse to handle increased passenger flow and increase accessibility to the station would also be an option. The ticketing concourse would likely have connectivity to nearby transit or other prominent intermodal facilities. Moving walkways could be provided for connections that are more distant.

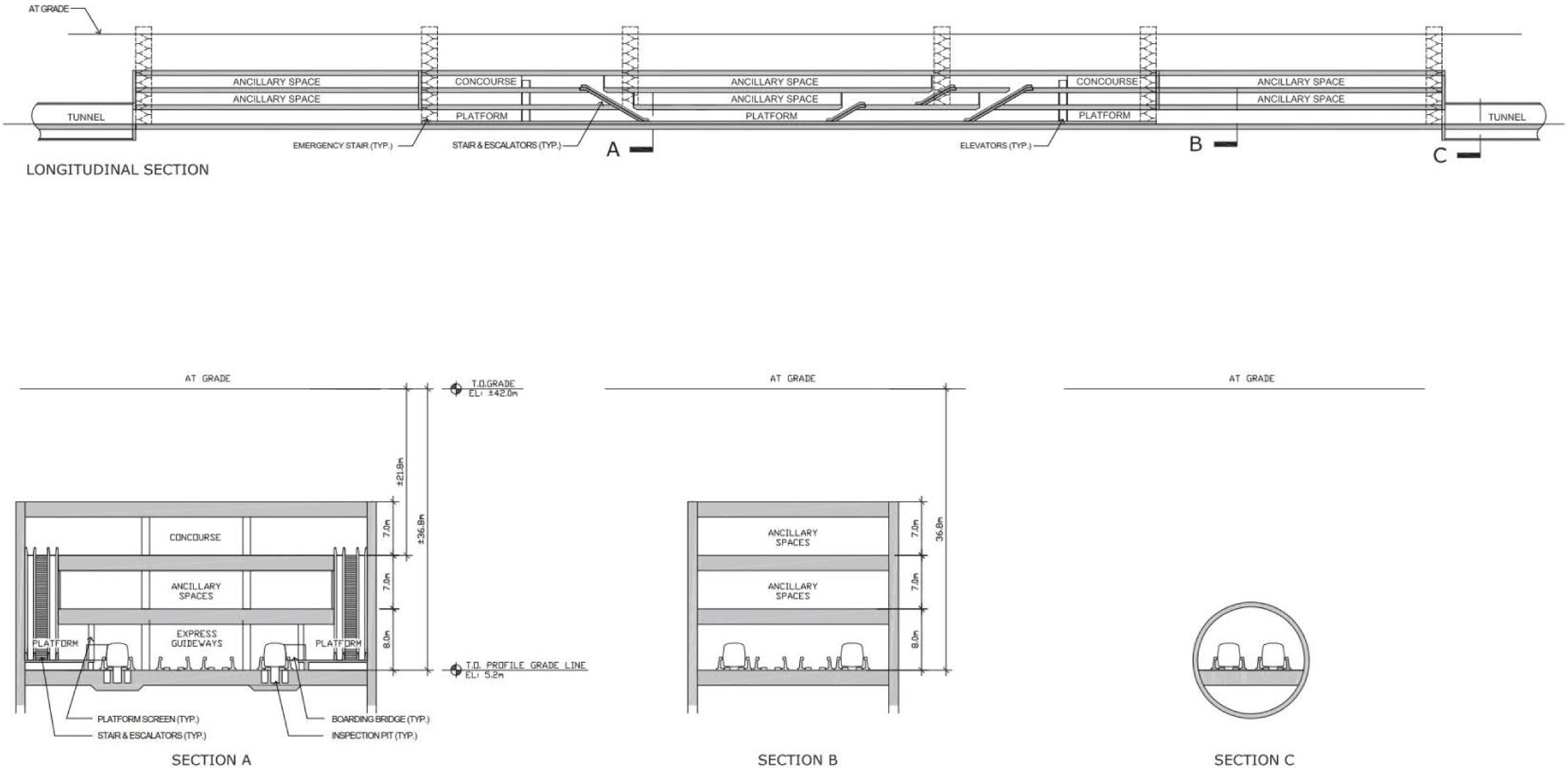
- The mezzanine would include a large open space dedicated to passenger circulation. In this space, passengers would disperse to elevators, escalators, and stairs. The mezzanine could also have a passenger waiting area, lounge, rest rooms, retail, and other features. The mezzanine could also have operational spaces that must be located in proximity to the platform, such as offices for train operations and locker facilities for operations personnel. Mechanical areas for station air conditioning would also be located on the mezzanine.

- For underground stations, the entrances would be either from the street or within buildings, similar to a subway. The graphical elements and dimensions listed in this report correspond to preliminary 12-car stations, which have 984 feet long platforms, but the proposed train car length will be studied further based on the ridership assessment during preparation of the DEIS. Station widths vary from 125 to 165 feet; station lengths vary from 1750 feet to 3260 feet. Ultimately, platforms could be approximately 1,300 feet long to accommodate 16-car trains, if the ridership assessment dictates. The station length accounts for the station platforms, as well as turnouts and crossovers. Underground stations are approximately 80 to 130 ft. deep.

- The elevated stations are expected to be a minimum of 18 feet above existing grade. Escalators, elevators and stairs would provide vertical circulation. The stations would be conveniently located to multimodal connections.

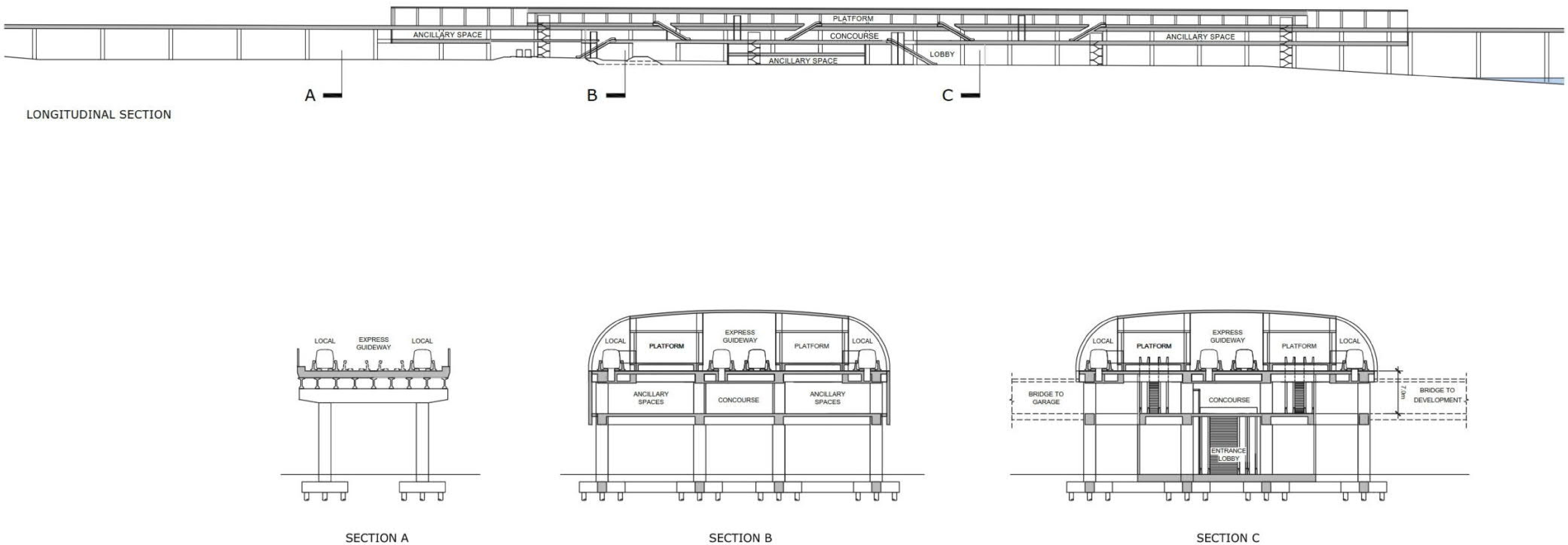
See Figure B-1 for a typical section representing an underground station and Figure B-2 for an above ground station.

Figure B-1: Underground Station Typical Section



Source: Station Typical Section provided by Baltimore-Washington Rapid Rail (BWRR), the private project sponsor, The Northeast Maglev (TNEM), Louis Berger, and di Domenico + Partners (dD).

Figure B-2: Elevated Station Typical Section



Source: Station Typical Section provided by Baltimore-Washington Rapid Rail (BWRR), the private project sponsor, The Northeast Maglev (TNEM), Louis Berger, and di Domenico + Partners (dD).

3. SCMAGLEV Ancillary Facilities

The SCMAGLEV system would consist of both underground tunnel segments and above ground segments on viaduct. The alternatives would also require the following ancillary facilities:

- Emergency Exits/Vent Plants - Vent plants would be required for the safe ventilation of smoke in the event of a fire, and often house emergency evacuation stairs. They would be spaced every three to four miles along tunnel segments, enclosed in aboveground buildings or built underground. The sites could be as large as three acres and could be co-located with other ancillary facilities. In addition to fan equipment, airshafts and emergency exits, the ventilation structures would house control facilities and emergency response equipment. Given the compatibility of spacing, airshaft positioning over the tunnel, and size, the ventilation structure sites would serve as launch sites for tunnel boring machines (TBMs) during construction.
- Tunnel Portals - Tunnel portals are areas where the alignment emerges from a tunnel and rises to form a viaduct or vice versa. The portal length could vary from less than 330 feet to 1600 feet or more. The train would emerge from the tunnel in an area with walls on either side, transition to an area where the guideway would be supported on retaining walls, and would then rise up to structural spans on piers.
- Power Substations - Power substations would be needed near or at each station and approximately every 12 to 25 miles along the route, for both tunnel and viaduct segments. Substations would provide power to the system, including facility requirements such as lighting, and ventilation. They could be built above or below ground, or possibly combined with other facilities. The space required would vary, approximately one and a half acres or larger, depending on what other functions would be incorporated at the site.
- Rolling Stock Depot (RSD) - There would be one RSD. The RSD would be used to store, maintain and repair trains while not in service. The site would have several buildings, the largest being the maintenance facility where a maintenance and repair program would be implemented. The facility would employ engineers, technicians, and other personnel at a site that would have an area of approximately 124 acres. The RSD could be co-located with a substation, the Maintenance-of-Way facility, and other smaller facilities.
- Maintenance of Way Facility - The Maintenance of Way (MOW) Facility would house workers and equipment for maintaining the system's physical infrastructure. The site would be similar to a municipal public works yard, with one or two buildings and a parking area for vehicles. There would be one facility approximately 7.4 acres in size located adjacent to a viaduct section of the alignment, likely at the RSD or near a substation.
- Operations Control Center - The Operations Control Center would serve as the central facility that manages all operations related to the SCMAGLEV system. It would be staffed 24/7 and direct train movement, manage safety and emergency activities, monitor power usage, and generally ensure that the system is operating to plan. The main facility would typically be located at a station or the RSD.
- Other Facilities - Additional smaller facilities would be located along the route for power distribution, communications, guideway drainage, and other minor functions. These facilities would generally be contained within the ROW of the viaduct, adjacent to a guideway tunnel, or in a small surface building above a tunnel, possibly co-located with other facilities. They will be identified during preliminary design.

4. SCMAGLEV Speed Requirements / Travel Time

Based on the technical memorandum on speed, the entire SCMAGLEV system (guideway geometry, tunnel configuration, power requirements, vehicle design, train control system, and other features) has been designed to operate at a maximum practical speed of 311 mph (500 km/h). At a cruising speed of 311 mph (500 km/h), SCMAGLEV would be capable of 15-minute travel times between Baltimore, Maryland and Washington, DC.

SCMAGLEV could accelerate to 311 mph (500 km/h) in two minutes at a rate of 0.1g with no adverse impact on passenger comfort. With approximately 30.4 miles (49 km) between the yet to be determined DC terminal station location option and BWI Marshall Airport station, the train would travel about 4.1 minutes at the optimum speed after accelerating, and before deceleration would be required to stop at the next station. On the BWI Marshall Airport to Baltimore segment, the quick acceleration rate results in a travel time of 3.9 minutes; the train would not attain the cruising speed of 311 mph (500 km/h) before having to decelerate. The full technical memorandum on speed was included in the appendix of the PASR.

5. SCMAGLEV System Requirements

SCMAGLEV adopts a total system approach governing propulsion, signaling and communications that ensures that trains would not collide. The driverless trains would be controlled from the operations control center, with acceleration, deceleration and levitation achieved through alternating currents applied to the magnets in the guideway sidewalls. The propulsion, signals and communications system will be addressed as part of the safety assessment.

The total power for the Baltimore-Washington operation will be determined as the operating plan is developed. SCMAGLEV trains would require 33,000 V motive power. Power consumption for an SCMAGLEV train running at 311mph is 35 MW, and peak power will be approximately double that. Power will also be needed for wayside facilities such as tunnel ventilation, but this will vary according to the substation's service range and the types of wayside facilities that are connected, and could range from 20-30 MW. Peak power for a substation is around 160-170 MW. The power would come from the grid and would be transformed to AC to power the trains. Instead of traditional train tracks, SCMAGLEV trains use powerful magnets to levitate in a unique concrete guideway. The lack of electrical resistance in superconducting magnets allows the SCMAGLEV to consume 30% less energy than other high-speed maglev trains, and 50% less than a commercial airliner.

It is currently assumed that two to six trains per hour would be needed for Baltimore-Washington service. Up to nine trains per hour could be expected when operating to New York in the future. SCMAGLEV trains would utilize regenerative braking, which uses the electric motors as generators to convert kinetic energy into electric power, to enhance the energy efficiency of the system.

Operational characteristics, such as train length and frequency of service, will be finalized during the ridership and revenue analysis. The service plan will dictate the fleet size and configuration of the stations and RSD. These elements, and the power and train control infrastructure, will be further defined during preliminary engineering and will be reflected in the DEIS.

Because the Alternative J and J1 alignments are qualitatively similar, both in alignment and associated structures, O&M requirements associated with linear infrastructure and facilities will be similar. The J1 alignment would have longer tunnel segments, however, which could require additional vent plants, which will influence O&M requirements.

6. SCMAGLEV Ventilation Requirements and Emergency Egress

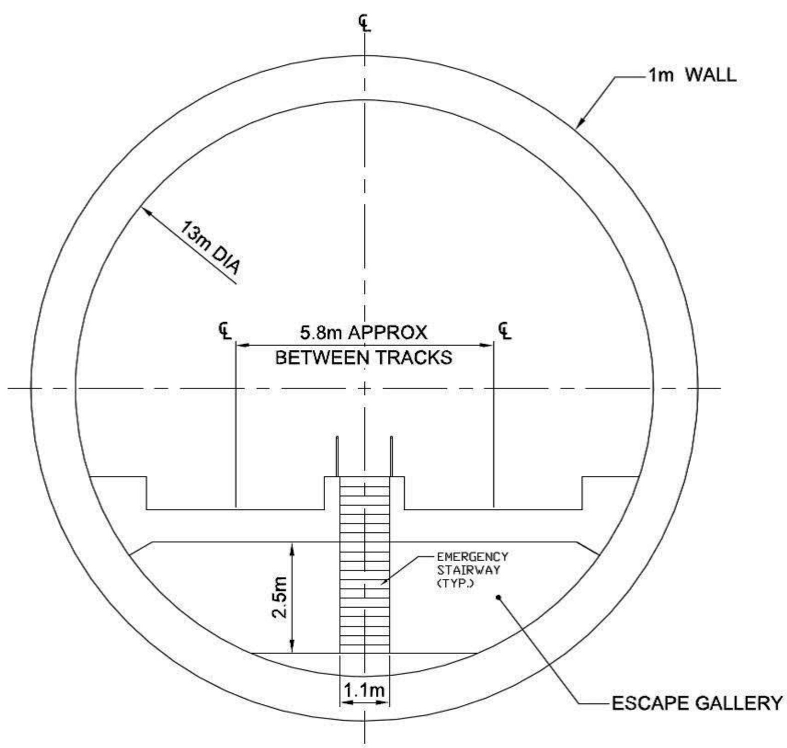
Vent plants would be located along underground sections of the alignment to provide smoke extraction from tunnels in the event of a fire or other incident. The location and size of the vent plants will be determined based on analysis in accordance with NFPA-130, the research and experience of Central Japan Railway Company (JR Central), discussions with FRA Office of Safety, and coordination with local emergency management forces. It is estimated that the vent plants would need to be placed every three to four miles.

Although the primary purpose would be to remove smoke and supply fresh air in the tunnel in the event of a fire or other disaster, the fan system could also be operated in a low speed mode during warmer periods to maintain comfortable temperatures inside the tunnel for the benefit of maintenance workers.

The vent plants would be co-located with emergency exits to be used by train passengers and emergency response teams in the event of a fire or other condition that causes trains to stop in the tunnel. An independent ventilation system would be incorporated into the vent plants to maintain tenable conditions in the emergency evacuation walkway that would be constructed below the guideways (see Figures B-3 and B-4 below).

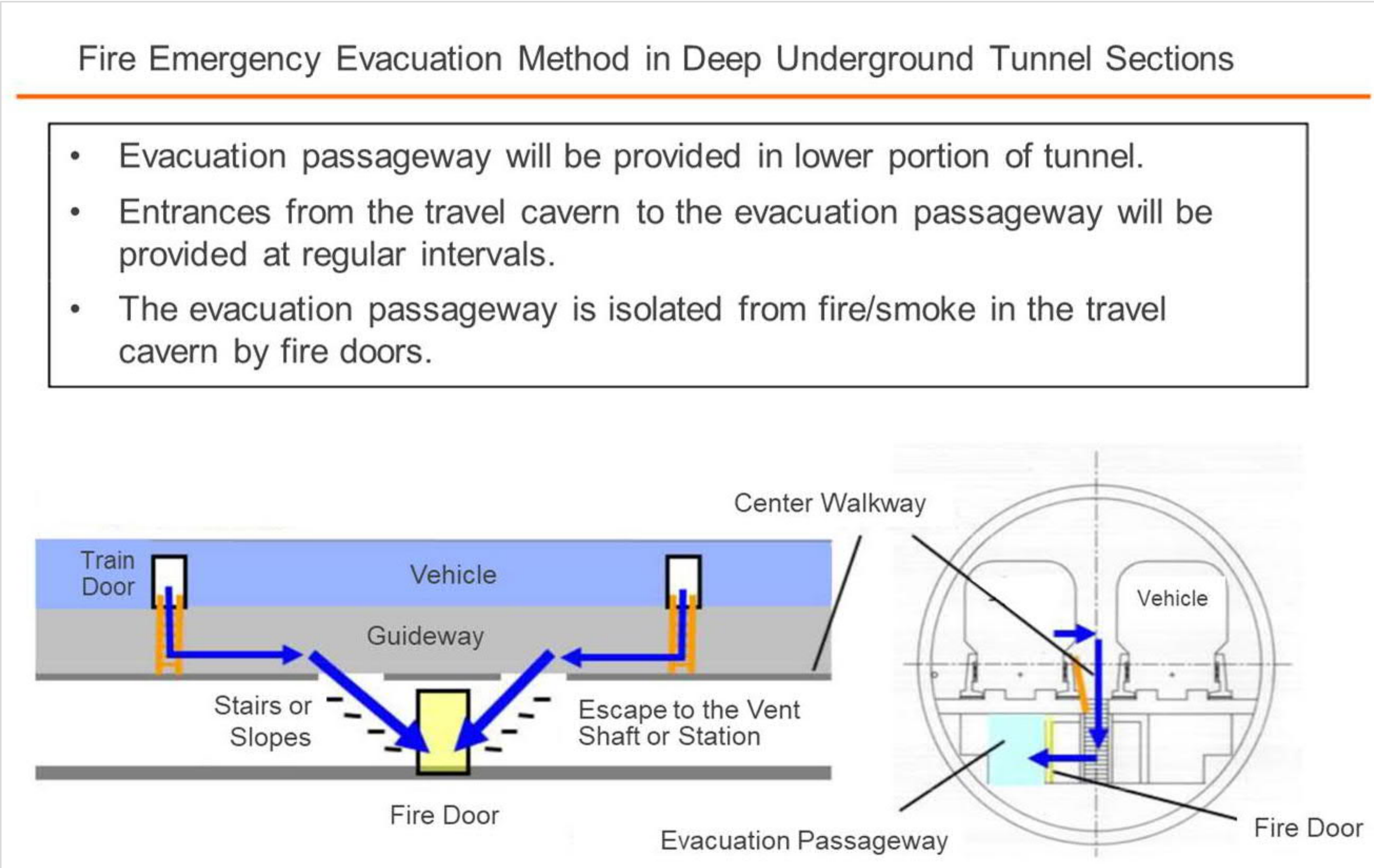
In addition to fan equipment, airshafts and emergency exits, the vent plants would house control facilities and emergency response equipment. Approximately 3 acres would be needed for each facility directly over the tunnel (See Figure B-5). Given the compatibility of spacing, airshaft positioning over the tunnel, and size, the ventilation structure sites would serve as launch sites for tunnel boring machines (TBMs) during construction.

Figure B-3: Conceptual Typical Section of SCMAGLEV Tunnel Illustrating Emergency Stairs to Escape Gallery



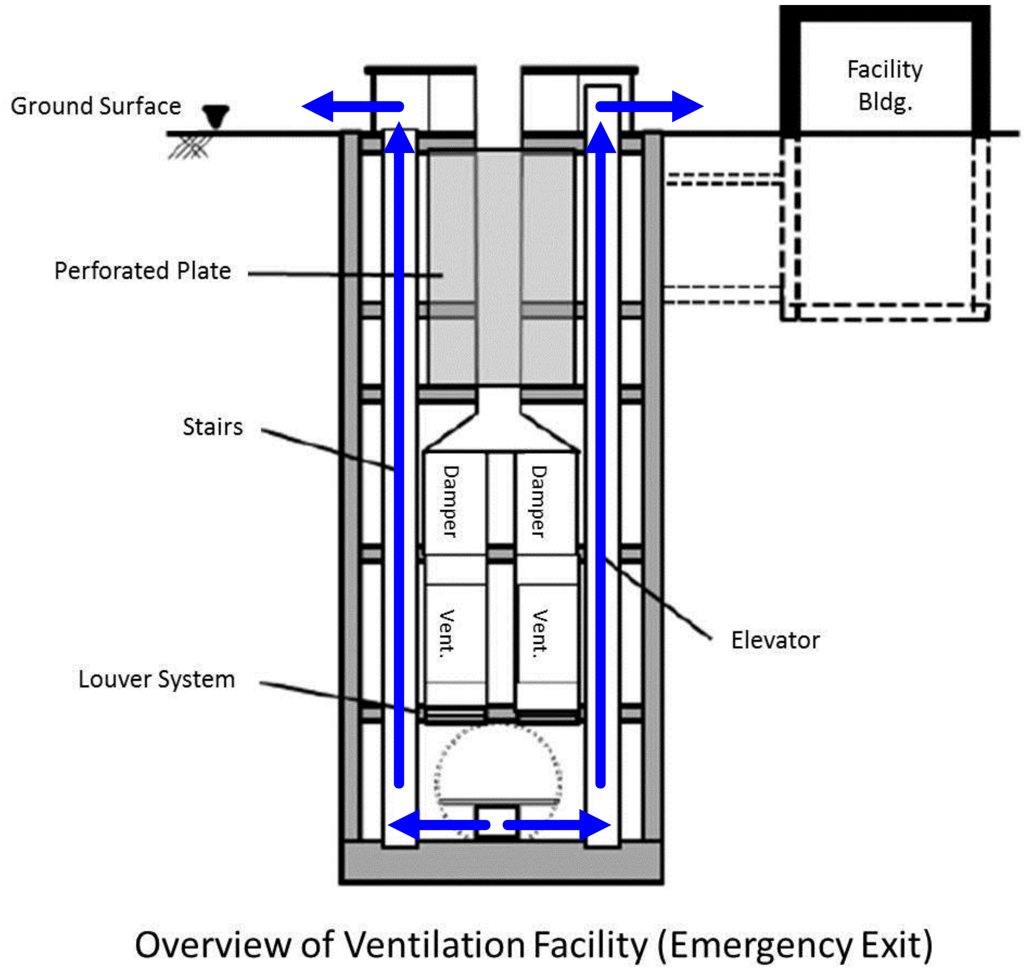
Source: Conceptual Illustration provided by BWRR. (Actual Design TBD, Not to Scale)

Figure B-4: Conceptual SCMAGLEV Emergency Egress from Train to Evacuation Passageway



Source: Conceptual Illustration provided by BWRR. (Actual Design TBD, Not to Scale)

Figure B-5: Conceptual Typical Section of SCMAGLEV Emergency Egress at Vent Plants



Source: Conceptual Illustration provided by BWRR.
(Actual Design TBD, Not to Scale)

7. SCMAGLEV Tunnels and Viaducts

Tunnels

About 62 to 81% of the two alignments would be in tunnel, depending on the terminus station options selected. The tunnel segments would contain a single tunnel with an interior diameter of approximately 43 feet carrying two guideways. Tunnel walls would be lined with concrete with a thickness of up to approximately 39 inches. The minimum interior tunnel diameter would be governed by the aerodynamics required for two SCMAGLEV trains to pass each other, going in opposite directions.

The tunnel sections would be constructed using a TBM at an average depth of approximately 80 to 170 feet. The TBMs could be expected to advance approximately 30 feet per day. The lower portion of the tunnel below the guideways would serve as an emergency evacuation route.

Refer to Figure B-3 for the typical cross section sketch for the guideway tunnel. See Figure B-4 and B-5 for a conceptual illustration of the guideway tunnel potential connection to an emergency exit/vent plant facility (with egress shown by blue arrows).

Viaduct

About 12 to 27% of the two alignments would be on viaduct, depending on the terminus station options selected. Viaduct would be used for each alignment in portions where surface development is less dense. The viaduct would carry two guideways with a width of approximately 46 feet and a height above ground of at least 18 feet. After construction, the area below the viaduct could be used for roadways, cycle and walking paths, restored and/or simply allowed to return to native vegetation. The approximately 46 foot wide mainline viaduct represents the actual guideway structure, which is offset by approximately 13 feet on each side to represent the anticipated LOD at ground level during construction. The approximately 72 foot wide LOD also represents the clear envelope needed at guideway level after the system is in operation. The approximate 13 foot offset is a typical dimension, consistent along each side of the mainline guideway, except at the river crossings where additional offset could be required during construction. See Figure 8 (in Chapter 3) for the typical cross section sketch for the viaduct.

8. SCMAGLEV Safety and Security Requirements

Safety will be addressed in the planning and design of the infrastructure, core systems, facilities, and operating and maintenance practices for the SCMAGLEV system. Fire and life safety considerations factor into all aspects of system design, including linear infrastructure (viaducts and tunnels), passenger stations, and O&M facilities. The following design standards and guidelines address fire and life safety requirements for each of these structures.

- National Fire Protection Association (NFPA)-130 Standard for Fixed Guideway Transit and Passenger Rail Systems
- NFPA-101 Life Safety Code
- NFPA-502 Standard for Road Tunnels, Bridges, and other Limited Access highways
- Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- Maryland Building Performance Standards
- Maryland State Fire Prevention Code
- Washington, DC, Building Code and Construction Code

Given the unique characteristics of the SCMAGLEV system, the standards and guidelines listed above will be supplemented by Japanese codes and practices that have contributed to that country's exemplary safety record. Safety systems and practices researched and developed by JR Central specifically for the SCMAGLEV system will be incorporated into the Baltimore-Washington SCMAGLEV Project to ensure deployment of the highest standards for safety. Emergency egress for passengers in tunnel sections of the route to a point of safety would be provided through an escape gallery inside the tunnel envelope (as illustrated in Figures B-2 through B-4 above). The tunnel cross section allots the space below the guideways as the escape gallery. In the event of an emergency requiring evacuation, passengers would exit the train and use stairways spaced periodically between the two guideways to access the escape gallery below. The gallery would be ventilated independently of the upper portion of the tunnel to ensure clean air in the event of a smoky condition. Passengers would walk along the gallery to the emergency exits, which would be co-located with the vent plants. The emergency exits and escape gallery would also be used by emergency responders to enter the tunnel and access the incident area. Emergency egress and access for viaduct structures would be provided via walkways along each side of the viaduct, which would include access stairways spaced along the route. Full measures for safety and security will be addressed during preliminary design in consultation with the FRA Office of Safety and local emergency response units.

Appendix C: Total Project Summary Table (Surface + Tunnel Results)

Table C-1: Total Project Summary Table (Surface LOD plus LOD above Tunnel)

Total Project Summary Table (Surface + Tunnel Results)	Alternative =	Alternative J (BWP East)								Alternative J1 (BWP West)							
	*Station Option =	MV-WEST to Cherry Hill LR		MV-WEST to Camden Yards		MV-EAST to Cherry Hill LR		MV-EAST to Camden Yards		MV-WEST to Cherry Hill LR		MV-WEST to Camden Yards		MV-EAST to Cherry Hill LR		MV-EAST to Camden Yards	
	**RSD Option =	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC	RSD MD 198	RSD BARC
Total Number of Residential Parcels (Count) in surface LOD + above tunnel		1098	1097	1098	1097	1101	1100	1101	1100	1203	1200	1203	1200	1206	1203	1206	1203
Subtotal for Number of Residential Parcels (Count) above Tunnel LOD		1091	1091	1091	1091	1091	1091	1091	1091	1188	1188	1188	1188	1188	1188	1188	1188
Subtotal for Number of Residential Parcels (Count) in Surface LOD		7	6	7	6	10	9	10	9	15	12	15	12	18	15	18	15
Total Number of Commercial Parcels (Count) in surface LOD + above tunnel		112	98	109	95	125	111	122	108	138	124	135	121	151	137	148	134
Subtotal for Number of Commercial Parcels (Count) above Tunnel LOD		62	62	83	83	62	62	83	83	86	87	104	105	86	87	104	105
Subtotal for Number of Commercial Parcels (Count) in Surface LOD		50	36	26	12	63	49	39	25	52	37	31	16	65	50	44	29
Number of Low Income Census Block Groups in LOD (Count)		13	13	12	12	14	14	13	13	17	17	16	16	18	18	17	17
Number of Minority Census Block Groups in LOD (Count)		93	93	91	91	97	97	95	95	100	96	98	94	104	100	102	98
Number of Community Resources in LOD (Count)		17	17	18	18	17	17	18	18	19	19	20	20	19	19	20	20
Number of Historic Landmarks and/or Eligible National Register Sites & Districts	Maryland	75	74	76	75	75	74	76	75	80	86	86	89	80	86	86	89
	Washington, DC	11	11	11	11	11	11	11	11	10	10	10	10	10	10	10	10
Parks (State, County, Local) in LOD	(Count)	28	28	29	29	28	28	29	29	37	34	38	35	37	34	38	35
	(Acres)	13	13	14	14	13	13	14	14	32	27	33	28	32	27	33	28
National Park Service (including B-W Pkwy) (Acres)		45	43	45	43	44	42	44	42	43	38	43	38	43	37	43	37
Patuxent Research Refuge (Acres)		19	17	19	17	19	17	19	17	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fort George G. Meade (Acres)		33	15	33	15	33	15	33	15	24	6	24	6	24	6	24	6
Beltsville Agricultural Research Center (Acres)		14	256	14	256	14	256	14	256	10	251	10	251	10	251	10	251
NASA - Goddard Space Flight Center (Acres)		2	2	2	2	2	2	2	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*MV-West = Underground Moun Vernon West; MV-East = Underground Moun Vernon East; Cherry Hill LR = Elevated Cherry Hill LR; Camden Yards = Underground Camden Yards.

** RSD BARC = Southern RSD in BARC; RSD MD 198 = Northern RSD between MD 198 and Fort Meade.

Note: These results would be from a total end to end project LOD perspective (surface LOD footprint + tunnel LOD footprint). See Appendix D for the detailed option specific tables for the breakdown of potential surface versus underground results.