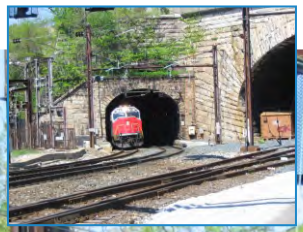
B&P TUNNEL PROJECT

B&P Tunnel Project
Baltimore, Maryland

NATURAL RESOURCES TECHNICAL REPORT

August 2015



U.S. Department of Transportation
Federal Railroad Administration

Maryland Department of Transportation

(This page intentionally left blank)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

This technical report presents a detailed analysis of the natural resources potentially impacted by the alternatives being studied for the Baltimore and Potomac (B&P) Tunnel Project. This technical report has been prepared in support of the Environmental Impact Statement (EIS)[1] being prepared by the Federal Railroad Administration (FRA)[2], in coordination with the Maryland Department of Transportation (MDOT)[3].

For the purposes of this technical report, the Study Area is defined as a 500-foot radius buffer extending from the centerline of each of the three B&P Tunnel alternative alignments under consideration. The Study Area is located in the west-central portion of Baltimore City along Amtrak's Northeast Corridor (NEC) between Penn Station to the north and the Gwynns Falls Bridge to the south.

Please note that all environmental evaluation in this technical report is current through August 2015.

II. PROJECT BACKGROUND

As shown in **Figure 1**, the B&P Tunnel is located beneath several West Baltimore neighborhoods, including Bolton Hill, Madison Park, and Upton. The tunnel is currently used by Amtrak[4], MARC[5], and Norfolk Southern Railway (NS)[6] and is owned by Amtrak. Built in 1873, the tunnel is one of the oldest structures on the NEC. It is approximately 7,500 feet (1.4 miles) long and is composed of three shorter tunnels: the John Street Tunnel, the Wilson Street Tunnel, and the Gilmor Street Tunnel. The B&P Tunnel is a centerpiece of the Baltimore rail network that contributes to the economic vitality of the Northeast region. The B&P Tunnel is important not only for Baltimore, but also the NEC (NEC MPWG, 2010). The NEC is the nation's most congested rail corridor and one of the highest volume corridors in the world (Amtrak, 2010).

[1] The EIS and associated technical reports are being conducted in compliance with the National Environmental Policy Act of 1969 (42 United States Code [USC] 4321 et seq.), the Council of Environmental Quality NEPA Regulations (40 CFR 1500-1508), the FRA Procedures for Considering Environmental Impacts (64 FR 28545, May 26, 1999), and FRA's Update to NEPA Implementing Procedures (78 FR 2713, January 14, 2013).

[2] FRA is serving as the lead Federal agency for the B&P Tunnel Project.

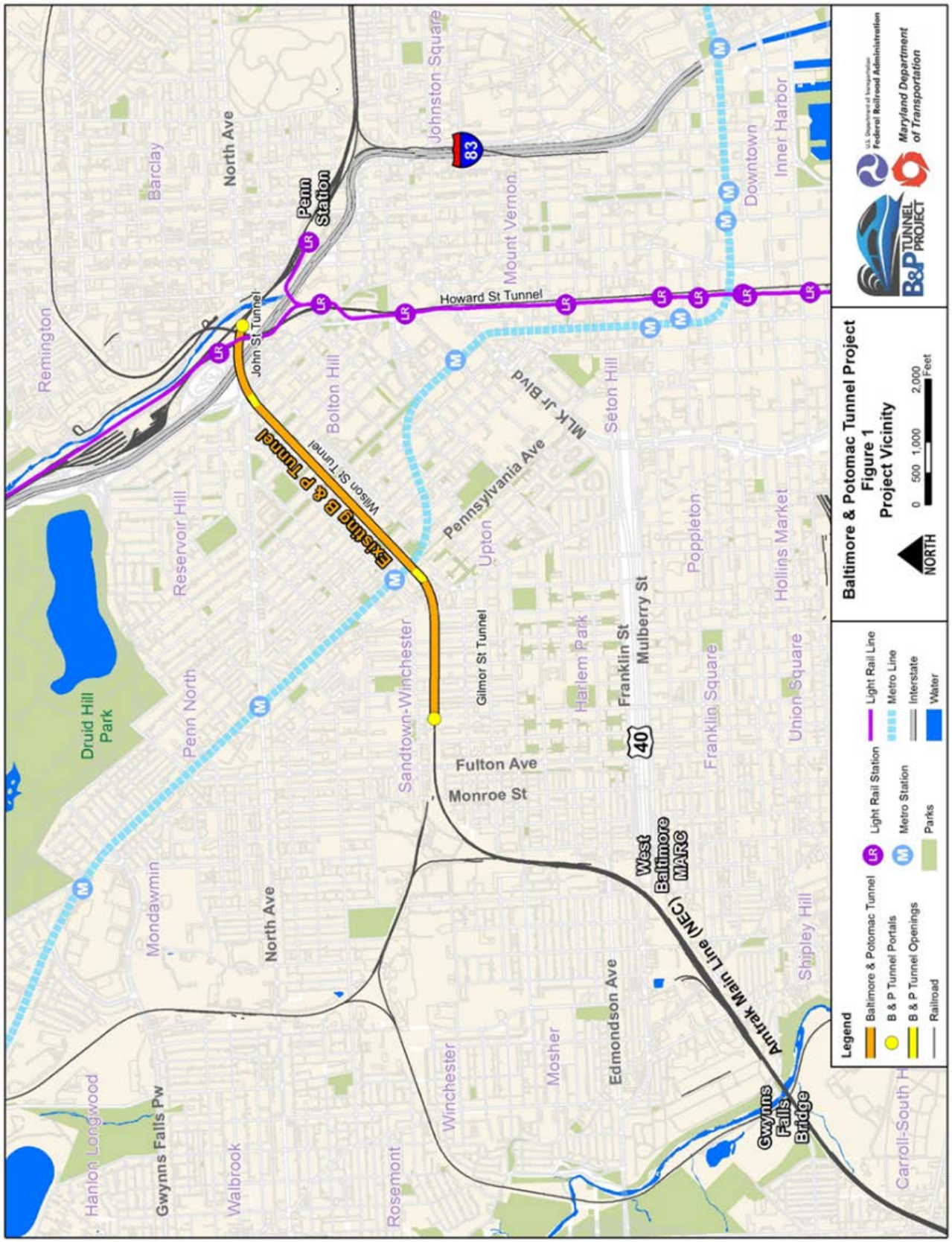
[3] MDOT is the funding grantee for the B&P Tunnel Project. MDOT oversees six modal state agencies, including the Maryland Transit Administration (MTA).

[4] Amtrak is the nation's high-speed rail operator and owns the existing B&P Tunnel.

[5] MARC (Maryland Area Regional Commuter) is administered by MTA. MARC is a commuter rail system comprised of three rail lines of service. One of the lines (the MARC Penn Line) operates along the NEC and through the B&P Tunnel, providing service between Washington, D.C. and Perryville, Maryland.

[6] NS is a freight transportation provider that manages a nearly 20,000-mile rail network across the United States, including freight service through the existing B&P Tunnel (NS, 2014a).

(This page intentionally left blank)


Baltimore & Potomac Tunnel Project
Figure 1
Project Vicinity
0 500 1,000 2,000 Feet
NORTH
Maryland Department of Transportation
Legend
Baltimore & Potomac Tunnel
B & P Tunnel Portals
B & P Tunnel Openings
Railroad
Light Rail Station
Metro Station
Parks
Light Rail Line
Metro Line
Interstate
Water
Existing B & P Tunnel
Howard St Tunnel
John St Tunnel
Wilson St Tunnel
Gilmor St Tunnel
Penn Station
North Ave
Fulton Ave
Monroe St
Pennsylvania Ave
MLK Jr Blvd
Mulberry St
Franklin St
West Baltimore MARC
Amtrak Main Line (NEC)
Gwynns Falls Bridge
Druid Hill Park
Johnston Square
Mount Vernon
Downtown
Inner Harbor
Bolton Hill
Seton Hill
Upton
Harlem Park
Poppleton
Hollins Market
Union Square
Franklin Square
Sandtown-Winchester
Penn North
Reservoir Hill
Barclay
Remington
Mondawmin
Hanlon Longwood
Gwynns Falls Pw
Walbrook
Rosemont
Winchester
Mosher
Edmondson Ave
Shipley Hill
Carroll-South H

(This page intentionally left blank)

III. PURPOSE AND NEED

A. Purpose of the Project

The primary purpose of the project is to address the structural and operational deficiencies of the B&P Tunnel. In addition, the project would: improve travel time, accommodate existing and projected travel demand for passenger services (regional and commuter), eliminate impediments to existing and projected operations along the NEC, provide operational reliability, and take into account the value of the existing tunnel as an important element of Baltimore's rail infrastructure.

B. Need for the Project

The purpose of the project was derived from the following needs:

- The existing B&P Tunnel is more than 140 years old and is approaching the end of its useful life with regard to its physical condition. While the tunnel currently remains safe for rail transportation, it requires substantial maintenance and repairs, and it does not meet current design standards. The tunnel is considered to be structurally deficient due to the horizontal radius of the original design, its age, and wear and tear.
- The tunnel is also functionally obsolete, meaning that it is not able to meet current and future rail demands due to its vertical and horizontal track alignment. The low-speed tunnel creates a bottleneck at a critical point in the NEC, affecting operations of the most heavily-traveled rail line in the United States.
- The existing double-track tunnel does not provide enough capacity to support existing and projected demands for regional and commuter passenger service.
- The existing tunnel is not suited for modern high-speed usage due to the current horizontal and vertical track alignment, which limits passenger train speeds through the tunnel to 30 MPH.
- The existing tunnel is a valuable resource. The disposition of the existing tunnel needs to be considered in the project.

IV. ALTERNATIVES

Sixteen preliminary alternatives were identified, evaluated using a two-level progressive screening approach, and narrowed to four alternatives in the *B&P Tunnel Project – Preliminary Alternatives Screening Report* (FRA/MDOT, December 2014). The four preliminary alternatives retained for further design development and environmental study include Alternative 1: No-Build, Alternative 2: Restore/Rehabilitate Existing B&P Tunnel, Alternative 3: Great Circle Passenger Tunnel, and Alternative 11: Robert Street South. Alternative 2 is hereafter referred to as “Reconstruction and Modernization of the Existing Tunnel” to more accurately reflect the components of the alternative.

These conceptual alternatives have evolved as the preliminary designs advanced. It was determined upon more detailed study of Alternatives 3 and 11 that several options could be accommodated within the

general corridors of each, and that each of the options should be considered as part of the Project. This technical report considers Alternative 3 Option A, Alternative 3 Option B, and Alternative 3 Option C, as well as Alternative 11 Option A and Alternative 11 Option B (**Figure 2**). Alternative 2 is hereafter referred to as "Reconstruction and Modernization of the Existing Tunnel" to more accurately reflect the components of the alternative.

A. Alternative 1: No-Build

Alternative 1 would entail continued use with minimal improvements to the existing B&P Tunnel. Routine maintenance of the tunnel would continue. The tunnel's basic geometry and structure would not be improved and the existing tunnel and tracks would be left in their current location. This alternative would not modernize the tunnel or bring it into a "state of good repair," but would maintain the existing service and ongoing maintenance as currently practiced with minimal disruption.

Necessary maintenance required to continue using the existing tunnel may include replacing damaged track slabs, repairing leaking utility lines above the tunnel, rebuilding deteriorated manholes, repairing brick and mortar, replacing catenary supports, and repairing the Gilmor Street portal.

B. Alternative 2: Reconstruction and Modernization of the Existing Tunnel

Alternative 2 includes the complete reconstruction of the existing B&P Tunnel in its current location. This alternative would address the existing B&P Tunnel's deteriorating conditions and eliminate restrictions on the size of railcar traffic over the NEC through Baltimore. This alternative would completely replace the existing tunnel liner, lower the tunnel invert for greater vertical clearance, and widen the tunnel for greater horizontal clearance. The geometry of the existing tunnel, such as curves and grades, would not be altered. The resulting tunnel would accommodate a two-track alignment through the Study Area.

C. Alternative 3

Alternative 3 consists of three options (A, B, and C), all of which would extend in a wide arc north of the existing B&P Tunnel. Each option would include a north portal located in the vicinity of the MTA North Avenue Light Rail station, north of where I-83 crosses North Avenue. The south portal for each option would be constructed at one of two sites located south of Presstman Street, between Bentalou and Payson Streets. Each option would result in a four-track alignment through the Study Area, and would involve construction of four separate tunnel bores. Each option would require three ventilation plants – one at each portal and one mid-tunnel plant. All of the alternatives have similar north portal locations but differ in their south portal locations and underground alignment.

Alternative 3 Option A would include a south portal located at the existing P. Flanigan Asphalt plant, just south of the athletic fields at Carver Vocational-Technical High School, roughly a third of a mile west of the existing B&P Tunnel south portal. The alignment would rejoin the existing NEC corridor at the curve located south of the asphalt plant. Option A would result in a total travel distance of approximately 3.7 miles between Penn Station and the Amtrak Gwynns Falls Bridge. The tunnel segment of the alignment comprises 1.9 miles of this total length.

Alternative 3 Option B would include a south portal located southeast of the P. Flanigan Asphalt plant, adjacent to the existing NEC between Mosher Street and Riggs Avenue, roughly a third of a mile southwest

of the existing B&P Tunnel south portal. Much of the underground portion of the alignment is identical to Option A. However, the alignment south of the south portal would be located east of the existing NEC. Alternative 3 Option B would result in a total travel distance of approximately 3.7 miles between Penn Station and the Amtrak Gwynns Falls Bridge. The tunnel segment of the alignment comprises 2.0 miles of this total length.

Alternative 3 Option C would include a south portal located at the P. Flanigan Asphalt plant, just south of the athletic fields at Carver Vocational-Technical High School, roughly a third of a mile west of the existing B&P Tunnel south portal. The underground portion of the tunnel would parallel the alignments identified under Options A and B; however, the alignment would be shifted further north. The alignment south of the south portal would be located west of the existing NEC. Option C would result in a total travel distance of approximately 3.83 miles between Penn Station and the Amtrak Gwynns Falls Bridge. The tunnel segment of the alignment comprises 2.2 miles of this total length.

D. Alternative 11

Alternative 11 includes two options (A and B) that provide for relatively straight alignments between Penn Station and the West Baltimore MARC Station, crossing diagonally underneath the existing B&P Tunnel. Each option would include a north portal in the vicinity of the MTA North Avenue Light Rail station, north of where I-83 crosses North Avenue. The south portal for each option would be located in the general vicinity of the West Baltimore MARC Station in the Midtown-Edmondson neighborhood. Each option would result in a four-track alignment through the Study Area, and would involve construction of four separate tunnel bores. Each option would require three ventilation plants – one at each portal and one mid-tunnel plant. Options A and B differ primarily in the south portal location and underground alignments.

Alternative 11 Option A would include a south portal located just west of the intersection of Harlem Avenue and Appleton Street, northeast of the West Baltimore MARC Station. The alignment would cross over Franklin and Mulberry Streets. Option A would result in a total travel distance of approximately 3.3 miles between Penn Station and the Amtrak Gwynns Falls Bridge. The tunnel segment of the alignment comprises 1.9 miles of this total length.

Alternative 11 Option B would exit the bored tunnel portion at a south portal located just southwest of the intersection of Edmondson Avenue and Pulaski Street, adjacent to the existing West Baltimore MARC Station. The underground portion of the alignment would run parallel to Option A, but would be shifted slightly north for the length of the tunnel alignment. The alignment would cross under Franklin and Mulberry Streets. Alternative 11 Option B would result in a total travel distance of approximately 3.3 miles between Penn Station and the Amtrak Gwynns Falls Bridge. The tunnel segment of the alignment comprises 2.2 miles of this total length.

V. BACKGROUND AND METHODOLOGY

Natural resources within the B&P Tunnel Study Area were preliminarily identified based on a desktop review of existing scientific literature; watershed reports; geographic information system (GIS) databases and mapping. The Study Area is defined as a 500-foot radius buffer extending from the centerline of each

of the alternative alignments under consideration. A desktop investigation of available mapped information identified Study Area topography, geology, hydrology, vegetative cover, 100-year floodplains, and soils information from the following agency resources:

- The United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS) Web Soil Survey (WSS) for Baltimore, Maryland
- The United States Geologic Survey (USGS) GIS Quadrangle Mapping
- Maryland Geological Survey
- Federal Emergency Management Agency (FEMA) GIS data
- National Wetlands Inventory (NWI) GIS data
- Maryland Department of Natural Resources (DNR) wetlands and waters GIS data
- Baltimore City GIS Data

The field investigation areas, those areas of potential above-ground construction of each of the six B&P Tunnel build alternatives as well as the existing tunnel alignment, were assessed by RK&K environmental scientists in May 2015. These areas include portal and vent shaft locations of Alternative 3 Option A, Alternative 3 Option B, Alternative 3 Option C, Alternative 11 Option A, and Alternative 11 Option B, and the right-of-way of the entire length of Alternative 2, as shown in **Figure 2**. All natural resources found within these potential construction areas were inventoried. The field investigation areas were investigated for wetlands, waterways, floodplains, street trees, and forests. Based on the desktop review of existing data for the field investigation areas, only tree and floodplain resources would likely be impacted by the project. Any street trees found were counted and size, condition, and species data were collected for any specimen trees, greater or equal to 30 inches diameter at breast height (dbh) found within the field investigation areas. Within the field investigation areas, wetland investigations were conducted in accordance with the 1987 *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory, 1987) and US Army Corps of Engineers (USACE), 2012 *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region Version 2.0*, (USACE, 2012). If wetlands were found within the field investigation areas, routine wetland determination methods with onsite inspection would be used to determine the presence

Figure 2. B&P Tunnel Project Alternatives

(This page intentionally left blank)

of wetlands in the field investigation areas. Similarly, if waterways were found within the field investigation areas, they would be delineated using the limits defined in 33 C.F.R. § 328. The boundaries of non-tidal waterways were set at the ordinary high water mark (OHW). The OHW is determined in the field using physical characteristics established by the fluctuations of water (e.g., change in plant community, changes in the soil character, shelving) in accordance with USACE Regulatory Guidance Letter No. 05-05. Forest and floodplain impacts were estimated by overlaying the project limits of above-ground disturbance on the mapped resources in GIS to estimate the areas of impact.

VI. EXISTING CONDITIONS AND ENVIRONMENTAL CONSEQUENCES

The B&P Tunnel Study Area is located within the highly-urbanized environment of Baltimore City. Land in this area is dominated by commercial, industrial, high-density residential, and transportation uses. The landscape has been altered significantly to construct urban infrastructure and amenities. Physical and water resources have been impacted considerably by the effects of urbanization.

A. Physical Resources

The physical environment of the Study Area has been altered to build roadways, railroad tunnels, light rail tracks, buildings, and industrial complexes. Soils have been impacted by construction, industrial processes, and transportation infrastructure. This section presents information on soils, topography, geology, aquifers, and groundwater of this region.

1. Soils

The USDA-NRCS WSS for Baltimore City identified 16 soil units within the Study Area, as shown in **Table 1**. The majority of the soils within the B&P Tunnel Study Area are non-hydric. A hydric soil is a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the soil layers closest to the surface. Two of the soil types, Keyport-Urban land complex and Urban land-Udorthents complex, are predominantly non-hydric, with hydric ratings of 5 and 3 percent, respectively. Hydric rating indicates the percentage of the soil unit that is hydric. A hydric rating of 100% is considered hydric, <100% to 66% predominantly hydric; <66% to 33% partially hydric; <33% to >0% predominantly non-hydric; and 0% non-hydric. The K-factor included in the soils table is a measure of soil erodibility or the likelihood that soil particles will detach and be transported by rainfall and stormwater runoff.

The project will remove large quantities of soil through either tunnel boring or cut and cover construction. Soil types within the Study Area will not likely be significantly impacted by the B&P Tunnel project, since the project will not involve large quantities of permanent fill material over large areas.

Table 1. Soil Types Found within Study Area

Map Unit Symbol	Map Unit Name	Hydric Rating (%)	K-Factor
13UB	Joppa-Urban land complex, 0 to 8 percent slopes	0	.10
14UB	Urban land-Joppa complex, 0 to 8 percent slopes	0	-
15UB	Keyport-Urban land complex, 0 to 8 percent slopes	5	.43
16UB	Urban land-keyport complex, 0 to 8 percent slopes	0	-
17C	Legore loam, 8 to 15 percent slopes	0	.32
17E	Legore loam, 15 to 45 percent slopes	0	.32
18UC	Legore-Urban land complex, 8 to 15 percent slopes	0	.32
19UC	Urban land-Legore complex, 8 to 15 percent slopes	0	-
22UB	Manor-Urban land complex, 0 to 8 percent slopes	0	.37
24UB	Matapeake-Urban land complex, 0 to 8 percent slopes	0	.55
29UB	Sassafras-Urban land complex, 0 to 8 percent slopes	0	.20
31UB	Urban land-Sassafras complex, 0 to 8 percent slopes	0	-
40C	Udorthents, loamy, very deep, 8 to 15 percent slopes	0	.32
42E	Udorthents, smoothed, 0 to 35 percent slopes	0	.10
43U	Urban land-Udorthents complex, occasionally flooded	3	-
44UC	Urban land, 0 to 15 percent slopes	0	-

2. Topography, Geology, Aquifers, and Groundwater

The Study Area is located in the Perry Hall Upland District of the Fall Zone Region within the Piedmont Plateau Physiographic Province of Maryland. This is within the Baltimore East and Baltimore West USGS quadrangles (7.5 minute series, 2014) at an elevation between 100 and 200 feet above mean sea level. This area is a geologic transition zone, where the sediments of the Coastal Plain Physiographic Province overlay the residual soils and basement rocks of the Piedmont Physiographic Province. The Coastal Plain deposits are found mostly in the higher elevations, whereas the soils and rock of the Piedmont are found mostly in the lower elevations of the Jones Falls Valley and the western portion of the Study Area where the sediments have been eroded, typically west of Fulton Avenue.

Most of the Coastal Plain sediments within the Study Area are mapped as Sand Facies of the Patuxent Formation. Near the center of the Alternative 2 alignment, some fine-grain materials are mapped as Clay Facies of the Patuxent Formation.

The geology of the Piedmont Plateau Province is characterized by meta-igneous and meta-sedimentary rock with igneous intrusions of pegmatite and smaller amounts of sedimentary rock interspersed (Maryland Geological Survey). Natural soils in this province are residual soils, which have formed in place through weathering of the parent bedrock. Residual soils typically form a profile characterized by a progression from soil to decomposed rock, or saprolite, to rock with increasing depths below the ground surface. In the eastern portion of the project Study Area, east of Mt. Royal Avenue and Callow Avenue, the parent materials are mapped as the Carroll Gneiss Member of the James Run Formation. The western portion of the Study Area, primarily west of Fulton Avenue, is also mapped as Carroll Gneiss Member to the south of Laurens Street and Jones Falls Schist to the north. The Jones Falls Schist in this area is included

in the Pegmatite Injection Complex where less than 50% of the bedrock consists of Pegmatite - a very hard rock with thin injection seams of quartzite.

Groundwater typically flows along the contacts of the Clay and Sand Facies of the Patuxent Formation, at the junction of the Coastal Plain and Piedmont Provinces, through the decomposed rock and in fractures and other discontinuities in the rock.

The information that follows is preliminary and based on available mapping, some of which was published in 1935. Borings and possibly geophysical exploration studies will need to be performed to develop more accurate evaluations. Localized concentrations of bedding planes, fractures and other discontinuities often result in decomposition extending to deeper levels. In areas of the pegmatite, hard rock can extend close to the ground surface.

Based on a review of the *Map of Baltimore City Showing the Configuration of the Underlying Rock Floor* (1935), the top of rock in the area of Alternative 2 is nearly 70 feet above sea level east of Pennsylvania Avenue and gradually rises to nearly 100 feet above sea level at the South Portal. These elevations are based on the datum in use in 1935 and should be considered approximate. It appears that most of the Alternative 2 tunnel will be in either Coastal Plain sediments or residual soils. Dewatering would likely be required and the excavation would be performed in mostly unconsolidated materials, increasing the risk that excavation could cause settlement of overlying utilities and structures. Precautions such as ground improvement and possible underpinning would likely be required, as would monitoring of settlements and groundwater withdrawal during dewatering.

For Alternative 3 Option A, Alternative 3 Option B, and Alternative 3 Option C, most of the alignment would be located below the upper contour of the mapped surface of the rock, except south of Presstman Street where it would start to emerge from the rock into mixed face conditions. A similar situation would be encountered east of Mt. Royal Avenue to the North Portal. Dewatering would likely be needed in excavating this tunnel option as well, but the excavations would likely be in stiffer materials with lower water flow rates in the rock, thereby reducing the risk of surface subsidence. Care will need to be exercised during construction to avoid settlements of the existing utilities and structures and monitoring of settlements will be necessary. This will be crucial when boring under the existing Metro Tunnel and when excavating in the mixed face and unconsolidated material near the portals.

Alternative 11 Option A and Alternative 11 Option B would mostly be located within mixed face south of the existing B&P Tunnel. North of the B&P Tunnel, the alignment would likely be below the mapped top of rock contour. In addition to boring under residential areas, as would also be done for Alignment 3, this alternative would involve boring under the Metro Subway Tunnel and the existing B&P Tunnel. Both of these tunnels will need to remain in service during construction of the new tunnel.

Most rock within the field investigation areas has very low permeability, as it has little pore space to transmit water, and conveys groundwater through joints, fractures and other discontinuities (Trapp and Horn, 1997). Piedmont rock ranges in age from 1.2 billion to 196 million years, formed from the Precambrian through the Jurassic periods (Trapp and Horn, 1997). The main types of crystalline rock found in this region are coarse-grained gneisses and schists that have undergone several periods of metamorphism (Trapp and Horn, 1997). Much of the consolidated rock is overlain with unconsolidated

material known as regolith, which is formed by the weathering of rock, and consists of saprolite, colluvium, alluvium, fill, and natural soil (Trapp and Horn, 1997).

The Study Area overlies the Piedmont Crystalline Rock Aquifer, an underground layer of water-bearing rock. Groundwater recharge is highly variable in this region, since it is almost entirely dependent on precipitation and local runoff that is absorbed through the regolith and into rock fractures (Trapp and Horn, 1997).

The U.S. Environmental Protection Agency (EPA) defines a Sole Source Aquifer (SSA) as an aquifer that "supplies at least 50% of the drinking water consumed in the area overlying [it]." These areas may have no alternative drinking water sources that could "physically, legally, and economically supply all those who depend on the aquifer for drinking water (EPA, 2014)." No Sole Source Aquifers, active water supply reservoirs, or wells are located in the vicinity of the B&P Tunnel Project. Surface water from rainfall and snowmelt is the source of the Baltimore City drinking water supply. Druid Lake, formerly known as Druid Hill Reservoir, is a 50-acre lake located in close proximity to Alternative 3 in Baltimore City. Druid Lake was an integral part of Baltimore City's water supply system, but was removed to comply with the 2006 federal water safety rule. There are plans to install underground tanks at Druid Lake to re-establish the water supply. Liberty Reservoir, Loch Raven Reservoir, Prettyboy Reservoir, and the Susquehanna River all contribute to Baltimore's water supply. None of these drinking water sources will be impacted by the B&P Tunnel Project.

The closest U.S. Geological Survey (USGS) groundwater well is in East Baltimore, within the Patuxent Formation Aquifer of the Lower Cretaceous age in the Coastal Plain Province. The groundwater characteristics of the well will have little bearing on the Study Area, since this aquifer is in a different physiologic province than the Study Area.

3. Water Resources

The entire Study Area is located within the highly-urbanized Lower Jones Falls Watershed, where a large portion of the land area is covered by impervious surfaces. This section focuses on surface waters within the Study Area, including the Jones Falls, the Gwynns Falls, their tributaries, their floodplains, stormwater, and water quality issues.

a. Streams and Navigable Waterways

Waterways are regulated under Sections 401 and 404 of the Clean Water Act. Clean Water Act jurisdiction of delineated features was determined in accordance with the June 5, 2007 joint guidance issued by EPA and USACE following the U.S. Supreme Court's decision in the consolidated cases Rapanos v. United States and Carabell v. United States (Rapanos); and the January 19, 2001 joint guidance issued by EPA and USACE following U.S. Supreme Court's decision in Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers (SWANCC).

The desktop investigation identified three waterways within the B&P Tunnel Study Area corridor: the Jones Falls, the Gwynns Falls, and a tributary to the Gwynns Falls. All mapped resources are included in **Appendix 1**.

The Jones Falls is a perennial traditionally navigable water (TNW) that flows through the northeastern portion of the Study Area. This waterway is considered a Navigable Water under Section 10 of the U.S.

Rivers and Harbors Act. The Jones Falls mainstem below Lake Roland is a Maryland Department of Environment (MDE) designated Use I waterway for Water Contact Recreation and Protection of Warm Water Nontidal Aquatic Life. Tributaries that drain to the Jones Falls include Moores Branch, Roland Run, Towson Run, Western Run, and Stony Run. There are no high quality, Tier II, stream segments located within the Jones Falls Watershed. The Jones Falls channel and its banks have been highly-altered, its deeply-incised nature and overlay of crystalline bedrock is typical of rivers of this region (Reger and Cleaves, 2008).

The Gwynns Falls is another perennial traditionally navigable water located in the southwest portion of the Study Area. This part of the Gwynns Falls is designated as a Use I waterway by MDE. The stream flows for 25 miles through Baltimore County and Baltimore City, before emptying into the tidal Patapsco River.

The Jones Falls, the Gwynns Falls, and a tributary of the Gwynns Falls are within the Study Area. These waterways would not be directly impacted by the proposed tunnel alignments, since the tunnel alignments as designed would remain on an existing structure over the Jones Falls and would not extend to the Gwynns Falls or its tributary. Groundwater and surface runoff could potentially be affected by this project, which could in turn affect the surface waters within the project area. Surface water impacts are likely to be minimal, given the erosion and sediment control regulations that are in place, however tunnel boring could impact groundwater flow and recharge of surface waters.

b. Wetlands

Wetlands and waterways are regulated under Sections 401 and 404 of the Clean Water Act (CWA). Executive Order 11990-*Protection of Wetlands* (42 FR 26961), was enacted to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands; to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative; and "each agency, to the extent permitted by law, shall avoid undertaking or providing assistance for new construction located in wetlands unless the head of the agency finds (1) that there is no practicable alternative to such construction, and (2) that the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use." The State of Maryland regulates these resources under the Maryland Tidal Wetlands Act and the Maryland Nontidal Wetlands Protection Act. Unavoidable impacts to nontidal resources may require a Maryland Nontidal Wetlands Permit, a Section 401 Water Quality Certificate, and a Waterway Construction Permit from MDE, as well as a Section 404 permit from the USACE for the discharge of dredge or fill material into wetlands and waterways.

A preliminary desktop analysis identified two NWI wetlands within the Study Area, one within the 100-year floodplain of the Jones Falls and one within the 100-year floodplain of the Gwynns Falls. See Natural Resources Mapping in **Appendix 1** for NWI wetland areas within each of the alternative alignments.

The two NWI wetlands located within the Study Area would not be impacted by any of the potential B&P Tunnel alignments. The field investigation areas were assessed for wetland areas in May 2015. No wetlands were identified within the field investigation areas during the field investigation.

c. Water Quality

Total Maximum Daily Loads (TMDLs) are developed as part of state requirements under the CWA. A TMDL plan is developed to determine the maximum amount of a pollutant that a waterbody can receive and still meet the ambient water quality standards set forth by Section 303 of the CWA and state requirements. Each state is required to prepare a biannual list of stream segments that are considered "impaired" and submit this 303(d) list to the EPA. These segments are known as Water Quality Limited Segments (WQLs), and a TMDL must be developed for each one. These WQLs can be considered "impaired" by analyzing a wide variety of water quality monitoring data, including chemical grab samples, *in situ* measurements, continuous measurements, and biological data. After listing a stream as a WQL on the 303(d) list, the state is required to prioritize the need for TMDL development for each waterbody.

Jones Falls Water Quality

Waters of the Jones Falls watershed are considered Impaired Waters under the CWA, and were first identified on Maryland's 303(d) List of Impaired Waters in 1996. The stream was listed as impaired by nutrients, sediment, copper, lead, zinc (1996 listings), fecal bacteria (2002 listing), and impacts to biological communities (2002, 2004, and 2006 listings).

A Water Quality Analysis (WQA) for zinc contamination in the Jones Falls was submitted by MDE to the EPA in 2002. According to this analysis, the aquatic life criteria and designated uses associated with zinc are being met in the Jones Falls, and the waterway does not require a TMDL for zinc to achieve water quality standards. (MDE, 2002). A WQA of copper and lead for the Jones Falls was submitted to the EPA in 2004. This study indicated that a TMDL for copper and lead is not required for the entire 8-digit basin of the Jones Falls, but is required for its lower most 12-digit basin (basin code 02-13-09-04-10-32), which was found to be impaired by copper in the WQA. The copper and lead WQA concludes that further monitoring within the 12-digit basin is required to identify the source of impairment and to determine whether a TMDL will be required. (MDE, 2004)

A WQA of eutrophication for the Jones Falls Watershed in Baltimore City and Baltimore County, Maryland was submitted to the EPA in 2009. This study indicated that the Jones Falls Watershed is not being impaired by nutrients based on a Biological Stressor Identification (BSID) analysis and recent water quality data analysis conducted by MDE. The WQA indicates that no TMDL is required for eutrophication in the Jones Falls Watershed. (MDE, 2009)

A proposed TMDL of Fecal Bacteria for the Non-Tidal Jones Falls Basin in Baltimore City and Baltimore County, Maryland was submitted to EPA in 2006, and the TMDL was established at 860 billion most probable number (MPN) of *E. coli* per day. The sources of fecal bacteria were estimated at five representative stations within the Jones Falls Watershed, based on one year of bacterial sampling. Multiple antibiotic resistance analysis was used to determine the bacterial source, and it was concluded that human waste is the source of the majority of the bacteria in the Jones Falls. (MDE, 2006)

A proposed TMDL of Sediment in the Jones Falls Watershed, Baltimore City and Baltimore County, Maryland was submitted in 2011. A TMDL of combined nonpoint source, stormwater, and processed wastewater allocations was established to ensure that sediment loads and their impacts would support the USE I, II, and IV designations for the Jones Falls Watershed and protect against sediment related

impacts to aquatic health. The Jones Falls Average Annual TMDL of Sediment/Total Suspended Solids (TSS) was established at 7,109.3 tons per year. The Average Annual TMDL is a total load allocation for nonpoint sources, regulated stormwater, and process water waste combined. The Load Allocation for nonpoint sources is 1,022.0 tons per year; the National Pollutant Discharge Elimination System (NPDES) regulated stormwater Load Allocation is 6,084.9 tons per year; and the Process Water Waste Load Allocation is 2.4 tons per year. These Load Allocations were set based on a BSID methodology, which concluded that biological communities in the Jones Falls watershed are impaired due to flow and sediment related stressors. Stressors impacting the biological community of the Jones Falls were identified as channelization, channel alteration, poor epifaunal substrate, poor bank stability, and high embeddedness. The sediment TMDL will not completely resolve the biological impairment of the Jones Falls watershed, since other potential stressors to biological communities including chlorides, sulfate, and conductivity were identified during the BSI analysis and other biological monitoring. Further analyses will be conducted by MDE to establish TMDLs for all impairing substances in the watershed. (MDE, 2011)

Water quality may be negatively impacted by the construction of alternatives that cross Jones Falls. Minor impacts are anticipated; however, during construction applicable best management practices would be employed to minimize impacts to water quality. In addition, an Erosion and Sediment Control Plan would be developed during the Final Design stage of the project. The plan minimizes the potential for sediment and other construction-related runoff, including concrete wash-out, to leave the limits of disturbance and contaminate the Jones Falls. A Hazardous Spill Prevention Plan would also be developed as part of the Phase I Environmental Site Assessment (ESA) to prevent hazardous materials such as equipment fuel and lubricants from contaminating the waterway.

Gwynns Falls Water Quality

Waters of the Gwynns Falls watershed are considered Impaired Waters under the CWA, and were first identified on Maryland's 303(d) List of Impaired Waters in 1996. The stream was listed as impaired by nutrients, sediments (1996 listings), fecal bacteria, and impacts to biological communities (2002 listings).

A Water Quality Analysis (WQA) of Eutrophication for the Gwynns Falls Watershed in Baltimore County and Baltimore City, Maryland was submitted by MDE in 2009 and approved by the EPA in 2010. According to this analysis, a TMDL for nutrients is not necessary to achieve water quality standards in the Gwynns Falls. EPA approved TMDLs for nitrogen and phosphorous in the Baltimore Harbor in 2007. The Gwynns Falls drains into the Baltimore Harbor, so BMPs to improve water quality in the harbor will require nutrient reductions in the Gwynns Falls. The nutrient WQA supports a revision of the phosphorous listing for the Gwynns Falls watershed from an impaired Category 5 waterbody to a Category 2 waterbody, indicating that it meets some water quality standards, but that there is insufficient data for all impairments to be assessed. (MDE, 2009)

A proposed TMDL of Fecal Bacteria for the Non-Tidal Gwynns Falls Basin in Baltimore City and Baltimore County, Maryland was submitted to EPA in 2006 and approved in 2007. USGS daily flow monitoring data was collected at four representative monitoring stations in the Gwynns Falls watershed for one year and was used to create a flow duration curve to estimate the sources of fecal bacteria in the stream. Multiple antibiotic resistance analysis source tracking was used to determine the relative proportion of fecal

bacteria sources. Human fecal bacteria was found to be the predominant source category adversely impacting the water quality of the Gwynns Falls. The fecal bacteria TMDL was set at 917.4 billion E. coli MPN/day for the Gwynns Falls watershed.

A proposed TMDL of Sediment in the Gwynns Falls Watershed, Baltimore City and Baltimore County, Maryland was submitted to EPA in 2009 and approved in 2010. MDE used BSID methodology to determine whether elevated sediment loads were negatively impacting the stream environment. This analysis determined that biological communities of the Gwynns Falls watershed are being impaired by flow and sediment related stressors, including channelization, channel alteration, and bar formation. A reference watershed approach was used to quantify the negative impact of sediment related stressors on the biological communities and a sediment loading threshold was established. The threshold was then used to determine a TMDL for the Gwynns Falls watershed. The Gwynns Falls Average Annual TMDL of Sediment/Total Suspended Solids (TSS) is 13,996.2 tons per year. This TMDL will ensure that the watershed can meet its Use Class criteria and not be negatively impacted by sediment loads.

The Gwynns Falls and a tributary of the Gwynns Falls would not be directly impacted by the proposed tunnel alignments since the alignments would not extend into these waterways. Since the Study Area is within the Gwynns Falls watershed, minor water quality impacts may occur due to stormwater runoff. During construction of the alignments, applicable best management practices would be employed to minimize impacts to water quality. In addition, an Erosion and Sediment Control Plan would be developed during the Final Design stage of the project. The plan minimizes the potential for sediment and other construction-related runoff, including concrete wash-out, to leave the limits of disturbance and contaminate the Jones Falls. A Hazardous Spill Prevention Plan would also be developed as part of the Phase I ESA to prevent hazardous materials such as equipment fuel and lubricants from contaminating the waterway.

d. Floodplains

The U.S. Department of Transportation (DOT) Order 5650.2, entitled *Floodplain Management and Protection,* prescribes policies and procedures to ensure that proper consideration be given to the avoidance and mitigation of adverse floodplain impacts. Data from the FEMA Flood Insurance Rate Maps (FIRM) was obtained and overlaid on GIS mapping of the B&P Tunnel Project to identify regulated floodplains within the Study Area (see project mapping in **Appendix 1**). Floodplains are also regulated at the state level and any construction in the nontidal floodplain will require a Waterway Construction Permit from MDE.

The 100- year floodplain will not be impacted by any of the B&P Tunnel alternatives, as no excavation will occur within the floodplain. Track work would occur along existing railroad track areas within the proposed North Portal, but this will not require excavation.

B. Wildlife and Habitat

Wildlife habitat within the Study Area is limited due to high levels of urbanization. The potential wildlife habitat in this region includes the Jones Falls, a few City parks, street trees, residential yards, landscaped areas around buildings, hedgerows and forested areas around the I-83 interchange. Some of the wildlife species known to inhabit Baltimore City include resident and migrating songbirds, birds of prey, pigeons,

squirrels, mice, rats, bats, opossums, raccoons, foxes, frogs, toads, salamanders, insects, spiders, and fish. The Study Area likely supports populations of many of these species. This section presents information regarding the aquatic and terrestrial habitat of the Study Area, including a section on invasive species.

The B&P Tunnel will have minor impacts on wildlife and their habitat, since most of the project will take place underground and above-ground vents will primarily impact urban areas with little habitat value. Aquatic habitats will not be impacted, since Alternatives 3 and 11 will remain on existing structure over the Jones Falls, Alternative 2 does not reach the Jones Falls, and none of the Alternatives will reach the Gwynns Falls.

4. Aquatic Habitat

The Jones Falls watershed is listed on the Maryland list of WQLs as impaired for impacts to biological communities. A quantitative assessment of the health of biologic communities within stream systems is conducted by the DNR, called the Index of Biological Integrity (IBI). The percentage of stream miles that have an IBI of less than 3 is calculated and then compared to a reference stream that is less than 10% degraded to determine the relative biological health of the stream. The Code of Maryland Regulations (COMAR) requires that the Jones Falls support a minimum Use I designation for Water Contact Recreation and Protection of Nontidal Warmwater Aquatic Life. The Jones Falls is not attaining the designated use of supporting aquatic life, since it is biologically impaired. MDE evaluates whether the designated use of supporting aquatic life is being achieved by assessing the Benthic and Fish Indices of Biological Integrity (BIBI/FIBI), developed by the Maryland Biological Stream Survey. Biological impairment is assessed using a (BSID) analysis that determines the main causes of reduced biological function.

The BSID indicates that the Jones Falls is negatively impacted by urban land use, which has led to altered hydrology, increased runoff, channel erosion, elevated suspended sediments, channelization, and degradation due to inorganic pollutants. Approximately 36% of the stream miles in the Jones Falls watershed are estimated as having impaired FIBI/BIBI scores in the very poor to poor category. The Jones Falls has very poor to poor ratings for epifaunal substrate, bank stability, embeddedness, presence of concrete/gabions, instream habitat, riffle/run quality, velocity and depth diversity, and channelization. Water quality analysis indicated low dissolved oxygen conditions in 19% of the stream miles, and high levels of sulfates, chlorides, and conductivity. High levels of point and nonpoint source inorganic pollutants in the Jones Falls are potentially toxic to aquatic organisms. Toxic water quality along with impaired stream structure result in poor habitat for aquatic organisms. (MDE, 2009)

A Watershed Report for Biological Impairment of the Gwynns Falls Watershed in Baltimore City and Baltimore County, Maryland Biological Stressor Identification Analysis Results and Interpretation was submitted to EPA in 2009 and approved in 2010. The BSID data suggests that the degradation of the biological communities of the Gwynns Falls is due in large part to the impacts of urban land use and the related impacts of altered hydrology, elevated ammonia levels, chlorides, and conductivity. It also suggests that the biological communities of the Gwynns Falls are likely degraded by flow and sediment related stressors and anthropogenic channelization of streams.

No National Marine Fisheries Service (NMFS) designated Essential Fish Habitat occurs within the Study Area.

The Jones Falls, Gwynns Falls, and a tributary of the Gwynns Falls are located within the Study Area. These waterways and associated aquatic habitats would not be directly impacted by the proposed tunnel alignments, since the alignments would not extend into these waterways. Since the Study Area is located within a highly urbanized area, the project is anticipated to have no adverse impact on aquatic habitat. During construction of the alignments, applicable best management practices would be employed to minimize impacts to aquatic habitats. In addition, an Erosion and Sediment Control Plan would be developed during the Final Design stage of the project. The plan minimizes the potential for sediment and other construction-related runoff, including concrete wash-out, to leave the limits of disturbance and contaminate the waterways. A Hazardous Spill Prevention Plan would also be developed as part of the Phase I ESA to prevent hazardous materials, such as equipment fuel and lubricants from contaminating the waterway and associated aquatic habitats.

5. Terrestrial Habitat

Terrestrial habitat, in this urbanized setting, is essentially limited to forest stands and street trees. DNR defines a forest as "a biological community dominated by trees and other woody plants covering a land area of 10,000 square feet or larger and at least 35 feet wide. Forest includes areas that have at least 100 trees per acre with at least 50 percent of those having a two-inch or greater dbh, and forest areas that have been cut but not cleared. Forest does not include orchards." Specimen trees are defined by DNR as "trees having a dbh of 30-inches or more, or trees having 75 percent or more dbh of the current state champion of that species."

The Maryland Forest Conservation Act applies to any activity requiring application for subdivision, a grading permit, or a sediment control permit for an area 40,000 square feet or greater. Applicants following the Forest Conservation Act are required to submit a Forest Stand Delineation (FSD) and a Forest Conservation Plan (FCP), prepared by a Maryland qualified forest professional, to DNR or the local reviewing agency for review and approval. A FSD is an inventory of existing forest/trees and other environmental site features, and it provides a basis for determination of the most suitable forest and resource protection areas during the early stages of site development planning.

A FCP is prepared during the latter stages of site design and details the limits of disturbance; amount of forest that would be retained, removed, reforested and afforested during site development; locations of specimen trees for retention and removal; types and locations of tree/forest protection devices and supplemental tree care; maintenance and monitoring parameters; and long-term protection measures. The *State Forest Conservation Technical Manual* (*Manual*), Third Edition (Howell and Ericson, 1997) outlines the requirements for FSD and FCP preparation and submittal.

The Maryland Roadside Tree Law was passed in 1914 to ensure that roadside trees were properly protected and cared for, and to ensure compatibility with public utilities. A Roadside Tree Care Permit must be obtained from DNR prior to pruning, fertilizing, removing, planting or caring for any roadside tree. A roadside tree is defined as "any tree that grows all or in part within a public road right-of-way." Any work (including removal) conducted on a roadside tree that is 20 feet or larger in height must be performed by a Maryland Licensed Tree Expert. A Roadside Tree Permit applies to trees within the public right of way that are not within forest stands. Most street trees occur along roadways either between the road and a sidewalk, or within a center island planting area between two roadways. Specimen tree

removals would require a variance in compliance with the 2009 Maryland Forest Conservation Act amendment, No Net Loss of Forest Policy (Senate Bill 666), which would be coordinated with DNR during final design.

A desktop assessment was conducted prior to the initiation of field work to approximate the potential boundaries of existing forest stands through review of current aerial photography in GIS. The field investigation areas and along the entire length of Alternative 2 were assessed. A field survey of natural resources was conducted in the field investigation areas in May 2015 to identify any forest and street trees resources that may be impacted by proposed construction. No forests were identified within the field investigation areas.

There would be approximately 80 street trees impacted by Alternative 2. Street trees within Alternatives 3A, 3B, 3C, 11A, and 11B are only likely to be impacted in areas where tunnel vents are proposed or due to cut-and-cover construction impacts near the tunnel portals. Approximate impacts to street trees within portal and vent shaft areas of the potential alignments are compared in **Table 2**. No specimen street trees were identified in the field.

Table 2. Potential Street Tree Impacts within the Field Investigation Areas

Alternatives	Portal Areas	Vent Shaft Areas
Alternative 2	80	N/A
Alternative 3 Option A	<10 street trees	100 street trees
Alternative 3 Option B	<10 street trees	110 street trees
Alternative 3 Option C	<10 street tree	80 street trees
Alternative 11 Option A	30 street trees	140 street trees
Alternative 11 Option B	1 street tree	72 street trees

6. Invasive Species

Executive Order 13112 was established to prevent and control the introduction and spread of invasive species. Non-native flora and fauna can cause significant changes to ecosystems, upset the ecological balance, and cause economic harm to agricultural and recreational areas. Transportation right-of-ways tend to be ideal habitat for invasive plant species, because of the high level of disturbance common to these areas. The Study Area is located in areas dominated by residential, industrial, and transportation land use. The Study Area contains no forested areas and the majority of the trees identified during the field investigation were planted street trees. A full-characterization of plant species was not conducted in this preliminary field investigation, although some invasive species were identified within the rail facilities, including tree-of-heaven (*Ailanthus altissima*), English ivy (*Hedera helix*), and Japanese honeysuckle (*Lonicera japonica*).

Construction activities associated with each alignment have the potential to provide mechanisms of transport for invasive species. Movement of equipment, soil, and other materials to disturbed sites can foster the spread of invasive plant species. Invasive species already within the Study Area could also

colonize newly disturbed areas. These species could also be spread beyond the Study Area to debris disposal sites. New construction would displace some of the invasive species within the Study Area and provide new vegetated areas that would eliminate invasive species. The transport of invasive species through development and construction can be avoided by incorporating best management practices. Measures to control invasive species during construction and the tunnel alignments could include the inspection and cleaning of construction equipment, the use of invasive-free mulches, topsoil and seed mixes, establishment of native vegetation and control or eradication strategies to be deployed should an invasion occur. These measures would be developed in the permitting and design stages when construction materials, excavation areas, landscaping plans, and construction specifications are developed.

C. Threatened and Endangered Species

Based on agency correspondence received to date, no state- or Federally-listed threatened or endangered species are known to exist within the Study Area. The Maryland Department of Natural Resources (DNR) Project Review Division (PRD) response from June 29, 2015 indicates that no threatened or endangered species are located in the Study Area. The United States Fish and Wildlife Service (USFWS) response, dated December 9, 2014 also indicated that no threatened or endangered species are located in the Study Area; however, the response is noted as preliminary.

The potential alternatives would therefore not impact threatened or endangered species. Agency correspondence regarding rare, threatened, and endangered species are included in **Appendix 2**.

VII. AVOIDANCE AND MINIMIZATION

The B&P Tunnel project is proposed within Baltimore City, a highly-urbanized environment. Street trees are the primary natural resource that would be potentially impacted by the tunnel project. Specific tree impact avoidance and minimization techniques would be detailed in the FCP developed in the Final Design stage. Tree protection fencing, as indicated in the FCP, would be installed along the boundary between tree protection area limits of disturbance to prevent access by construction equipment and the staging and stockpiling of materials within tree protection areas. Root pruning may be conducted along the edge of the limits of disturbance where excavation is required, to cleanly cut the roots of retained trees, reduce stress by promoting fibrous root growth, and prevent tearing of the roots beyond the limits of disturbance. Proper branch pruning will reduce construction stress, provide equipment clearance, and correct for any construction-related limb damage. Supplemental watering, fertilization, and mulching may be required to reduce tree stress and promote tree health. Additional construction techniques may be considered to avoid and minimize tree impacts including tree wells, retaining walls, air spading, root aeration matting, and at-grade sidewalk construction.

An Erosion and Sediment Control Plan would be developed during the Final Design stage of the project for approval by MDE. The plan minimizes the potential for sediment and other construction-related runoff, including concrete wash-out, to leave the limits of disturbance and contaminate tree protection

areas and waterways. A Hazardous Spill Prevention Plan would also be developed as part of the Phase I ESA to prevent hazardous materials such as equipment fuel and lubricants from contaminating tree protection areas and waterways.

VIII. MITIGATION

Coordination with MDNR and Baltimore City Forestry staff would help to identify street tree planting locations within the road right-of-way in the immediate vicinity of the impact areas and within City property adjacent to the Study Area. Mitigation within the right-of-way would be on a 1:1 basis pursuant to the Roadside Tree Law, and the planting of individual trees would be considered on private property where practicable, and as agreed upon by MDOT and the property owner. Landscaping and street tree replacement would be considered within the immediate vicinity of the resource impacts, where possible.

Substantial or long-term adverse changes to the water quality from the discharge of stormwater will be minimized through the implementation of a stormwater management plan; which would be developed as more detailed design is prepared in accordance with MDE Stormwater Management Guidelines. No stormwater mitigation would be required for the tunnel alignments. Implementation of stormwater management plans to treat stormwater for the tunnel alignment, construction activities, and the discharge of stormwater runoff would prevent a net increase in pollutant loading to the Jones Falls and Gwynns Falls Watersheds.

Implementation of erosion and sediment control measures, along with stormwater management plans to treat stormwater quality, will prevent degradation of potential wetland areas and will not result in adverse impacts to terrestrial and aquatic resources; therefore, no wetlands mitigation would be required for the tunnel alignments.

IX. REFERENCES

Environmental Laboratory. 1987. Corps of Engineers Wetland Delineation Manual, Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Environmental Protection Agency (EPA). 2014: www.epa.gov/region1/eco/drinkwater/pc_solesource_aquifer.html

Executive Order 11988, *Floodplain Management and Protection*, April 23, 1979. U.S. DOT Order 5650.2

Executive Order 11990, *Protection of Wetlands,* May 24, 1977. 42 FR 26961, 3 CFR, 1977 Comp., p. 121.

Federal Emergency Management Agency. 2011. *Flood Insurance Rate Map for Baltimore, MD*. Available online: http://www.msc.fema.gov

FRA/MDOT. December 23, 2014. *Baltimore and Potomac Tunnel Project – Preliminary Alternatives Screening Report*.

FRA/MDOT. September 29, 2014. *B&P Tunnel Project Baltimore, Maryland Purpose and Need.*

Howell, G.P., and Ericson, T. 1997. State Forest Conservation Technical Manual, 3rd edition, Maryland Department of Natural Resources, Annapolis, MD.

Maryland Department of the Environment. December 2002. Water Quality Analysis of Zinc for the Jones Falls Baltimore City and Baltimore County, Maryland.

Maryland Department of the Environment. September 2004. Water Quality Analysis of Copper and Lead for the Jones Falls Baltimore City and Baltimore County, Maryland.

Maryland Department of the Environment. September 2006. Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Jones Falls Basin in Baltimore City and Baltimore County, Maryland.

Maryland Department of the Environment. September 2009. Water Quality Analysis of Eutrophication for the Jones Falls Watershed in Baltimore City and Baltimore County, Maryland.

Maryland Department of the Environment. May 2009. Watershed Report for Biological Impairment of the Jones Falls Watershed in Baltimore City and Baltimore County, Maryland biological Stressor Identification Analysis Results and Interpretation.

Maryland Department of the Environment. September 2011. Total Maximum Daily Load of Sediment in the Jones Falls Watershed, Baltimore City and Baltimore County, Maryland.

Maryland Department of Natural Resources, 2005. *Maryland Department of Natural Resources Wetlands Inventory, Geo-Spatial Data for Baltimore City*. Available online: http://dnrweb.dnr.state.md.us/gis/data/

Natural Resources Conservation Service, United States Department of Agriculture, accessed December, 2014. *Official Soil Series Descriptions*. USDA-NRCS, Lincoln, NE. Available online: https://soilseries.sc.egov.usda.gov/

NEC Master Plan Working Group (NEC MPWG). May 2010. *The Northeast Corridor Infrastructure Master Plan.*

Norfolk Southern Railway (NS). Accessed on September 3, 2014a. *About Us*. http://www.nscorp.com/content/nscorp/en/get-to-know-norfolk-southern/about-ns.html

Reger, J.P., and E.T. Cleaves. 2008. Draft physiographic map of Maryland and explanatory text for the physiographic map of Maryland. Maryland Department of Natural Resources, Maryland Geological Survey, Annapolis, MD. Available online at: http://www.mgs.md.gov/coastal/maps/physio.html.

Trapp, H., Jr., and Horn, M.A. 1997. Ground-water atlas of the United States--segment 11, Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, West Virginia: U.S. Geological Survey Hydrologic Investigations Atlas 730-L, 24 p.

US Army Corps of Engineers (USACE). 2012. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region Version 2.0, ed*. J.F. Berkowitz, J.S. Wakeley, R.W. Lichvar, and C.V. Noble. ERDC/EL TR-12-9. Vicksburg, MS: US Army Engineer Research and Development Center.

US Fish and Wildlife Service. 2002. *National Wetlands Inventory, Geo-Spatial Data for Baltimore, Maryland*. Available online: http://www.fws.gov/wetlands/index.html

US Geological Survey (USGS), 2014: http://md.water.usgs.gov/groundwater/webwells/current/confined/coutnies/Baltimore city/#2s5e1

US Geological Survey (USGS). 1985. *Baltimore East and Baltimore West Quad Maps*. Scale 1:24,000.

X. ACRONYMS

B&P	Baltimore and Potomac
BIBI	Benthic Index of Biological Integrity
BSID	Biological Stressor Identification
CFR	Code of Federal Regulations
COMAR	Code of Maryland Regulations
CWA	Clean Water Act
DBH	Diameter at Breast Height
DNR	Department of Natural Resources
DOT	Department of Transportation
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Environmental Site Assessment
FCP	Forest Conservation Plan
FEMA	Federal Emergency Management Agency
FIBI	Fish Index of Biologic Integrity
FIRM	Flood Insurance Rate Map
FR	Federal Register
FRA	Federal Railroad Administration
FSD	Forest Stand Delineation

GIS	Geographic Information System
IBI	Index of Biological Integrity
MARC	Maryland Area Regional Commuter
MDE	Maryland Department of Environment
MDOT	Maryland Department of Transportation
MDNR	Maryland Department of Natural Resources
MPN	Most Probable Number
MPWG	Master Plan Working Group
MTA	Maryland Transit Administration
NEC	Northeast Corridor
NMFS	National Marine Fisheries Service
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resource Conservation Service
NS	Norfolk Southern Railway
NWI	National Wetlands Inventory
OHW	Ordinary High Water
SSA	Sole Source Aquifer
SWANCC	Solid Waste Agency of North Cook County
TMDL	Total Maximum Daily Load
TNW	Traditionally Navigable Waters
TSS	Total Suspended Solids
USACE	United States Army Corps of Engineers
USC	United States Code
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
WQA	Water Quality Analysis
WQL	Water Quality Limited Segment
WSS	Web Soil Survey

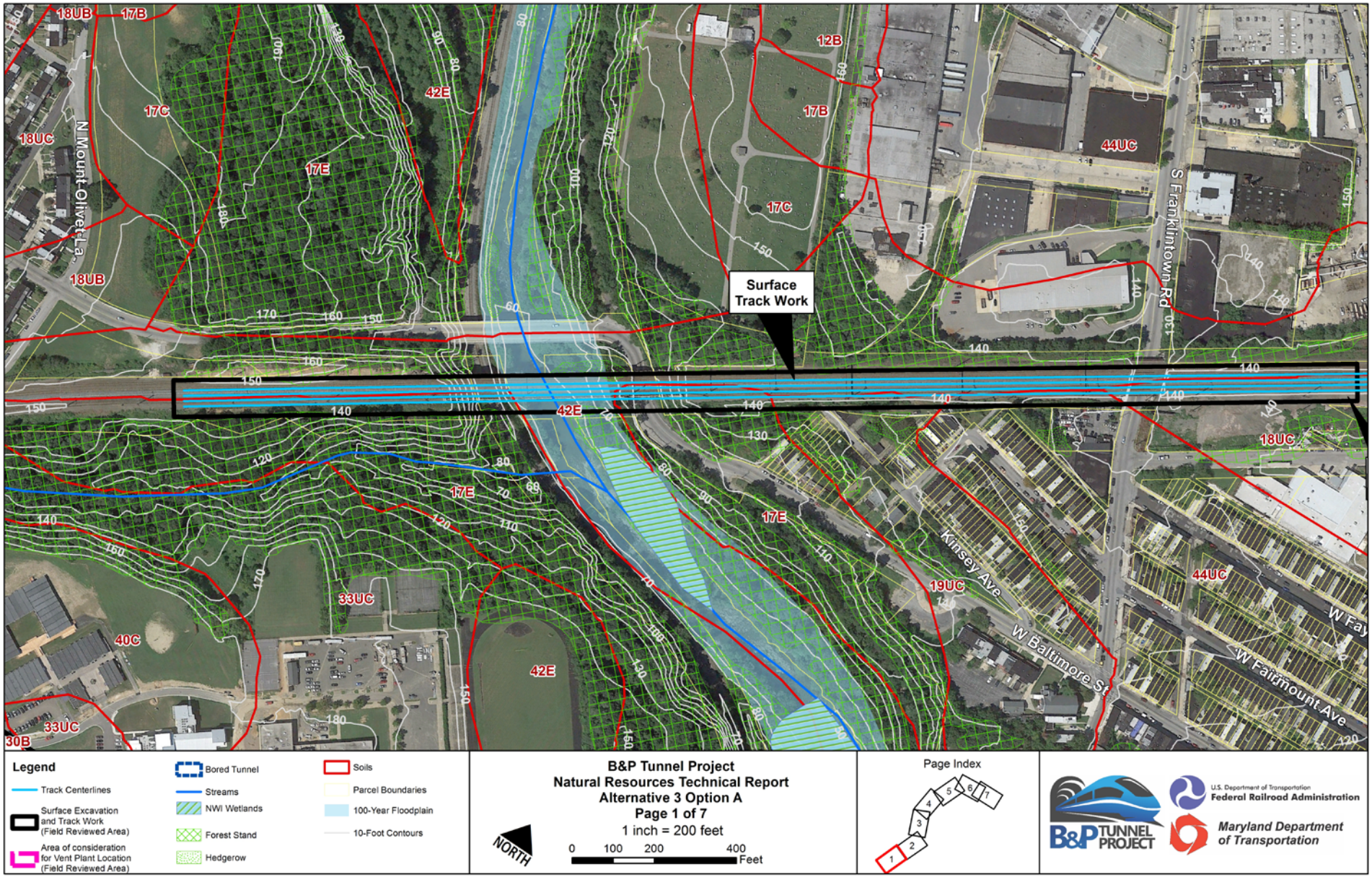
XI. APPENDICES

(This page intentionally left blank)

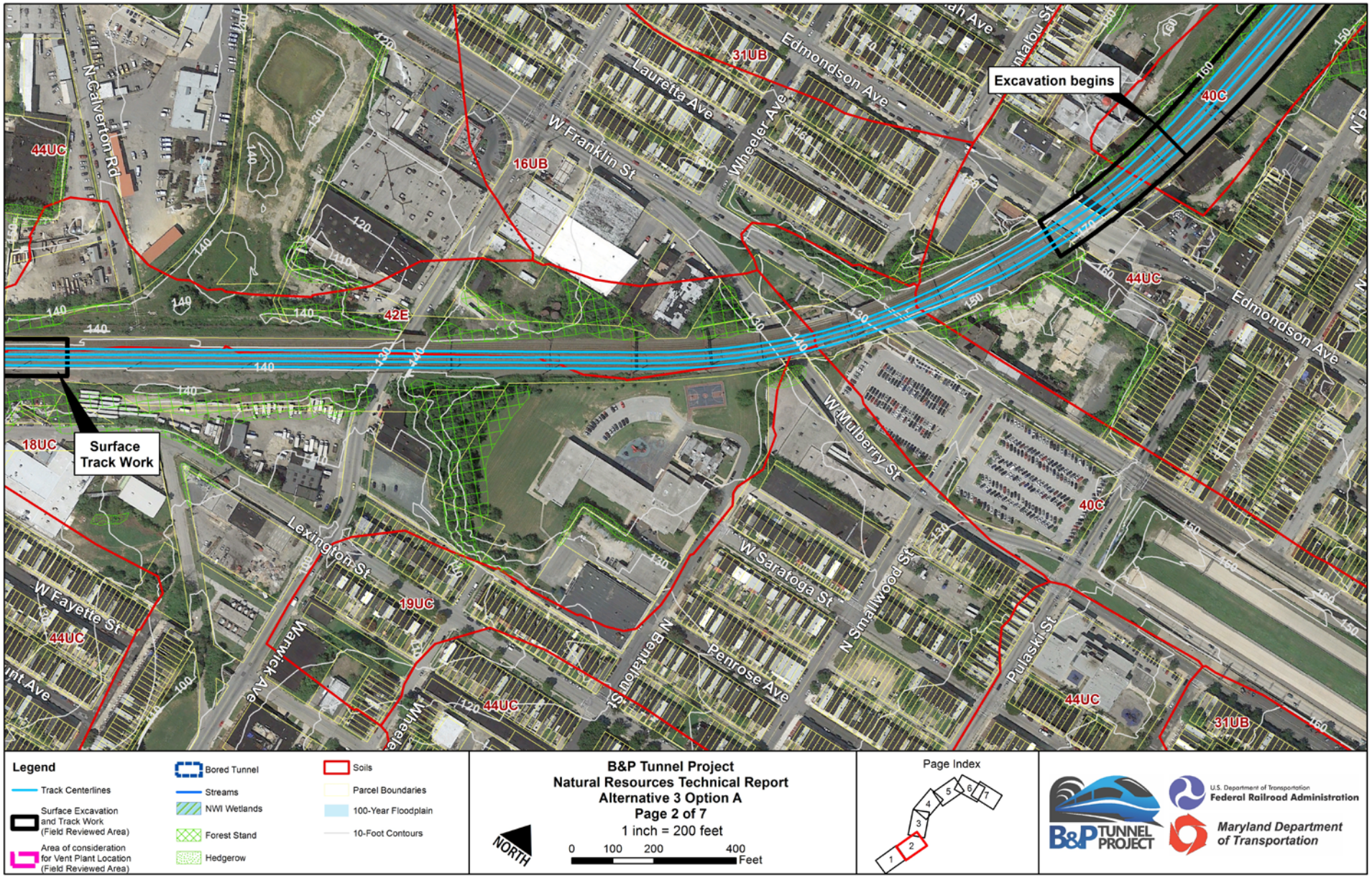
Appendix 1

Alternative 3 Option A
Natural Resources Mapping

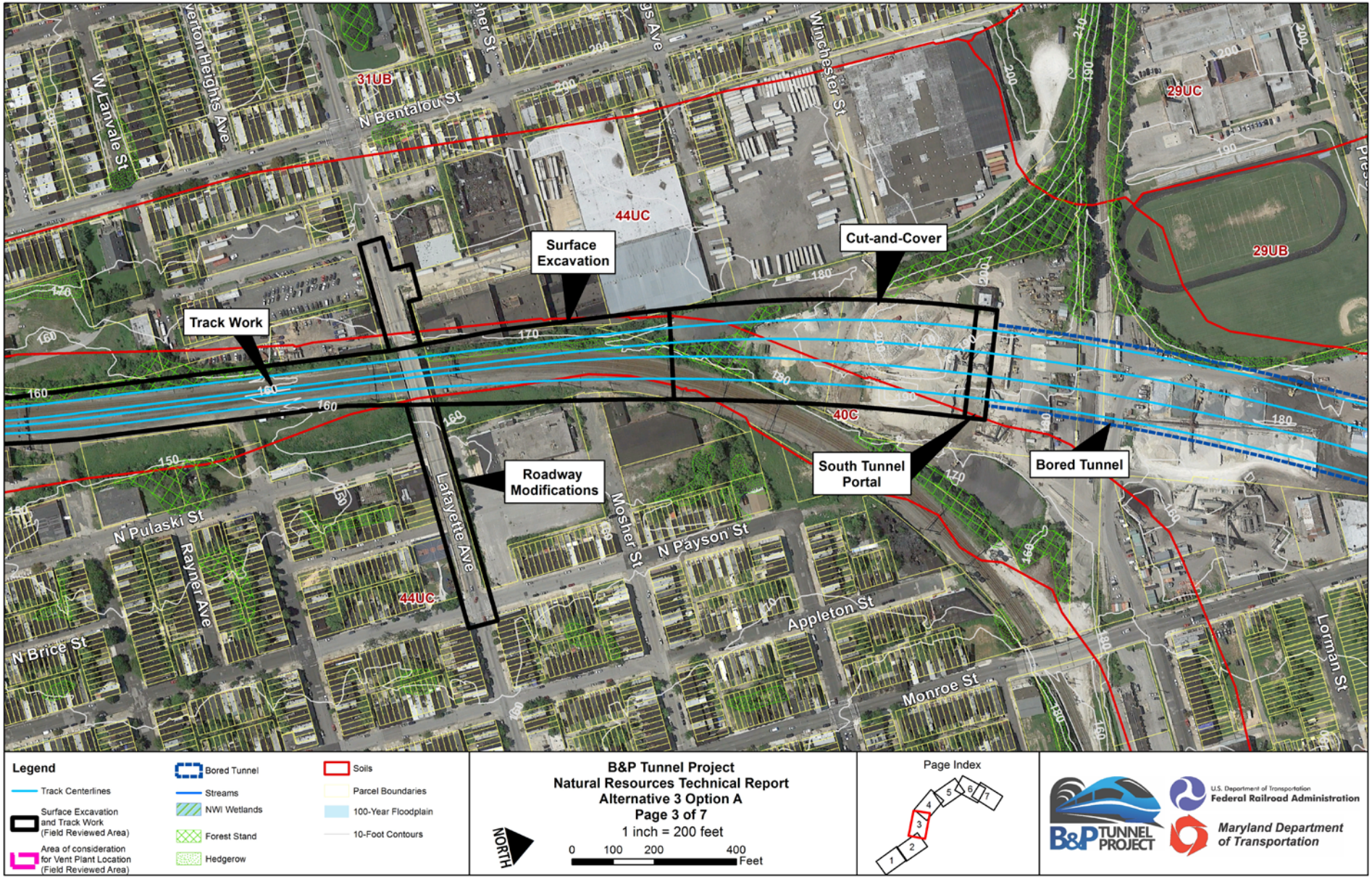
(This page intentionally left blank)


Surface Track Work
N Monroe St
S Franklintown Rd
Kinsey Ave
W Baltimore St
W Fairmount Ave
18UB
17B
17C
18UC
42E
17E
12B
44UC
33UC
40C
19UC
30B
Legend
Track Centerlines
Surface Excavation and Track Work (Field Reviewed Area)
Area of consideration for Vent Plant Location (Field Reviewed Area)
Bored Tunnel
Streams
NWI Wetlands
Forest Stand
Hedgerow
Soils
Parcel Boundaries
100-Year Floodplain
10-Foot Contours
B&P Tunnel Project
Natural Resources Technical Report
Alternative 3 Option A
Page 1 of 7
1 inch = 200 feet
0 100 200 400 Feet
NORTH
Page Index
U.S. Department of Transportation
Federal Railroad Administration
Maryland Department of Transportation

(This page intentionally left blank)


Excavation begins
Surface Track Work
N Calverton Rd
W Franklin St
Laurelta Ave
Wheeler Ave
Edmondson Ave
W Mulberry St
Lexington St
W Fayette St
Warwick Ave
W Saratoga St
N Smallwood St
N Bentalou St
Penrose Ave
Pulaski St
31UB
16UB
42E
44UC
40C
18UC
19UC
Legend
Track Centerlines
Surface Excavation and Track Work (Field Reviewed Area)
Area of consideration for Vent Plant Location (Field Reviewed Area)
Bored Tunnel
Streams
NWI Wetlands
Forest Stand
Hedgerow
Soils
Parcel Boundaries
100-Year Floodplain
10-Foot Contours
B&P Tunnel Project
Natural Resources Technical Report
Alternative 3 Option A
Page 2 of 7
1 inch = 200 feet
NORTH
0 100 200 400
Feet
Page Index
U.S. Department of Transportation
Federal Railroad Administration
Maryland Department of Transportation

(This page intentionally left blank)


Surface Excavation
Cut-and-Cover
Track Work
Roadway Modifications
South Tunnel Portal
Bored Tunnel
31UB
44UC
29UC
29UB
40C
W Lanvale St
Overton Heights Ave
N Bentalou St
Winchester St
N Pulaski St
Rayner Ave
Lafayette Ave
Mosher St
N Payson St
Appleton St
Monroe St
N Brice St
Lorman St
Legend
Track Centerlines
Surface Excavation and Track Work (Field Reviewed Area)
Area of consideration for Vent Plant Location (Field Reviewed Area)
Bored Tunnel
Streams
NWI Wetlands
Forest Stand
Hedgerow
Soils
Parcel Boundaries
100-Year Floodplain
10-Foot Contours
B&P Tunnel Project
Natural Resources Technical Report
Alternative 3 Option A
Page 3 of 7
1 inch = 200 feet
0 100 200 400 Feet
NORTH
Page Index
1 2 3 4 5 6 7
B&P TUNNEL PROJECT
U.S. Department of Transportation
Federal Railroad Administration
Maryland Department of Transportation

(This page intentionally left blank)