OP•LANES™
MARYLAND

I-495 & I-270 Managed Lanes Study

APPENDIX M

FINAL NATURAL RESOURCES TECHNICAL REPORT

June 2022

U.S. Department of Transportation
Federal Highway Administration

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1 INTRODUCTION

1.1 Overview

The Federal Highway Administration (FHWA), as the Lead Federal Agency, and the Maryland Department of Transportation State Highway Administration (MDOT SHA), as the Local Project Sponsor, are preparing a Final Environmental Impact Statement (FEIS) in accordance with the National Environmental Policy Act (NEPA) for the I-495 & I-270 Managed Lanes Study (Study). The I-495 & I-270 Managed Lanes Study (Study) is the first environmental study under the broader I-495 & I-270 Public-Private Partnership (P3) Program.

This Final Natural Resources Technical Report (NRTR) has been prepared to support the FEIS and focuses on the analysis of the Preferred Alternative. The Preferred Alternative, also referred to as Alternative 9 – Phase 1 South, includes building a new American Legion Bridge and delivering two high-occupancy toll (HOT) managed lanes in each direction on I-495 from the George Washington Memorial Parkway in Virginia to west of MD 187 on I-495, and on I-270 from I-495 to north of I-370 and on the I-270 eastern spur from east of MD 187 to I-270. Refer to **Figure 1**. This Preferred Alternative was identified after extensive coordination with agencies, the public and stakeholders to respond directly to feedback received on the DEIS to avoid displacements and impacts to significant environmental resources, and to align the NEPA approval with the planned project phased delivery and permitting approach.

The purpose of the Final NRTR is to present the existing conditions, an assessment of potential direct impacts of the Preferred Alternative to natural resources and final mitigation, if applicable, for unavoidable impacts. This Final NRTR builds upon the analysis in the Draft NRTR, DEIS and Supplemental DEIS (SDEIS), and has been prepared to support and inform the FEIS.

1.2 Study Corridors and the Preferred Alternative

In the SDEIS, published on October 1, 2021, FHWA and MDOT SHA identified the Preferred Alternative: Alternative 9 – Phase 1 South to be consistent with the previously determined phased delivery and permitting approach, which focuses on Phase 1 South. As a result, Alternative 9 – Phase 1 South includes the same improvements proposed as part of Alternative 9 in the DEIS but focuses the build improvements within the Phase 1 South limits only. The limits of Phase 1 South are along I-495 from the George Washington Memorial Parkway to west of MD 187 and along I-270 from I-495 to north of I-370 and on the I-270 east and west spurs as shown in **dark blue** in **Figure 1**. The improvements include two new HOT managed lanes in each direction along I-495 and I-270 within the Phase 1 South limits. There is no action, or no improvements included at this time on I-495 east of the I-270 east spur to MD 5 (shown in **light blue** in **Figure 1**). While the Preferred Alternative does not include improvements to the remaining parts of I-495 within the Study limits, improvements on the remainder of the interstate system may still be needed in the future. Any such improvements would advance separately and would be subject to additional environmental studies and analysis and collaboration with the public, stakeholders and agencies.

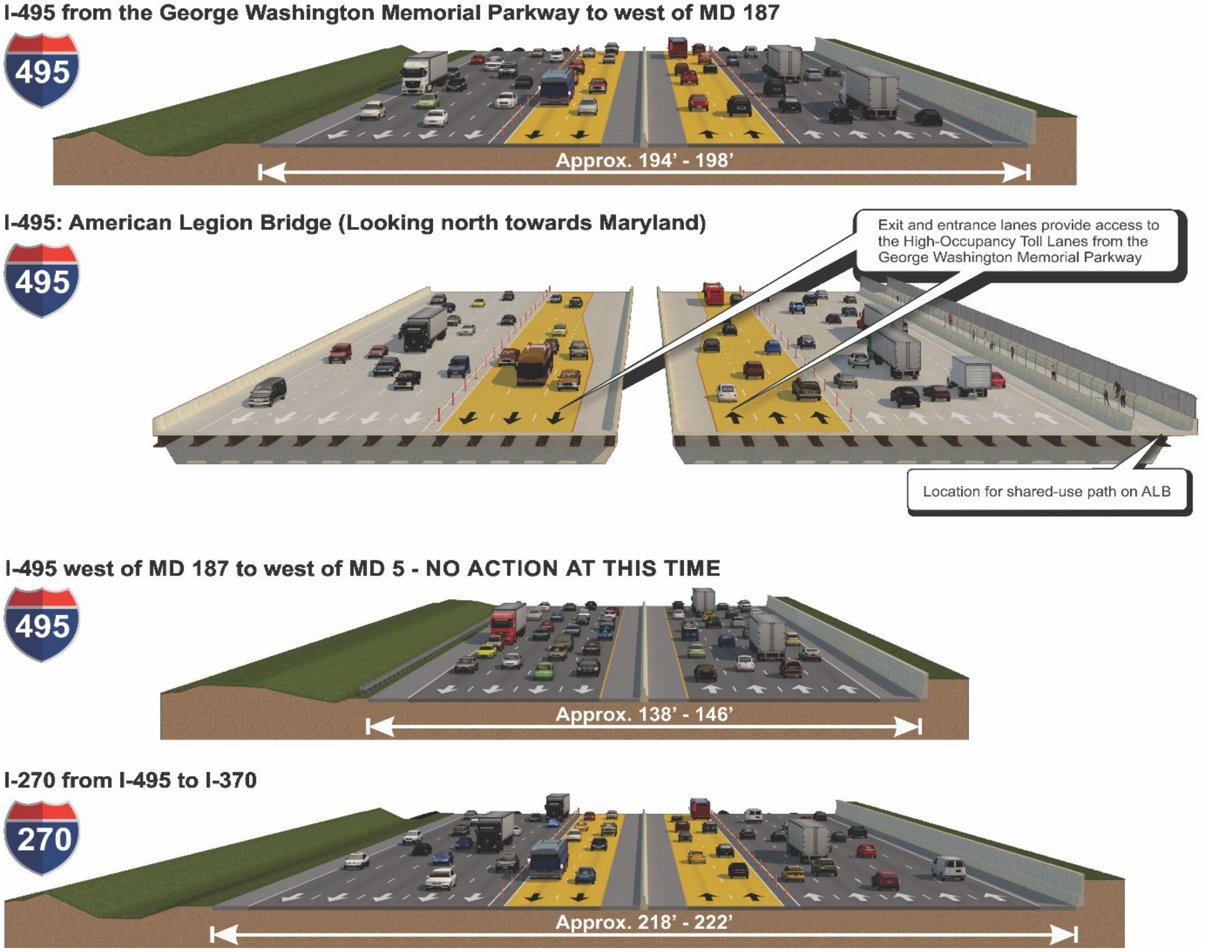
The 48-mile corridor Study limits remain unchanged: I-495 from south of the George Washington Memorial Parkway in Fairfax County, Virginia, to west of MD 5 and along I-270 from I-495 to north of I-370, including the east and west I-270 spurs in Montgomery and Prince George's Counties, Maryland (shown in both dark and light blue in **Figure 1**).

Figure 1. I-495 & I-270 Managed Lanes Study Corridors – Preferred Alternative

1.3 Description of the Preferred Alternative

The Preferred Alternative includes a two-lane HOT managed lanes network on I-495 and I-270 within the limits of Phase 1 South only (**Figure 2**). On I-495, the Preferred Alternative consists of adding two, new HOT managed lanes in each direction from the George Washington Memorial Parkway to east of MD 187. On I-270, the Preferred Alternative consists of converting the one existing HOV lane in each direction to a HOT managed lane and adding one new HOT managed lane in each direction on I-270 from I-495 to north of I-370 and on the I-270 east and west spurs. There is no action, or no improvements included at this time on I-495 east of the I-270 east spur to MD 5. Along I-270, the existing collector-distributor (C-D) lanes from Montrose Road to I-370 would be removed as part of the proposed improvements. The managed lanes would be separated from the general purpose lanes using pylons placed within a four-foot wide buffer. Transit buses and HOV 3+ vehicles would be permitted to use the managed lanes toll-free.

Figure 2. Preferred Alternative Typical Sections (HOT Managed lanes Shown in Yellow)



2 EXISTING CONDITIONS AND ENVIRONMENTAL EFFECTS

The Existing Conditions and Environmental Effects section details the existing environmental features within the Phase 1 South portion of the corridor study boundary of the I-495 & I-270 Managed Lanes Study; the potential environmental effects to natural resources resulting from the Alternative 9 – Phase 1 South (Preferred Alternative); and the avoidance and minimization strategies used during the planning phase of this study. The field delineation and investigation of environmental features was conducted within the I-495 & I-270 Managed Lanes Study corridor study boundary, a 48-mile long and approximately 600-foot wide roadway corridor spanning two states, three counties, and 15 MD 12-digit watersheds, plus part of Fairfax County, Virginia. All agency coordination and data collection was conducted for the entire corridor study boundary. Only the features within the Phase 1 South portion of the corridor study boundary are presented in this report. The features in the remainder of the corridor study boundary are included in the Draft NRTR, Appendix R of the DEIS.

Impact tables included in **Appendix A** identify the quantifiable natural resource impacts of the Preferred Alternative LOD.

2.1 Topography, Geology, and Soils

2.1.1 Regulatory Context and Methods

Environmental scientists conducted a desktop review of publicly available topography, geology, and soils data within the Phase 1 South portion of the corridor study boundary on behalf of MDOT SHA. Geological and soils data were sourced from the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) website and Web Soil Survey, elevations were determined using US Geological Survey (USGS) geospatial data, and agricultural land was identified using Maryland's Environmental Resources and Land Information Network (MERLIN).

The Farmland Protection Policy Act (FPPA) 7 U.S.C. 4201 et seq, implementing regulations 7 CFR Part 658, of the Agriculture and Food Act of 1981, as amended aims to minimize the conversion of important food and fiber producing farmland into non-agricultural land by federal programs (USDA, 1981). Coordination of an FPPA review by NRCS must be completed at the Alternatives Retained for Detailed Study (ARDS) level if a project has the potential to convert prime, statewide, unique, or locally important farmland to non-farm use. Prime Farmland Soils, Soils of Statewide Importance, and unique farmland soils within the Phase 1 South portion of the corridor study boundary were identified using desktop review. FFPA does not apply to most of the Phase 1 South portion of the corridor study boundary because there is only a very small area that is not a census-designated urban area, which is excluded from FFPA regulation. If required, NRCS review establishes a farmland conversion impact rating score using a land evaluation and site assessment (LESA) system (Form AD-1006) to identify potential impacts to important agricultural land within federally funded or assisted project sites. Consideration of alternative sites is suggested if the score and potential adverse impacts on farmland exceed the recommended allowable level (USDA, 1981).

2.1.2 Existing Conditions

A. Topography and Geology

The Phase 1 South portion of the corridor study boundary is entirely within the Piedmont Plateau Physiographic Province and elevation in this area ranges from 51 to 495 feet above mean sea level (**Appendix B**). The lowest elevations occur along the Potomac River near the American Legion Bridge on the western side of the project limits. The areas of highest elevation occur near the convergence of I-270 and I-370 along Shady Grove Road in Montgomery County.

The Piedmont Plateau Physiographic Province has broadly undulating to rolling topography underlain by metamorphic rock, with low knobs, ridges, and valleys. The Phase 1 South portion of the corridor study boundary includes two Physiographic Districts within the Piedmont Plateau Physiographic Province: the Hampstead Upland District and Middle Potomac Gorge District (Reger & Cleaves, 2008). The Hampstead Upland District consists of rolling to hilly uplands interrupted by steep-walled gorges. This district has distinctive ridges, hills, barrens, and valleys, and its streams include short segments of narrow, steep-sided valleys. The Middle Potomac Gorge District is where the Potomac River flows through a steep sided gorge. Bedrock islands are common in this district, while rapids and falls occur downstream, including the Great Falls of the Potomac River (USDA NRCS, 2018).

B. Soils

a. Soil Types

A soil map unit is a collection of areas on a soil map defined by their dominant taxonomic components, which can include a combination of soil type and miscellaneous, non-soil areas (e.g. rock outcrop) (USDA NRCS, 2018). The USDA-NRCS Web Soil Survey (2018) identified 44 soil map units within the Phase 1 South portion of the corridor study boundary, as summarized in **Appendix C** and depicted in the Natural Resources Inventory Maps in **Appendix B.**

b. Soil Hydrologic Groups

The USDA NRCS classifies soils into "hydrologic soil groups" based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration that is expected to occur when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The four hydrologic soil groups are defined in **Table 2-1.** If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter refers to drained areas and the second refers to undrained areas. The majority of soils in the Phase 1 South portion of the corridor study boundary are in Hydrologic Groups B and C, with slow to moderate infiltration rates. Soils with slower infiltration rates have higher runoff potential during rain events (USDA NRCS, 2018).

Table 2-1. Soils Hydrologic Group Descriptions

Group	Description
A	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
B	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
D	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Source: NRCS Web Soil Survey

c. Hydric Soils

The National Technical Committee for Hydric Soils (NTCHS) defines hydric soils as soils that are saturated or inundated long enough during the growing season to become anaerobic in their upper layer and support the growth and reproduction of hydrophytic vegetation (59 FR 16835, proposed July 13, 1994). The hydric soil ratings shown in the soils tables in **Appendix C** indicate the percentage of the soil map units that meet the NRCS criteria for hydric soils. Map units are composed of one or more components or soil types, with each rated as hydric or not hydric soil. Each map unit is rated based on its respective components and the percentage of each component within the map unit. The five rating groups are separated as hydric (100 percent hydric components), predominantly hydric (66 to 99 percent hydric components), partially hydric (33 to 65 percent hydric components), predominantly non-hydric (1 to 32 percent hydric components), and non-hydric (less than one percent hydric components) (USDA NRCS, 2018).

Within the Phase 1 South portion of the corridor study boundary, two soil units are classified as hydric (covering approximately 2 percent of the area within the corridor study boundary), one soil unit is classified as predominantly hydric (covering approximately 5 percent of the area within the corridor study boundary), zero soil units are classified as partially hydric, 13 soil units are classified as predominantly non-hydric (covering approximately 36 percent of the area within the corridor study boundary), and 26 soil units are classified as non-hydric (covering the remaining 57 percent of the area within the corridor study boundary).

d. Highly Erodible Soils

Highly erodible soils are potentially more prone to erosion from wind, rain, and disturbance (USDA NRCS, 2010). The Code of Maryland Regulations (COMAR) defines "highly erodible soils" as soils with a slope greater than 15 percent, or those soils with a soil erodibility factor (K factor) greater than 0.35 and with slopes greater than 5 percent (COMAR 26.17.01). Based on this definition, 35 soil units within the Phase

1 South portion of the corridor study boundary are highly erodible. Highly erodible soils are located throughout the Phase 1 South portion of the corridor study boundary, with higher concentrations along I-270, and I-495 west of New Hampshire Avenue.

e. Prime Farmland, Soils of Statewide Importance, and Unique Farmland Soils

USDA NRCS classifies farmland soils as Prime Farmland Soils, Soils of Statewide Importance (also referred to as farmland of statewide importance), or Unique Farmland Soils by identifying the location and extent of soils that are best suited to growing human food, animal feed, fiber, forage, and oilseed crops. Prime Farmland Soils have the best quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed according to widely acceptable farming methods. In general, Prime Farmland Soils have an adequate and dependable water supply from precipitation or irrigation, favorable temperature and growing seasons, acceptable pH, adequate salt and sodium content, and few or no rocks. These soils are permeable to water and air, are not excessively erodible or saturated for long periods, and do not frequently flood (43 FR Ch 675.5, 1978).

Unique Farmland Soils are soils other than Prime Farmland Soils that have the best combination of physical and chemical characteristics to produce a specific high value food or fiber crop like citrus, tree nuts, olives, cranberries, fruits, or vegetables. Unique Farmland Soils have a combination of soil quality, growing season, temperature, humidity, air drainage, elevation, and other factors like nearness to market that favor the specific crop (USDA, 1981).

Soils of Statewide Importance are soils, in addition to prime and unique farmland soils, that are of statewide importance to produce human food, animal feed, fiber, forage, and oilseed crops as designated by the appropriate state agency. Soils of Statewide Importance are typically nearly Prime Farmland soils that produce high crop yields when managed properly (43 FR Ch 675.5, 1978).

Nine soils within the Phase 1 South portion of the corridor study boundary were identified by USDA NRCS (2018) as Prime Farmland Soils, all located on NPS land or within the Potomac River; seven soils were identified as Soils of Statewide Importance; and no soils were identified as Unique Farmland Soils.

2.1.3 Environmental Effects

A. Topography and Geology

Topography within the Preferred Alternative LOD construction areas would be altered by surficial excavation and grading, thereby changing the relative ground elevation, but this work is not anticipated to have a substantial effect on underlying sediments. Possible impacts to geologic formations and rock structures include impacts from construction activities, such as cutting and filling.

B. Soils

The primary impact to soils from the Preferred Alternative LOD would be soil removal or alterations to the soil profile and structure due to construction activities. Additional potential impacts could include leaching of chemicals into the soil from general construction or accidental spills, soil erosion, and soil compaction associated with the use of heavy equipment. Erosion of topsoil may result in the loss of soil nutrients and nutrient holding capacity, as well as a reduction of organic material in the soil. The loss of organic-rich topsoil reduces the soil's natural ability to provide nutrients to plants and regulate water flow, making the soil more susceptible to pests, disease, and compaction. Soil compaction reduces infiltration rates and can cause rapid surface water runoff or ponding, resulting in shifts in vegetation from wet to dry or dry to wet. Soil compaction can also damage roots, leading to plant mortality. Erosion from construction sites can lead to the transport of excess nutrients and sediments downstream, but this will be minimized to the greatest extent possible by state required erosion and sediment control measures (USDA NRCS, 2000).

a. Hydric Soils and Highly Erodible Soils

Impacts to soils within the Preferred Alternative LOD are presented in **Table 2-2**[1]. Note that hydric soil acreage identified in this section are as defined in the NRCS Web Soil Survey and do not reflect the hydric soils identified as jurisdictional wetlands.

Table 2-2. Impact to Soils by Type in Acres

	Perm	Temp	Total
Farmland of Statewide Importance[1]	1.78	0.02	1.80
Prime Farmland[2]	0.00	0.00	0.00
Hydric	20.77	0.08	20.85
Predominantly Hydric	62.20	0.41	62.61
Partially Hydric	0.00	0.00	0.00
Predominantly Non-Hydric	408.12	5.06	413.18
Non-Hydric	587.98	25.97	613.95

Notes: [1] All of the Farmland of Statewide Importance are located within Virginia.
[2] Prime farmland soils exclude acres that are parkland or waterways.

Impacts to highly erodible soils by the Preferred Alternative LOD are summarized in **Table 2-3**.

Table 2-3. Impacts to Steep Slopes and Highly Erodible Soils in Acres

	Perm	Temp	Total
Steep Slopes > 5, K Factor > 0.35	222.40	4.31	226.71
Steep Slopes 15	273.21	8.25	281.46

b. Prime Farmland, Soils of Statewide Importance, and Unique Farmland Soils

A farmland assessment was conducted to refine the potential for impacts to Prime Farmland Soils and Soils of Statewide Importance. There are no Unique Farmland Soils within the Preferred Alternative LOD. Farmland soils occur throughout the Preferred Alternative LOD; however, many areas within the Preferred Alternative LOD that were once mapped as Prime Farmland Soils or Soils of Statewide Importance were developed or converted to impervious surface and no longer qualify as these soil types under the FPPA, Section 523.10.B(2). Consequently, lands identified as "urbanized area" (UA) on Census Bureau maps were removed from the calculation of farmland soil impacts to assess the potential for impacts to these resources. Impacts to Prime Farmland Soils and Farmland of Statewide Importance are in **Table 2-2**. The Preferred Alternative LOD will result in 1.8 acres of impacts to Farmland of Statewide Importance and will not impact Prime Farmland Soils since all Prime Farmland soils found within the Preferred Alternative LOD are located on parkland within the Potomac River.

---

[1] For reference, impact tables presented in the report are also included in Appendix A.

As noted in the *I-495 & I-270 Managed Lanes Study Community Effects Assessment and Environmental Justice Analysis (CEAEJ) Technical Report*, the Preferred Alternative LOD is not within the Maryland Agricultural Land Preservation Program, the Maryland Agricultural Easement Program, the Maryland Environmental Trust (MET), the Maryland Rural Legacy Program, or the Montgomery County Agricultural Reserve, (MCATLAS, 2019; Montgomery County Rustic Roads Advisory Committee, 2015). See the CEAEJ Technical Report for further information.

2.1.4 Avoidance, Minimization, and Mitigation

Detailed geotechnical studies will be performed prior to construction to identify subsurface issues that may impact project construction or the surrounding environment. MDOT SHA will mitigate any negative effects, such as unstable soils or high-water table, through engineering design. Negative impacts to the surrounding environment, such as sedimentation, will be mitigated through implementation and strict adherence to erosion and sediment control plans.

Construction within the Preferred Alternative LOD requires consideration of hydric and highly erodible soils, as well as steep slopes. Measures to protect soils from erosion would be implemented based on approved Erosion and Sediment Control Plans (E&S Plans) prepared in accordance with the "Maryland Standards and Specifications for Soil Erosion and Sediment Control" (MDE, 2011) and the Virginia Erosion and Sediment Control Law (VDEQ, 2014) in accordance with the Virginia Erosion and Sediment Control Handbook (VDEQ, 1992) and the VDOT Drainage Manual (VDOT, 2017). The E&S Plans will be prepared by the Developer during final design and include erosion and sediment control devices to avoid or minimize the impacts of soil erosion such as: sediment traps, silt fencing, sedimentation basins, interception channels, and seeding and mulching. Drainage patterns would be preserved to the extent practicable during future design which would maintain hydric soils where possible. Additionally, BMPs will be considered to prevent negative impacts to hydric soils and wetlands such as the use of matting in temporarily impacted wetlands to avoid soil compaction.

Additional water quality protection measures are required for highway construction projects in Maryland to prevent soil erosion and subsequent sediment influx into nearby waterways. Construction contractors are designated as co-permittees on the National Pollutant Discharge Elimination System (NPDES) permit to ensure compliance. This permit is issued under Maryland's General Permit for construction activities and is implemented with a regular inspection program for construction site sediment control devices that includes penalties for inadequate maintenance. To ensure compliance, onsite evaluations by an MDE certified erosion and sediment control “Responsible Person” would occur throughout the duration of construction.

Fairfax County, Virginia requires any projects with land-disturbing activities exceeding 2,500 square feet (SF) to prepare an erosion and sediment control plan (Fairfax County, 2018a). The County must approve each plan before any land-disturbing activities begin, and each project is subject to inspections throughout the duration of land-disturbing activities to prevent erosion and sediment control violations.

2.2 Air Quality

2.2.1 Regulatory Context and Methods

As required by the Clean Air Act and Amendments, the US Environmental Protection Agency (EPA) sets the National Ambient Air Quality Standards (NAAQS) for airborne pollutants that have adverse impacts on human health and the environment, referred to as criteria pollutants. The criteria pollutants are carbon monoxide (CO), sulfur dioxide (SO_2), ozone (O_3), particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), and lead (Pb). In addition to the criteria pollutants for which there are NAAQS, EPA also regulates Mobile Source Air Toxics (MSATs). The nine priority MSATs are: benzene, 1,3-butadiene, formaldehyde, acrolein, acetaldehyde, diesel particulate matter, ethylbenzene, naphthalene, and polycyclic organic matter. Greenhouse gases (GHGs) are another pollutant monitored by EPA. The primary GHGs in the Earth's atmosphere are Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), and Fluorinated Gases. The methodologies for assessing the pollutants is summarized in the **DEIS, Chapter 4, Section 4.8** and within the *Air Quality Technical Report* (AQTR) (**DEIS, Appendix I**) (https://oplanesmd.com/wp-content/uploads/2020/07/DEIS_AppI_Air-Quality_web.pdf), and **FEIS, Appendix K** the *Final Air Quality Technical Report*.

2.2.2 Existing Conditions

The Preferred Alternative is located in Montgomery County, Maryland and a small area in Fairfax County, Virginia. The EPA Green Book[2] lists these counties as attainment for all NAAQS with the exception of the 2015 8-hour ozone standard,[3] for which the counties are nonattainment. The EPA recently redesignated the area to maintenance/attainment for the 2008 8-hour ozone standard.[4] The 2015 Ozone NAAQS (0.070ppm) are more stringent than the 2008 NAAQS (0.075ppm). Maryland, Virginia and the District of Columbia submitted maintenance plans to EPA that demonstrated maintenance of the 2008 ozone NAAQS through 2030 and therefore their request to be redesignated to maintenance/attainment of those NAAQS was granted by EPA in April 2019. The measured ambient air concentrations closest to the study area were all well below the corresponding NAAQS, except for the exceedance of the 2015 8-hour ozone standard recorded at all the monitor locations.

The Maryland counties were redesignated from a nonattainment area to attainment and entered a 20-year maintenance period for CO in March 1996. The area was considered a maintenance area for the 20 years following until March 2016 when the counties completed the maintenance period. Since the Maryland counties have completed the maintenance period, transportation conformity no longer applies for CO. The study corridor is an attainment area for fine particulate matter (PM2.5). Similarly, Fairfax County is designated attainment for CO, and is also considered attainment for the 1997 PM2.5 NAAQS per the EPA 2016 ruling.

The Study is currently included in the NCRTPB Fiscal Year (FY) 2019 – 2024 TIP [TIP ID 6432 and Agency ID AW0731 (planning activities)] and the NCRTPB Visualize 2045 Long Range Plan (CEID 1182, CEID 3281, and

---

[2] https://www.epa.gov/green-book

[3] These counties were redesignated to attainment of the 2008 ozone NAAQS, effective May 15, 2019 (See: https://www.federalregister.gov/documents/2019/04/15/2019-06128/air-plan-approval-district-of-columbia-maryland-and-virginia-maryland-and-virginia-redesignation).

[4] https://www.federalregister.gov/documents/2019/04/15/2019-06128/air-plan-approval-district-of-columbia-maryland-and-virginia-maryland-and-virginia-redesignation

Appendix B page 56). This Study is included in the Air Quality Conformity Determination that accompanies the Visualize 2045 Plan. The Visualize 2045 Air Quality Analysis is based upon the latest planning assumptions available for the Washington region. The analysis used MOVES2014a, the latest emission factor model specified by EPA for use in preparation of state implementation plans and conformity assessments at the time of analysis.

2.2.3 Environmental Effects

The DEIS presented the results of the potential impacts for CO at worst-case intersections throughout the study corridors. The methodologies and assumptions applied for the analysis are consistent with FHWA[5] and EPA guidance.[6,7] An updated traffic analysis to determine the worst-case intersections and interchanges on Preferred Alternative throughout the corridors was performed. The results of the traffic study showed that, although some different interchanges and intersections were identified as being worst case in the updated analysis, overall the maximum peak hour volumes and maximum peak hour delays were less than the top three intersections and interchanges used in the DEIS analysis. For this reason, the DEIS analysis can still be assumed to have projected worst-case emissions and that there would not be an exceedance of the CO NAAQS.

In accordance with the latest MSAT guidance, the Study is still best characterized as one with "higher potential MSAT effects" since the projected Design Year traffic is still expected to reach the 140,000 to 150,000 AADT criteria.[8] Therefore, a quantitative MSAT analysis was conducted. The results of the MSAT analysis show that all of the MSAT pollutant emissions are expected to increase slightly for the Preferred Alternative when compared to the No Build condition for 2025 and 2045. All MSAT pollutant emissions are expected to significantly decline in the Opening (2025) and Design years (2045) when compared to existing conditions (2016). These long-term reductions occur despite projected increase in VMT from 2016 to the 2025 and 2045 Build scenarios. Refer to **FEIS, Appendix K, Section 3.3.3** for additional detail on the MSAT results.

Consistent with the 2016 Council of Environmental Quality Final GHG NEPA guidance[9], a quantitative GHG assessment was conducted. The analysis shows GHG emissions under the Preferred Alternative are expected to decline in the Opening (2025) and Design (2045) years for all GHG pollutants when compared to existing conditions. Specifically, for CO2e, there is projected to be a 94,664 TPY decrease (13% reduction) in the Opening year and a 67,272 TPY decrease (9% reduction) in the Design year. These reductions occur despite projected increase in VMT on the affected network between the 2016 and 2025 and 2045 Build scenarios. Refer to **FEIS, Appendix K, Section 3.4.1** for additional detail on the GHG results.

---

5 https://www.environment.fhwa.dot.gov/projdev/impTA6640.asp

6 https://www3.epa.gov/scram

7 https://nepis.epa.gov/Exe/ZyPdf.cgi?Dockey=P100M2FB.pdf

8 Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents. October 18, 2016. https://www.fhwa.dot.gov/environMent/air_quality/air_toxics/policy_and_guidance/msat/page03.cfm

9 https://www.federalregister.gov/documents/2016/08/05/2016-18620/final-guidance-for-federal-departments-and-agencies-on-consideration-of-greenhouse-gas-emissions-and

2.2.4 Avoidance, Minimization, and Mitigation

While no mitigation measures are required since the Preferred Alternative does not cause or contribute to a violation of the NAAQS, additional measures have been considered and committed to by MDOT SHA to further reduce impacts to air quality. Measures that will be implemented during construction to help minimize emissions include the following:

- Implementing a ***Diesel Emissions Reduction Program*** that exceeds pertinent Federal and state regulations to minimize air pollution including MSAT emissions during construction.
- Implementing a ***Greenhouse Gas Reduction Program*** to reduce emissions during construction.
- Implementing an **Anti-Idling Policy** to avoid unnecessary idling of construction equipment in order to reduce engine emissions and to provide air quality benefits to those who live and work in or adjacent to the construction sites.

For additional detail on these measures refer to **FEIS, Appendix K, Section 4.**

2.3 Waters of the US and Waters of the State, Including Wetlands

Only nontidal wetlands and waterways are located within the Phase 1 South portion of the corridor study boundary; therefore, this section will only reference non-tidal wetlands and waterways regulations.

2.3.1 Regulatory Context and Methods

A. Regulations

Wetlands and waterways are protected by several federal and state regulations. Jurisdictional Waters of the US, including wetlands, are jointly defined by the Environmental Protection Agency (EPA) and the US Army Corps of Engineers (USACE) in 40 CFR 230.3(s) and 33 CFR 328.3. Executive Order 11990 of the Federal Register (FR), entitled *Protection of Wetlands*, 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" (42 FR 26961, E.O. 11990, May 1977).

The EPA and USACE implemented the Navigable Waters Protection Rule (85 FR 22250) on June 22, 2020. The Navigable Waters Protection Rule (NWPR) replaced the Clean Water Rule as the federal regulation defining Waters of the US. The rule defined four categories of jurisdictional waters and 12 categories of exclusions, in addition to clarifying terms used to define these waters and exclusions. However, on June 9, 2021, the EPA and USACE announced their intent to revise the definition of Waters of the US, arguing that the NWPR defined Waters of the US too narrowly and would reduce clean water protections. On August 30, 2021, the EPA and USACE received a court order to vacate the NWPR, prompting the USACE to implement a reversion to the pre-2015 regulatory regime until further notice. Therefore, the FEIS reports all wetlands and waterway features within the Phase 1 South portion of the corridor study boundary in accordance with the pre-2015 regulatory definitions.

Unavoidable impacts caused by the discharge of dredge or fill material into Waters of the US, including wetlands, within the Preferred Alternative LOD are federally regulated under Section 404 of the Clean Water Act (CWA) (33 U.S.C. 1344) and Section 10 of the Rivers and Harbors Act (33 U.S.C. 403). Section 404 of the CWA provides regulatory authority to the USACE to issue or deny permits for the discharge of dredged or fill material into Waters of the US, including wetlands, and a Section 404 permit is required for impacts. Authorization under a Section 404 Permit, a MDE Nontidal Wetlands and Waterways Permit, and a Virginia Water Protection Permit (VWPP) are required prior to any construction. Section 10 of the Rivers and Harbors Act provides regulatory authority to the US Coast Guard (USCG) for the permitting of bridges over navigable rivers and the USACE for the permitting of piers, abutments, and associated impacts. In a letter dated September 19, 2019, included in **Appendix N**, the USCG stated that the ALB reconstruction over the Potomac River would not require a bridge permit. However, the USACE would permit the ALB piers and abutments within the Potomac River under Section 10. Section 10 will only apply to the Potomac River for the I-495 & I-270 Managed Lanes Study.

The NPS has developed a set of policies and procedures found in Director's Order (D.O.) #77-1: Wetland Protection (NPS, 2010) and Procedural Manual #77-1: Wetland Protection (NPS, 2016) to comply with Executive Order 11990 within the context of the NPS's mission. These policies and procedures emphasize: 1) exploring all practical alternatives to building on, or otherwise adversely affecting, wetlands; 2) reducing impacts to wetlands whenever possible; and 3) providing direct compensation for any unavoidable wetland impacts by restoring degraded or destroyed wetlands on other NPS properties. If a preferred alternative would have adverse impacts on wetlands, a Statement of Findings (SOF) must be prepared that documents the above steps and presents the rationale for choosing an alternative that would have adverse impacts on wetlands. The SOF includes a mitigation plan proposed to compensate for impacts to wetlands and floodplains on NPS land.

Wetlands and their buffers are also protected by the State of Maryland Environment Article Title 5, Subtitles 5 and 9 of the Maryland Annotated Code. Pursuant to the Maryland Code, the MDE has promulgated stringent regulations to protect wetlands (COMAR, Title 26). Nontidal wetlands and their buffers are defined in COMAR 26.23.01.01. Nontidal wetlands are defined as "an area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation." A buffer is "a regulated area, 25 feet in width, surrounding a nontidal wetland, measured from the outer edge of the nontidal wetland." According to COMAR 26.23.01.04, nontidal wetland buffers shall be expanded in special circumstances. Wetlands of Special State Concern are examples of Maryland's most valuable wetlands resources and are designated for special protection under COMAR 26.23.06. These wetlands have high ecological or educational value and may provide specialized habitat for rare plant or animal species. Waterways regulated by the State are defined in COMAR 26.17.04.02 as Waters of the State and include the 100-year floodplain. Impacts to waterways, 100-year floodplains, nontidal wetlands, 25-foot nontidal wetland buffers, or 100-foot expanded buffers require a Maryland Nontidal Wetlands and Waterways Permit. Additionally, a Section 401 Water Quality Certification from MDE is required for any impacts to waterways or wetlands requiring a USACE Section 404 permit.

In Virginia, the Virginia Department of Environmental Quality (VDEQ) is the authority that provides the Section 401 certification through its VWPP Program (9VAC 25-210), which gets its statutory authority from the Code of Virginia (Va. Code §62.1-44.15). State law requires that a VWPP be obtained before disturbing a stream by clearing, filling, excavating, draining, or ditching (VDEQ, 2018). Work in non-tidal streams with drainage areas greater than five square miles also requires a permit from the Virginia Marine Resources Commission (VMRC) under the authority of the Code of Virginia (Va. Code §28.2-1204).

B. Methodology

Prior to beginning the field investigation, environmental scientists conducted a desktop review of mapped waterways and nontidal wetlands within the corridor study boundary on behalf of MDOT SHA using existing National Wetlands Inventory (NWI) and Maryland Department of Natural Resources (MDNR) Wetlands and Waters Geographic Information System (GIS) data. No similar statewide wetland and stream GIS layer exists for Virginia. The results of the desktop investigation for the area within the Phase 1 South portion of the corridor study boundary are included in **Appendix B**.

The I-495 & I-270 Managed Lanes Study corridor study boundary, a 48-mile long and approximately 600-foot-wide roadway corridor, was split into 29 field sub-segments (See **Appendix D, Overview Map**) for the purposes of the wetlands and waterways field investigation, and field sub-segment numbers were incorporated into the naming convention of features within each sub-segment. Field sub-segment breaks were established at major road crossings to provide clear physical boundaries and to limit the number of features that may occupy more than one segment.

The 48-mile corridor study boundary remains unchanged: I-495 from south of the GWMP in Fairfax County, Virginia, to west of MD 5 and along I-270 from I-495 to north of I-370, including the east and west I-270 spurs in Montgomery and Prince George's Counties, Maryland. The Preferred Alternative, Alternative 9 - Phase 1 South (shown in **dark blue** in **Figure 1**), includes build improvements within the limits of Phase 1 South only, totaling approximately 15 miles of proposed improvements. There is no action, or no improvements included at this time on I-495 east of the I-270 east spur to MD 5 (shown in **light blue** in **Figure 1**). While the Preferred Alternative does not include improvements to the remaining parts of I-495 within the scope of the Study area, future improvements on these remaining parts of the system may still be needed.

A two-tier approach was applied to fieldwork within the corridor study boundary since properties adjacent to the ROW were not fully accessible when delineation efforts began. Before delineation efforts began, MDOT SHA notified property owners of non-invasive fieldwork (i.e., involving no soil disturbance). When field teams identified potential wetland areas based on the non-invasive field visit, letters were then sent to the respective properties to request invasive access. Tier one fieldwork consisted of full delineation of wetlands and waterways features within the MDOT SHA ROW, and non-invasive access to properties adjacent to the ROW. Non-invasive access allows access for stream delineation, flagging, photography, characterization of vegetation, and surface hydrology, but not digging soil pits for soil characterization or groundwater hydrology. In areas outside of the MDOT SHA ROW, field crews delineated waterway features and conducted planning level investigation of wetlands, including conservative estimations of potential wetland boundaries based on surface hydrology and vegetation. Tier two fieldwork consisted of soils investigations to finalize delineations of the potential wetland areas identified during tier one fieldwork on public and private properties where the property owners granted MDOT SHA access to perform invasive investigations.

Environmental scientists delineated wetlands and waterways within the corridor study boundary on behalf of MDOT SHA and VDOT from March 2018 through October 2021, with delineation areas revised as the LOD was refined. Much of the MDOT SHA ROW within the corridor study boundary was previously delineated as part of the Prince George's and Montgomery County Integrated Roadside Vegetation Management (IRVM) and I-270 ICM projects. All previously delineated features were field reviewed, and delineations were revised as needed for the purposes of the I-495 & I-270 Managed Lanes Study. No previous delineations were referenced for the Virginia portion of the corridor study boundary. Environmental scientists completed data sheets for features delineated in areas that were not previously delineated by the IRVM or ICM projects, previously delineated features without data sheets, and previously delineated features that changed classification (e.g., palustrine emergent [PEM] wetland to palustrine forested [PFO] wetland or intermittent to perennial stream) since the previous delineation. All features were photographed and given a unique identifier containing the number of its associated field sub-segment. Data obtained from the field reconnaissance was collected with an iPad and boundary points were located using global positioning systems (GPS).

Wetlands features were delineated in accordance with the following:

- USACE Wetlands Delineation Manual, Y-87-I (Environmental Laboratory, 1987);
- USACE 2012 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region Version 2.0 (USACE, 2012); and
- USACE 2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (USACE, 2010).

These manuals employ a three-parameter approach to wetland identification, including (1) hydrology, (2) hydrophytic vegetation, and (3) hydric soils. All three parameters must be present for an area to be considered a jurisdictional wetland under Section 404 of the CWA. Routine wetland determination methods with onsite inspection were used to determine the presence of wetlands in the corridor study boundary. Wetlands including dying ash trees were characterized as PFO wetlands, as requested by MDE and USACE. Wetlands and waterways located on National Park Service (NPS) park land were identified by Cowardin classification including the system, subsystem, class, subclass, and any applicable modifiers (Cowardin, 1979).

Wetland scientists completed a functions and values assessment for all delineated wetlands using the USACE New England Method as presented in The Highway Methodology Workbook Supplement – Wetland Functions and Values; A Descriptive Approach (USACE, 1999). Along with the best professional judgment of an experienced wetland scientist, this method uses the presence of certain physical characteristics broadly understood to indicate the presence of related functions. The functions and values assessed include:

- Groundwater Recharge/Discharge,
- Floodflow Alteration,
- Fish and Shellfish Habitat,
- Sediment/Toxicant Retention,
- Nutrient Removal,
- Production Export,

- Sediment/Shoreline Stabilization,
- Wildlife Habitat,
- Recreation,
- Educational/Scientific value,
- Uniqueness/Heritage,
- Visual quality/Aesthetics, and
- Endangered Species Habitat.

Waterways features were delineated using the limits defined in 33 Code of Federal Regulations (CFR) § 328. The boundaries of nontidal waterways features were set at the ordinary high water (OHW) mark and include but are not limited to: in-line stormwater management (SWM) ponds, palustrine open water (POW or ponds), stream systems (waterways), and some disturbed areas. The OHW mark was 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. Prior to August 16, 2018, CWA jurisdiction of delineated features was determined in accordance with the June 5, 2007, joint guidance issued by EPA and USACE following the US Supreme Court's decision in the Rapanos case; and the January 19, 2001, joint guidance issued by EPA and USACE following US Supreme Court's decision in SWANCC. After August 16, 2018, jurisdiction of new delineated features was determined in accordance with the Clean Water Rule (CWR), and previously delineated feature data was revised to determine likely jurisdiction under the new jurisdictional definitions of Waters of the US outlined by the rule. Between July 2018 and December 2019, representatives from the USACE, MDE, and EPA conducted field review of numerous wetland and waterways features delineated within the corridor study boundary. The goal of the meetings was to review representative delineated wetlands and waterways to gain general concurrence on the delineation in support of a preliminary jurisdictional determination (JD).

After June 22, 2020, federal jurisdiction of new delineated features was determined in accordance with the Navigable Waters Protection Rule, and previously delineated feature data was revised to reflect jurisdiction under the new jurisdictional definitions of Waters of the US outlined by the rule. All ephemeral channels and some isolated ditches and wetlands were removed from USACE jurisdiction. After August 30, 2021, jurisdiction of new delineated features was determined in accordance with pre-2015 regulatory definitions, and previously delineated feature data was revised to reflect jurisdiction under the pre-2015 definitions. Ephemeral channels and ditches were added back to the data if jurisdictional under the pre-2015 definitions, and some wetlands were returned to jurisdictional status for the USACE under pre-2015 definitions.

Waterway function and value was assessed based on the Maryland Stream Mitigation Framework (MSMF) using the USACE Stream Mitigation Calculator (Stream Calculator) (USACE, 2020). The MSMF requires that the habitat of existing stream reaches be assessed and scored based on the length of the existing reach that will be impacted. If 300 linear feet (LF) or less of a stream reach will be impacted, then a habitat based bioassessment was completed as detailed in the Rapid Bioassessment Protocols (RBP) for Use in Streams and Wadeable Rivers (Barbour et al., 1999). If greater than 300 LF of a stream reach will be impacted, then a function-based assessment is required as outlined in the Rapid Function-Based Stream Assessment Methodology (FBSAM) (Starr et al., 2015).

The Stream Calculator considers the impact activity type, reach length, channel thread, drainage area, site sensitivity score, and temporal loss of a given channel to determine the mitigation need for each activity. The functional feet required to mitigate each impact activity is determined by inputting the existing and proposed condition information into the Stream Calculator. All positive values output by the calculator for any given stream reach will be given a value of 0 in the Stream Calculator and that impact activity will not require mitigation. All negative values output by the Stream Calculator are totaled for each stream reach to determine the overall mitigation need in functional feet. The waterway mitigation determination process is discussed further in Section 4 of the Final CMP.

The MDE regulation of nontidal wetlands, nontidal wetland buffers, and waterways is based on the COMAR Title 26 Subtitle 17, Water Management; COMAR Title 26 Subtitle 23, Nontidal Wetlands; and field review of delineated features. Unlike USACE, MDE does not regulate ephemeral channels, however it does regulate isolated wetlands and certain intermittent features that may not be considered jurisdictional by USACE. USACE and MDE jurisdictional results for each delineated feature are represented in **Appendix E.** VDEQ determines jurisdiction based on Virginia Code §62.1-44.15 and VMRC based on the Virginia Code §28.2-1204. Virginia state permits will be acquired by the end of the NEPA process. In addition, wetlands and waterways located on NPS park land were identified by Cowardin classification including the system, subsystem, class, subclass, and any applicable modifiers (Cowardin, 1979).

Since the publication of the DEIS, the MLS Natural Resources Team has participated in the agency coordination meetings listed in **Table 2-4** below, including coordination for: nontidal wetlands and waterways mitigation, permitting, Section 401 Water Quality Certification, Tier II coordination, NPS wetland and floodplain SOF, MSMF, Section 7 Consultation, property access, culvert augmentation analysis, DEIS comment discussion, interagency coordination, and NEPA document coordination.

Table 2-4. Agency Coordination Meetings Since the Publication of the DEIS

Date	Name of Meeting	Agencies Included	General Topics Covered
July 9, 2020	MLS Public Hearing Logistics Meeting	MDE, USACE	Discussion of the logistics of the MLS Public Hearings, both virtual and in-person for Section 404/401 purposes.
July 21, 2020	AN-6 Mitigation Meeting	DNR	Review Additional Potential Fish Blockages noted by MDE and USFWS Upstream and Downstream of the 404 Mitigation Paint Branch Fish Passage Site (AN-6)
July 22, 2020	CA-5 Concept Design Mitigation Meeting	M-NCPPC Montgomery County	Montgomery County M-NCPPC Comments on the 404 Mitigation Tributary to Seneca Creek Site (CA-5) Concept Design
July 24, 2020	MLS Mitigation Concept Design Meeting	WSSC	Logistics for Proposed Mitigation Site Work Over WSSC Sewer and Water Lines.
August 12, 2020	AN-1 Concept Design Mitigation Meeting	M-NCPPC Montgomery County	Montgomery County M-NCPPC & WSSC Comments on the Crabbs Branch Site (AN-1) 404 Mitigation Concept Design
August 12, 2020	MLS JD Discussion	USACE	Discussion of new regulatory definition of Waters of the U.S. (WUS) and any implications on the Jurisdictional Determination
August 27, 2020	MLS Tier II Coordination Meeting	MDE	Discussion of impacts within the MDE Tier II boundary and the Tier II package requirements

Date	Name of Meeting	Agencies Included	General Topics Covered
September 3, 2020	MLS NPS Wetlands Mitigation Kick-Off Meeting	NPS	Discussion of the Statement of Findings requirement as it pertains to MLS and path forward for coordination meetings.
September 4, 2020	MLS Stream Calculator Assessment Discussion	USACE, MDE	Discussion with the regulatory agencies about how to apply the MSMF stream calculator and which stream assessments to use.
September 29, 2020	CA-2/3 Preliminary Design Mitigation Meeting	M-NCPPC Montgomery County	404 Mitigation Magruder Branch (CA-2/3) Site Preliminary Design
September 29, 2020	Culvert/Permitting Meeting with FHWA	FHWA	Culvert augmentation
Bi-weekly, started on September 29, 2020	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Provide project updates and receive updates from the regulatory agencies related to MLS permitting. This meeting focused on: Rock Run culvert/Plummers Island, mitigation site schedule, and Virginia mitigation.
September 29, 2020	MLS Informal Section 7 Consultation	DNR, USFWS	2020 Bat Survey Results
October 5, 2020	NPS Wetland Mitigation Meeting for CHOH and GWMP	NPS	Discuss CHOH and GWMP potential mitigation opportunities
October 14, 2020	NPS Wetland Mitigation Meeting for NACE	NPS	Discuss NACE potential mitigation opportunities
October 15, 2020	MLS Permitting Discussion	FHWA, USACE, MDE	Culvert augmentation LOD expansion and permitting
October 16, 2020	CA-2/3 & AN-3 Preliminary Design Mitigation Meeting	MDE, USACE, DNR, EPA	404 Mitigation Magruder Branch (CA-2/3) and Pebblestone Dr. Tributary Preliminary Designs
October 29, 2020	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Vernal pools, Compensatory Stormwater Quality Treatment, Section 7 Consultation, MSMF
November 9, 2020	MLS Permitting Discussion Follow-Up Meeting	FHWA, USACE, MDE	Culvert augmentation permitting discussion continued
November 12, 2020	MLS Permitting Update Meeting	USACE, MDE	Public comments, off-site SWM, M-NCPPC SWM discussions, MSMF stream calculator, augmented culverts
November 18, 2020	MLS M-NCPPC Montgomery County SWM Field Meeting	M-NCPPC Montgomery County	Sligo Creek and Indian Spring Terrace Local Park
November 19, 2020	MLS Stream Assessment Field Meeting	USACE, MDE	Review stream functional assessment activities
November 19, 2020	CA-2/3 Wetland Delineation Review Meeting	MDE, USACE	404 Mitigation Magruder Branch (CA-2/3) Wetland Delineation Field Review
November 24, 2020	MLS Permitting Meeting	USACE, MDE	Identify augmented culvert locations for field meeting, off-site SWM site GIS data review
December 1, 2020	MLS M-NCPPC Montgomery County SWM Field Meeting	M-NCPPC Montgomery County	Review SWM locations on M-NCPPC Montgomery County property
December 2, 2020	MLS ROE Agreement Extension Meeting with M-NCPPC Prince George's County	M-NCPPC Prince George's County	ROE Agreement extension

Date	Name of Meeting	Agencies Included	General Topics Covered
December 8, 2020	Plummers Island Coordination Meeting	USACE, MDE, FHWA, DNR, USFWS, NPS	DEIS LOD for Plummers Island; Wetland, tree, RTE impacts
December 10, 2020	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Augmented culverts, Compensatory Stormwater Quality Treatment, phased permitting, RFP-5 mitigation site, ALB/Plummers Island
December 11, 2020	MLS Culvert Field Meeting with Agencies	EPA, MDE, USACE, FHWA	Augmented culverts
December 14, 2020	NPS DEIS Comments Discussion	NPS, FHWA	DEIS comments
December 14, 2020	MLS Phased Permit Process Discussion	EPA, FHWA, USACE, MDE	Discuss potential for phased permitting
December 21, 2020	MLS Culvert Field Visit	MDE, USACE	Augmented culverts
January 7, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Compensatory Stormwater Quality Treatment, wetland delineation field reviews, stream assessments, Tier II, mitigation package with phase permitting
January 14, 2021	CA-5 & AN-1 Wetland Delineation Review Meeting	MDE, USACE	404 Mitigation Seneca Creek Tributary (CA-5) and Crabbs Branch (AN-1) Wetland Delineation Field Reviews
January 19, 2021	MLS 401 WQC Working Session	MDE, USACE, EPA	Schedule; public notices/meetings
January 21, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Compensatory Stormwater Quality Treatment, Tier II, mitigation package for Phase I
January 22, 2021	RFP-5 & RFP-6 Wetland Delineation Review Meeting	MDE	404 Mitigation Henson Creek (RFP-5) and Mill Swamp Creek (RFP-6) Wetland Delineation Field Reviews
February 3, 2021	NCPC's DEIS Comments Discussion	FHWA, NCPC	NCPC DEIS comments and responses
February 4, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Compensatory Stormwater Quality Treatment, augmented culverts, permitting schedule
February 8, 2021	MLS – ALB and BW Parkway Discussion	FHWA, NPS	A discussion of the avoidance and minimization at the American Legion Bridge and Baltimore Washington Parkway
February 9, 2021	MDOT-VDOT Coordination Meeting	VDOT	Coordination between MLS and project NEXT
February 9, 2021	DNR's DEIS Comments Discussion	DNR, FHWA	Review DNR's DEIS comments and responses
February 10, 2021	USACE and MDE's DEIS Comments Discussion	USACE, MDE, FHWA	Review USACE and MDE's DEIS comments and responses
February 16, 2021	MLS and MSMF Meeting	USACE, MDE	A presentation to the regulatory agencies of how the Maryland Stream Mitigation Framework stream calculator is being applied to the MLS.
February 17, 2021	MLS February IAWG Meeting	All Participating and Cooperating Agencies	Agency and stakeholder coordination and collaboration efforts, design efforts to address common comments, phased delivery approach, MDOT SHA's RPA Alternative 9

Date	Name of Meeting	Agencies Included	General Topics Covered
February 18, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Compensatory Stormwater Quality Treatment, mitigation site review schedule, refined Alternative 9 LOD, nontidal wetlands and waterways mitigation
February 18, 2021	EPA's DEIS Comments Discussion	EPA, FHWA	EPA's DEIS comments and responses
February 22, 2021	MLS 401 WQC Working Session #2	MDE, USACE, EPA	401 WQC Request
March 1, 2021	Washington Biologists Field Club Coordination Meeting	NPS	Plummers Island
March 4, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Compensatory Stormwater Quality Treatment, Konterra
March 4, 2021	MLS NPS Coordination Meeting	NPS, FHWA	ALB, GWMP, BW Parkway
March 9, 2021	RFP-2 & AN-3 Wetland Delineation Review Meeting	MDE, USACE	404 Mitigation Cabin Branch (RFP-2) and Pebblestone Dr. Tributary (AN-3) Wetland Delineation Field Reviews
March 10, 2021	M-NCPPC Phase 1 South DEIS Comments and Off-Site SWM Discussion	M-NCPPC Montgomery County	MNCPPC's DEIS comments and responses and off-site SWM
March 15, 2021	M-NCPPC Montgomery County DEIS Comments – Continued Discussion	M-NCPPC Montgomery County	MNCPPC's DEIS comments and responses
March 18, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Off-site SWM, Konterra Stream Site Phase II 1st draft
March 19, 2021	CA-5 Semi-Final Design Mitigation Meeting	PEPCO	404 Mitigation Tributary to Seneca Creek (CA-5) Semi-Final Design
March 19, 2021	M-NCPPC Prince George's County SWM Meeting	M-NCPPC Prince George's County	HP Johnson Park and Cherry Hill Park
March 24, 2021	CA-5 Semi-Final Design Mitigation Meeting	M-NCPPC Montgomery County, MDE, USACE	404 Mitigation Tributary to Seneca Creek (CA-5) Semi-Final Design
April 1, 2021	RFP-1 Wetland Delineation Review Meeting	MDE, USACE	404 Mitigation Indian Creek and Tributaries at Konterra (RFP-1) Wetland Delineation Field Review
April 6, 2021	USACE/MDE ALB Discussion	USACE, MDE	ALB alignment options
April 9, 2021	CA-2/3 PRD Site Development Submittal Meeting	PRD	404 Mitigation PRD Comments on the Magruder Branch (CA-2/3) Site Development Submittal
April 12, 2021	M-NCPPC Montgomery County DEIS Comments	M-NCPPC Montgomery County	M-NCPPC DEIS comments and responses regarding the Rock Creek Area
April 14, 2021	City of Rockville SWM Discussion	City of Rockville	SWM within the City of Rockville
April 16, 2021	RFP-1 Wetland Delineation Review Meeting	MDE, USACE	404 Mitigation Indian Creek and Tributaries at Konterra (RFP-1) Wetland Delineation Field Review
April 22, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Off-site SWM; ALB temporary access requirements, geotechnical investigation permitting
April 29, 2021	City of Rockville Park Land and Mitigation Coordination Meeting	City of Rockville	Mitigation for the City of Rockville

Date	Name of Meeting	Agencies Included	General Topics Covered
May 6, 2021	CA-2/3 Semi-Final Design Mitigation Meeting	M-NCPPC Montgomery County, MDE, USACE	404 Mitigation Magruder Branch (CA-2/3) Semi-Final Design
May 12, 2021	IAWG Meeting	All Participating and Cooperating Agencies	Recommended Preferred Alternative, Supplemental Draft Environmental Impact Statement, Combined FEIS/ROD, MLS schedule
May 12, 2021	M-NCPPC Montgomery County Phase 1 South Park Mitigation Meeting	M-NCPPC Montgomery County	M-NCPPC park mitigation discussion
May 20, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	New permitting/NEPA/WQC combined schedule, off-site SWM, Avoidance and Minimization documentation approach, mitigation site prioritization
June 15, 2021	MLS Discussion Regarding the JPA and NEPA Documents	MDE, USACE	Discussion of impact presentation in JPA and NEPA documents
June 21, 2021	NPS Coordination Meeting	NPS, FHWA	ALB trail connection
June 25, 2021	Off-site Compensatory Stormwater Quality Treatment Delineation Field Review	USACE, MDE	Review Off-site Compensatory Stormwater Quality Treatment delineations
July 1, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Off-site SWM, mussel survey, National Capital Region Transportation Planning Board vote, temporary and permanent impacts, AMR narrative, permitting/NEPA/WQC combined schedule
July 15, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Off-site SWM, schedule updates, MSMF update, Henson Creek Revised Phase II Plan, Phase I South Mitigation Plan
August 4, 2021	I-495 & I-270 – LOD Review	USACE, MDE	Walk-through LOD and proposed impacts
August 19, 2021	Change in Jurisdiction for Navigable Waters	USACE	Discuss jurisdictional changes as they relate to the MLS.
August 25, 2021	FHWA SDEIS Comment Discussion	FHWA	FHWA's SDEIS comments and responses
August 26, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Off-site SWM, Henson Creek Revised Phase II Plan, Alternate Limits (LOR, LOS, LOI)
September 9, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	Off-site SWM, USACE jurisdiction/WUS definition, Approach to defining jurisdictional features in FEIS
September 24, 2021	Compensatory Stormwater Quality Treatment Field Review	USACE, MDE, USFWS, MDNR, EPA, M-NCPPC	Review of off-site compensatory stormwater quality treatment site delineations
September 30, 2021	NPS Coordination Meeting	NPS	Wetland and Floodplain Statement of Findings; ALB access road
October 13, 2021	LOD Review Meeting	USACE, MDE	Review minor changes to LOD
October 14, 2021	NPS Coordination Meeting	NPS	Chesapeake and Ohio Canal Lock 13. wetland mitigation site, mitigation items
October 14, 2021	M-NCPPC Coordination Meeting	M-NCPPC	Mitigation package for Cabin John Regional Park, screening barriers, parkland

Date	Name of Meeting	Agencies Included	General Topics Covered
			replacement acquisition options, potential mitigation options
October 28, 2021	NPS Natural Resources Coordination Meeting	NPS	Temporary LOD, animal translocation, RTE plant species mitigation, stream restoration
October 28, 2021	NPS Reforestation Coordination Meeting	NPS	Forest mitigation, valuation for trees
October 28, 2021	M-NCPPC Coordination Meeting	M-NCPPC Montgomery County	Mitigation package for Cabin John Stream Valley Park – Unit 2, parkland replacement, NEPA schedule/mandatory referral process
November 3, 2021	Nontidal Wetlands and Waterways Permitting Update Meeting	USACE, MDE	LOD changes, AMP design, AMP SWM concept, JPA schedule
November 5, 2021	M-NCPPC Park Mitigation Stormwater Outfalls Field Meeting	M-NCPPC Montgomery County	Park mitigation and stormwater outfalls
November 9, 2021	I-495 & I-270 Managed Lanes Study and NEXT Project Overlapping Impacts	VDOT	MLS and NEXT Project overlapping impacts
November 10, 2021	M-NCPPC Forest Mitigation Field Meeting	M-NCPPC Montgomery County	Review forest mitigation
November 18, 2021	NPS Coordination Meeting	NPS	Response to GWMP comments, Chesapeake and Ohio Canal Lock 13 and tow path, shared use path, stream restorations, condition assessment requests, archaeological district National Register nomination, parkland replacement properties
November 22, 2021	City of Rockville Coordination Meeting	City of Rockville	MD-189 interchange, parkland mitigation
December 14, 2021	M-NCPPC Mitigation Discussion	M-NCPPC	SWM SDEIS comment response, LOD discussion, Final Mitigation Package
December 15, 2021	NPS Coordination Meeting	NPS	GWMP renderings, signing plan near GWMP, Final Mitigation Plan
December 15, 2021	Inter-Agency Working Group Meeting	Various	SDEIS comments, COVID traffic update, design updates, bicycle/pedestrian improvements, intersection improvements, Environmental Justice Initiative, Section 106 update
December 21, 2021	JPA Package Review Meeting	USACE, MDE	Review JPA package components
January 7, 2022	I-495 & I-270 MLS: SWM Discussion	USACE, MDE, M-NCPPC Montgomery County, MDNR, FHWA, EPA	Discuss stormwater concept on-site and off-site
January 25, 2022	JPA and Water Quality Certification Request Review Meeting	USACE, MDE	JPA package and WQC Request
February 22, 2022	Water Quality Certification Request Check-In and JPA Comment Clarification Meeting	USACE, MDE	JPA package and WQC Request

Date	Name of Meeting	Agencies Included	General Topics Covered
March 4, 2022	American Legion Bridge Alignment Options Review	USACE, MDE	Review ALB alignment options
March 10, 2022	Hardened Channels and Avoidance and Minimization	USACE, MDE	Review hardened channels and Avoidance and Minimization areas requested by USACE
March 14, 2022	Aquatic Life Passage Discussion	NMFS, EPA, USFWS, USACE, MDNR, MDE	Aquatic life passage
March 18, 2022	Plummers Island Field Visit	USACE, MDE	Plummers Island

Unavoidable impacts to regulated wetlands and waterways within the Preferred Alternative LOD in Maryland are subject to a Section 404 permit from the USACE, a Maryland Nontidal Wetlands and Waterways Permit, and Section 401 Water Quality Certification. USACE Baltimore District will be the lead district for permitting impacts to Waters of the US within both the Virginia and Maryland portions of the Preferred Alternative LOD. The Potomac River is considered a Traditionally Navigable Water (TNW) under Section 10 of the Rivers and Harbors Act. Typically, the designation of a waterway under Section 10 would require a bridge permit to be issued by the USCG, but in a letter dated September 19, 2019, the USCG stated that a bridge permit would not be required under Section 10 for the ALB. USACE will regulate the Potomac River under Section 10 regarding the piers and abutments for the ALB reconstruction. In Virginia, VDEQ is the authority that provides the Section 401 certification through its VWPP Program (9VAC25-210). Work in non-tidal streams with drainage areas greater than five square miles also require a permit from the VMRC under the authority of the Code of Virginia (Va. Code §28.2-1204).

2.3.2 Existing Conditions

A total of 66 nontidal wetlands and 239 stream segments were delineated within the Phase 1 South portion of the corridor study boundary. Only one TNW, the Potomac River, was identified within the Phase 1 South portion of the corridor study boundary. All other perennial waters are classified as tributaries of the Potomac River. Long stream channels were segmented due to changes in classification, splitting by culverted sections, or other refinement needs during data processing. Therefore, the number of individual stream segments is greater than the features presented in field documents. No Wetlands of Special State Concern or outstanding national resource waters are within the Phase 1 South portion of the corridor study boundary. The quantity of features delineated within the Phase 1 South portion of the corridor study boundary and quantity of the delineated features by classification are provided in **Table 2-5**. A detailed summary of surface water resources, including stream systems, is included in **Section 2.4**.

Table 2-5. Total Delineated Features within the Phase 1 South Portion of the Corridor Study Boundary

Features	Totals
Wetlands	**66**
Palustrine Emergent (PEM)	27
Palustrine Forested (PFO)	38
Palustrine Scrub-Shrub (PSS)	1
Waterways	**239**
Ephemeral	19
Intermittent	102
Perennial	118

The delineated wetland and waterway features are summarized in **Appendix E** and maps of each feature's location and boundaries within the Phase 1 South portion of the corridor study boundary are provided in **Appendix F**. Routine Wetland Determination Data Forms, Waters Datasheets, and Wetland Functions and Values Evaluation Forms completed for each delineated feature are included in **Appendix G**, and photographs of each feature are included in **Appendix H**.

A total of three palustrine and nine riverine NPS wetlands were identified on NPS park land within the Preferred Alternative LOD. Impacts to, and full Cowardin classification of these features are summarized in **Appendix I** and the Draft NPS SOF, Appendix G of the SDEIS. A final signed SOF will be attached to the Record of Decision (ROD) as a separate document.

Wetlands in the Phase 1 South portion of the corridor study boundary provide one or more ecological functions such as:

- Groundwater Recharge/Discharge,
- Floodflow Alteration,
- Fish and Shellfish Habitat,
- Sediment/Toxicant Retention,
- Nutrient Removal,
- Production Export,
- Sediment/Shoreline Stabilization,
- Wildlife Habitat,
- Recreation,
- Educational/Scientific value,
- Uniqueness/Heritage,
- Visual quality/Aesthetics, and
- Endangered Species Habitat.

The quantity and degree of wetland functions varies based on location, vegetation type, hydroperiod, and level of disturbance. Principal functions for each wetland are listed in the Summary of Wetland Functions and Values Table (**Appendix J**). A summary of the impacts to the functions and values of wetlands within the Preferred Alternative LOD is presented in **Table 2-6.**

Table 2-6. Wetland Function & Value Impact Summary

	Function/Value	On-Site Improvements		
		Function/Value Loss (AC)	Number of Wetlands with Function/Value Loss	Percentage of Wetlands with Function/Value Loss
Functions	Nutrient Removal	3.50	35	97
	Sediment/Toxicant Retention	3.45	34	94
	Groundwater Discharge/Recharge	3.40	33	92
	Floodflow Alteration	3.31	28	78
	Wildlife Habitat	2.92	21	58
	Sediment/Shoreline Stabilization	2.71	15	42
	Production Export	2.67	12	33
	Fish and Shellfish Habitat	2.46	9	25
Values	Uniqueness/Heritage	2.48	4	11
	Visual Quality/Aesthetics	2.34	5	14
	Recreation	1.55	3	8
	Education/Scientific Value	1.46	2	6
	Endangered Species Habitat	0.00	0	0

Note: The Preferred Alternative will permanently impact a total of 36 wetlands, resulting in 3.51 acres of permanent impact. Temporary impacts do not require mitigation.

2.3.3 Environmental Effects

Direct impacts to wetlands, their buffers, waterways, and floodplains associated with construction of the Preferred Alternative LOD include roadway impacts (i.e., widening, grading, etc.), bridge expansions or rehabilitations, culvert extensions or augmentations, relocation of impacted channels, SWM facility outfalls, noise barriers, and construction-related access.

Indirect impacts to wetlands, their buffers, waterways, and floodplains from the Preferred Alternative LOD may result from roadway runoff, sedimentation, and changes to hydrology. A detailed assessment of hydrologic effects will occur once final areas of cut and fill are determined in the final phase of engineering design.

Direct and indirect impacts may lead to a decrease in available wetland and waterway habitat within the project area and ultimately a decrease in plant and animal species inhabiting these areas. Impacts to wetland functions may include losses of groundwater recharge/discharge, fish and shellfish habitat, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation, production export, sediment/shoreline stabilization, wildlife habitat, recreation, educational/scientific value, uniqueness/heritage, visual quality/aesthetics, wildlife habitat, endangered species habitat, and capacity for floodflow alteration. Since the DEIS was published in July 2020, design has advanced, and quantified impacts have been further broken down into permanent or long-term effects and temporary or short-term construction-related effects. The JPA Impact Plates display two Preferred Alternative LODs, one representing permanent and one representing temporary activities. Some impacts to Waters of the US or Waters of the State will be considered permanent despite being partially or entirely located within the temporary LOD. In addition to the temporary and permanent LODs, several areas within the Phase 1 South limits will be considered limits of restoration, stabilization, or improvements to stormwater capacity. These three categories will be displayed as unique limits within the Preferred Alternative LODs and additional regulatory agency review and approval will be required prior to any clearing or construction in these areas. The three limits categories are: Limits of Restoration (LOR), Limits of Stabilization (LOS), and Limits of Improvements to Stormwater Capacity (LOI).

LOR relate to on-site stream restoration activities that will impact some streams and the wetlands adjacent to those streams. Impacts to these environmentally sensitive areas are often associated with culvert augmentation. These impacts typically result from excavation and/or fill associated with stream restoration treatments that may include, but are not limited to: rock toe protection, log vanes, cross vanes, and boulder step pools. At this preliminary stage of design, the details of the restoration have not been completed and the estimated limits are conservative. To ensure environmentally sensitive design and to prevent unnecessary tree clearing or impacts, these stream restoration areas have been excluded from the LOD and included in LOR linework on the JPA impact plates. In LOR areas, USACE and MDE approval of final restoration design and permit authorization is required prior to conducting any clearing or construction.

LOS relate to on-site stream stabilization activities that will impact some short segments of stream and wetlands adjacent to these streams. Impacts to these environmentally sensitive areas are often associated with culvert augmentation. These impacts typically result from excavation and/or fill associated with stream stabilization treatments that may include, but are not limited to, scour pools and bank armoring. At this preliminary stage of design, the details of the stabilization have not been completed and the estimated limits are conservative. To ensure environmentally sensitive design and to prevent unnecessary clearing or impacts, these stream stabilization areas have been excluded from the LOD and included in the LOS linework on the JPA impact plates. In LOS areas, USACE and MDE approval of final stabilization design and permit authorization is required prior to conducting any clearing or construction.

LOI are related to modifications to stormwater treatment facilities that will impact streams and wetlands. In some cases, these modifications are necessary to increase storage capacity upstream of culverts and in other cases, modification may be needed to increase on-site stormwater quality or quantity treatment. Final stormwater design and culvert analysis cannot be completed at this stage of design and the estimated limits are conservative. To prevent unnecessary clearing and impacts, these improved stormwater and storage areas have been excluded from the LOD and included in LOI linework on the JPA impact plates. In LOI areas, USACE and MDE approval of stormwater treatment modifications and permit authorization is required prior to conducting any clearing or construction.

Detailed impacts to nontidal wetlands, their buffers, and waterways from the Preferred Alternative LOD are included in **Appendix A. Table 2-7** to **Table 2-14**[10] summarize the impacts to wetlands and waterways in square feet (SF), linear feet (LF), or acres (AC), by classification in total, by county, by federal USGS 8-digit hydrologic unit code (HUC), by Maryland 8-digit, and by MD 12-digit watersheds. The impact numbers presented are the total impacts for the project and do not represent either the total USACE or total MDE impacts, due to jurisdictional differences. The MD 12-digit watershed that will be least impacted is Rock Creek (021402060836), with no proposed temporary and approximately 400 linear feet of permanent impact to waterways, and no proposed temporary or permanent impacts to wetlands. The MD 12-digit watershed that will incur the most impact would be Cabin John Creek (021402070841), with more than 90 LF of proposed

[5] For reference, impact tables presented in the report are also included in Appendix A.

temporary and more than 30,000 LF of proposed permanent impact to waterways, and 0.01 acres of proposed temporary and more than 1 acre of proposed permanent impact to wetlands.

Impacts to these features along with their functions and values are summarized for each NPS property by Cowardin classification in **Appendix I** and the SDEIS, Appendix G, Draft SOF. A final signed SOF will be attached to the ROD as a separate document.

Table 2-7. Summary of Impacts to Wetlands and Waterways by Classification

Type	Classification	Permanent		Temporary		Total	
		AC	SF	AC	SF	AC	SF
Wetlands	PEM	2.64	115,107	0.15	6,273	2.79	121,380
	PFO	0.86	37,346	0.27	11,832	1.13	49,178
	PSS	0.01	481	0.00	0	0.01	481
	Grand Total	**3.51**	**152,934**	**0.42**	**18,105**	**3.93**	**171,039**
Waterways		LF	SF	LF	SF	LF	SF
		Permanent		Temporary		Total	
	Ephemeral	1,334	6,225	11	65	1,345	6,290
	Intermittent	11,551	94,158	1,226	8,386	12,777	102,544
	Perennial	27,048	536,697	1,116	314,685	28,164	851,382
	Grand Total	**39,933**	**637,080**	**2,353**	**323,136**	**42,286**	**960,216**

Table 2-8. Summary of Impacts to Wetland Buffers by Classification

Classification	AC	SF	AC	SF	AC	SF
	Permanent		Temporary		Total	
PEM	3.36	146,183	0.16	6,908	3.52	153,091
PFO	2.79	121,535	0.08	3,455	2.87	124,990
PSS	0.11	4,841	0.00	0	0.11	4,841
Grand Total	**6.26**	**272,559**	**0.24**	**10,363**	**6.50**	**282,922**

Table 2-9. Summary of Impacts to Wetlands and Waterways by Classification within Virginia and Maryland Counties

Type	Classification	Permanent AC	Permanent SF	Temporary AC	Temporary SF	Total AC	Total SF
Wetlands	**Fairfax**	**0.00**	**0**	**0.05**	**2,166**	**0.05**	**2,166**
	PFO	0.00	0	0.05	2,166	0.05	2,166
	Montgomery	**3.51**	**152,934**	**0.37**	**15,939**	**3.88**	**168,873**
	PEM	2.64	115,107	0.15	6,273	2.79	121,380
	PFO	0.86	37,346	0.22	9,666	1.08	47,012
	PSS	0.01	481	0.00	0	0.01	481
	Grand Total	**3.51**	**152,934**	**0.42**	**18,105**	**3.93**	**171,039**
Waterways		**Permanent LF**	**Permanent SF**	**Temporary LF**	**Temporary SF**	**Total LF**	**Total SF**
	Fairfax	**897**	**14,387**	**47**	**455**	**944**	**14,842**
	Ephemeral	26	358	5	31	31	389
	Intermittent	871	14,029	42	424	913	14,453
	Perennial	0	0	0	0	0	0
	Montgomery	**39,036**	**622,693**	**2,306**	**322,681**	**41,342**	**945,374**
	Ephemeral	1,308	5,867	6	34	1,314	5,901
	Intermittent	10,680	80,129	1,184	7,962	11,864	88,091
	Perennial	27,048	536,697	1,116	314,685	28,164	851,382
	Grand Total	**39,933**	**637,080**	**2,353**	**323,136**	**42,286**	**960,216**

NOTES: 1. All wetland buffers are in Montgomery County, MD, since Virginia does not regulate wetland buffers.

Table 2-10. Summary of Impacts to Waterways by Classification within USGS HUC8 Watersheds

Watershed Number and Classification	Permanent LF	Permanent SF	Temporary LF	Temporary SF	Total LF	Total SF
Middle Potomac-Catoctin (02070008)	**39,526**	**633,199**	**2,353**	**323,136**	**41,879**	**956,335**
Ephemeral	1,334	6,225	11	65	1,345	6,290
Intermittent	11,347	93,523	1,226	8,386	12,573	101,909
Perennial	26,845	533,451	1,116	314,685	27,961	848,136
Middle Potomac-Catoctin-Occaquan (02070010)	**407**	**3,881**	**0**	**0**	**407**	**3,881**
Intermittent	204	635	0	0	204	635
Perennial	203	3,246	0	0	203	3,246
Grand Total	**39,933**	**637,080**	**2,353**	**323,136**	**42,286**	**960,216**

NOTES: 1. All wetland buffers are in Montgomery County, MD, and all wetlands are within the Middle Potomac-Catoctin (02070008) HUC8 watershed.

Table 2-11. Summary of Impacts to Wetlands and Waterways by Classification within MD 8-Digit Watersheds

Type	Watershed Number and Classification	AC	SF	AC	SF	AC	SF
		Permanent		Temporary		Total	
Wetlands	**Potomac River - Montgomery County (02140202)**	**2.20**	**95,980**	**0.36**	**15,582**	**2.56**	**111,562**
	PEM	1.64	71,455	0.14	5,916	1.78	77,371
	PFO	0.55	24,044	0.22	9,666	0.77	33,710
	PSS	0.01	481	0.00	0	0.01	481
	Cabin John Creek (02140207)	**1.31**	**56,954**	**0.01**	**357**	**1.32**	**57,311**
	PEM	1.00	43,652	0.01	357	1.01	44,009
	PFO	0.31	13,302	0.00	0	0.31	13,302
	Grand Total	**3.51**	**152,934**	**0.37**	**15,939**	**3.88**	**168,873**
Waterways		**LF**	**SF**	**LF**	**SF**	**LF**	**SF**
		Permanent		**Temporary**		**Total**	
	Potomac River - Montgomery County (02140202)	**8,024**	**143,436**	**2,208**	**319,484**	**10,232**	**462,920**
	Ephemeral	174	604	0	0	174	604
	Intermittent	4,136	40,852	1,174	7,884	5,310	48,736
	Perennial	3,714	101,980	1,034	311,600	4,748	413,580
	Rock Creek (02140206)	**407**	**3,881**	**0**	**0**	**407**	**3,881**
	Intermittent	204	635	0	0	204	635
	Perennial	203	3,246	0	0	203	3,246
	Cabin John Creek (02140207)	**30,605**	**475,376**	**98**	**3,197**	**30,703**	**478,573**
	Ephemeral	1,134	5,263	6	34	1,140	5,297
	Intermittent	6,340	38,642	10	78	6,350	38,720
	Perennial	23,131	431,471	82	3,085	23,213	434,556
	Grand Total	**39,036**	**622,693**	**2,306**	**322,681**	**41,342**	**945,374**

Table 2-12. Summary of Impacts to Wetland Buffers by Classification within MD 8-Digit Watersheds

Watershed Number and Classification	AC	SF	AC	SF	AC	SF
	Permanent		Temporary		Total	
Potomac River - Montgomery County (02140202)	**2.70**	**117,522**	**0.24**	**10,265**	**2.94**	**127,787**
PEM	1.12	48,599	0.16	6,810	1.28	55,409
PFO	1.47	64,082	0.08	3,455	1.55	67,537
PSS	0.11	4,841	0.00	0	0.11	4,841
Cabin John Creek (02140207)	**3.56**	**155,037**	**0.00**	**98**	**3.56**	**155,135**
PEM	2.24	97,584	0.00	98	2.24	97,682
PFO	1.32	57,453	0.00	0	1.32	57,453
Grand Total	**6.26**	**272,559**	**0.24**	**10,363**	**6.50**	**282,922**

Table 2-13. Summary of Impacts to Wetlands and Waters by Classification within MD 12-Digit Watersheds

MDNR Watershed Number and Classification	AC/LF	SF	AC/LF	SF	AC/LF	SF
	Permanent		Temporary		Total	
Potomac River/Rock Run (021402020845)						
Waterway	**1,538**	**34,478**	**2,208**	**319,484**	**3,746**	**353,962**
Ephemeral	126	364	0	0	126	364
Intermittent	886	6,034	1,174	7,884	2,060	13,918
Perennial	526	28,080	1,034	311,600	1,560	339,680
Wetland	**0.26**	**11,368**	**0.36**	**15,508**	**0.62**	**26,876**
PEM	0.14	6,127	0.14	5,842	0.28	11,969
PFO	0.12	5,241	0.22	9,666	0.34	14,907
Watts Branch (021402020846)						
Waterway	**4,295**	**73,410**	**0**	**0**	**4,295**	**73,410**
Ephemeral	48	240	0	0	48	240
Intermittent	2,637	29,268	0	0	2,637	29,268
Perennial	1,610	43,902	0	0	1,610	43,902
Wetland	**1.94**	**84,612**	**0**	**74**	**1.94**	**84,686**
PEM	1.50	65,328	0	74	1.50	65,402
PFO	0.43	18,803	0	0	0.43	18,803
PSS	0.01	481	0	0	0.01	481
Muddy Branch (021402020848)						
Waterway	**2,180**	**35,479**	**0**	**0**	**2,180**	**35,479**
Intermittent	602	5,481	0	0	602	5,481
Perennial	1,578	29,998	0	0	1,578	29,998
Rock Creek (021402060836)						
Waterway	**407**	**3,881**	**0**	**0**	**407**	**3,881**
Intermittent	204	635	0	0	204	635
Perennial	203	3,246	0	0	203	3,246
Cabin John Creek (021402070841)						
Waterway	**30,616**	**475,445**	**98**	**3,197**	**30,714**	**478,642**
Ephemeral	1,134	5,263	6	34	1,140	5,297
Intermittent	6,351	38,711	10	78	6,361	38,789
Perennial	23,131	431,471	82	3,085	23,213	434,556
Wetland	**1.31**	**56,954**	**0.01**	**357**	**1.32**	**57,311**
PEM	1.00	43,652	0.01	357	1.01	44,009
PFO	0.31	13,302	0.00	0	0.31	13,302
Grand Total Waterways	**39,036**	**622,693**	**2,306**	**322,681**	**41,342**	**945,374**
Grand Total Wetlands	**3.51**	**152,934**	**0.37**	**15,939**	**3.88**	**168,873**

Table 2-14. Summary of Impacts to Wetland Buffers by Classification within MD 12-Digit Watersheds

MDNR Watershed Number and Classification	AC	SF	AC	SF	AC	SF
	Permanent		Temporary		Total	
Potomac River/Rock Run (021402020845)	**1.03**	**44,998**	**0.22**	**9,306**	**1.25**	**54,304**
PEM	0.43	18,858	0.14	5,851	0.57	24,709
PFO	0.60	26,140	0.08	3,455	0.68	29,595
Watts Branch (021402020846)	**1.67**	**72,524**	**0.02**	**959**	**1.69**	**73,483**
PEM	0.69	29,741	0.02	959	0.71	30,700
PFO	0.87	37,942	0.00	0	0.87	37,942
PSS	0.11	4,841	0.00	0	0.11	4,841
Cabin John Creek (021402070841)	**3.56**	**155,037**	**0.00**	**98**	**3.56**	**155,135**
PEM	2.24	97,584	0.00	98	2.24	97,682
PFO	1.32	57,453	0.00	0	1.32	57,453
Grand Total	**6.26**	**272,559**	**0.24**	**10,363**	**6.50**	**282,922**

2.3.4 Avoidance, Minimization, and Mitigation

A. Avoidance and Minimization

Wetland and stream impacts from the Preferred Alternative LOD are unavoidable. The area within the Preferred Alternative LOD is characterized by an extensive network of streams and wetlands that are located adjacent to and flow beneath the existing roadway, resulting in unavoidable impacts to these resources with roadway modification and/or widening. However, efforts to avoid and minimize impacts have occurred throughout the planning process and would continue during more detailed phases of project design.

Avoidance and minimization efforts to reduce impacts to Waters of the US, including wetlands, involve a two-tiered approach. The first tier occurred during the planning stage of the study, where every reasonable effort was made to avoid wetlands and waterways to the maximum extent practicable. Agency recommendations for avoidance and minimization were evaluated and implemented wherever practicable. Permit conditions requiring avoidance of features would be included in the Nontidal Wetlands and Waterways Permit issued by MDE, and Department of the Army authorization issued by USACE under Section 404. Efforts to avoid and minimize direct impacts to stream channels and wetlands to date have included alignment shifts, alteration of SWM swales, addition of retaining walls, and revision of preliminary SWM and sound wall locations to avoid streams and wetlands. The Avoidance, Minimization, and Impacts Report (AMR) discusses avoidance and minimization efforts during the NEPA process in detail, including targeted avoidance and minimization areas. The AMR is a supporting document of the JPA and an appendix to the MLS FEIS. MDOT SHA is committed to continuing efforts to maximize avoidance and minimization where practicable.

The second tier of avoidance and minimization occurred at the public-private partnership (P3) design stage, with advancement of the design and further refinements to the limits of disturbance (LOD). The P3 Developer reduced impacts to wetlands and streams wherever practicable and their design was incorporated into the

FEIS LOD. Impacts to wetlands and waterways will continue to be reduced wherever practicable as design is refined and finalized. The Developer will continue to look for opportunities to avoid and minimize impacts throughout the remainder of the design process to the greatest extent practicable. Monetary incentives have been added to the Section Developer's Technical Provisions to encourage further avoidance and minimization of impacts to wetlands and waterways.

Impacts to several waterways, wetlands and wetland buffers were reduced following public and agency comments received during the DEIS public comment period. All sound wall locations were reviewed and revised, as needed, to avoid impacts to wetlands and waterways. MDOT SHA and FHWA coordinated closely with M-NCPPC in a series of office and field meetings to avoid and minimize impacts to wetlands and waterways within all M-NCPPC parks located within the Preferred Alternative LOD. The most significant avoidance and minimization focus area since the DEIS is the area surrounding the American Legion Bridge.

American Legion Bridge Strike Team Avoidance and Minimization

MDOT SHA and Federal Highway Administration met with the NPS on December 8, 2020, to discuss the LOD in the vicinity of the American Legion Bridge that was presented in the MLS DEIS. The NPS requested that MDOT SHA re-assess the LOD in the vicinity of the ALB to limit impacts to NPS land and its natural resources. MDOT SHA convened an 'ALB Strike Team' composed of national and local experts on bridge design, natural resources, and cultural resources who were charged with the following mission:

To develop and evaluate alternatives for the replacement of the ALB to avoid impacts, to the greatest extent practicable, and reduce overall acreage impacts to the Chesapeake and Ohio Canal National Historic Park (CHOH) and GWMP units of the NPS.

The ALB Strike Team conducted an intensive investigation in January 2021 to explore alternative design solutions, project phasing solutions, site access solutions, and the potential use of specialty construction techniques to limit the LOD. The ALB Strike Team presented its results to the NPS on February 8, 2021.

MDOT SHA established the Base LOD as the "Base Option," which includes a conventionally constructed bridge structure built in two phases on the existing bridge centerline with the assumption of temporary construction access over the Potomac River via trestles and causeways. This Base Option included minor LOD reductions from the DEIS LOD to minimize impacts to Plummers Island. The Base Option also started with construction access in all four quadrants and was minimized to remove the construction access in the southwest, southeast, and northeast quadrants, which significantly reduced impacts to NPS property.

The ALB Strike Team first reviewed the avoidance and minimization options developed by MDOT SHA to date, and agreed that these options were not practicable, except perhaps the top-down construction option, which they investigated in further detail. The Strike Team then reviewed the viability of the Base Option and confirmed that this on-center alignment with a conventional construction approach was a viable option. The ALB Strike Team also considered a "west shift" of the LOD to entirely avoid impacts to Plummers Island and determined that a conventional construction approach with a west shift was also a viable option.

The ALB Strike Team then considered other bridge construction approaches to determine if any of them could limit the LOD further than the Base Option could. The Strike Team conducted detailed investigation on a top-down segmental construction approach; a top-down cable stayed approach; and a slide-in place bridge construction approach.

After field analysis and known information review, MDOT SHA and the ALB Strike Team determined that access to the site at river level could be consolidated to the north side of the river along CBP, eliminating the construction access from the other three quadrants around the bridge and significantly reducing impacts to NPS land. This would be achieved by constructing a temporary construction access road entrance off of the Clara Barton Parkway in the northwest quadrant and installing a temporary bridge over the Chesapeake and Ohio Canal and a temporary haul road paralleling the Chesapeake and Ohio Canal towpath.

MDOT SHA determined the LOD options for the ALB based on the results of the ALB Strike Team investigations. The bridge construction types with the smallest LOD footprint were the Base Option and the Cast-In-Place Segmental Option, both with a similar LOD requirement. Both construction types could be built with an on-center alignment or a west-shift alignment. MDOT SHA compared the NPS land impacts and those of the natural and cultural resources surrounding the ALB and determined that the on-center alignment would impact the least amount of total NPS Land; would not require re-configuration of the CBP interchange; and would not require residential displacement, as the west shift alignment would. For these reasons, the on-center alignment with the reduced LOD required by the Base Option or Cast-In-Place Segmental bridge types was incorporated into the Preferred Alternative LOD.

Avoidance and minimization was coordinated closely with the NPS in the vicinity of the ALB. The NPS requires that a wetland and floodplain SOF be prepared in accordance with the Procedural Manual #77-1: Wetland Protection (NPS, 2016) during the NEPA process, documenting compliance with Director's Orders #77-1 and #77-2 for proposed actions that would result in adverse impacts to wetlands and floodplains. The NPS SOF characterizes the wetland and floodplain resources that may be adversely impacted within NPS managed lands as a result of implementing the Preferred Alternative LOD, describes adverse impacts that the project would likely have on these resources, and documents the steps that have been taken to avoid, minimize, and offset these impacts.

B. Screened Alternatives and Avoidance and Minimization Steps

A LOD was established for each Screened Alternative. Refer to the DEIS, Appendix L, Section 2.3.4.B for details regarding the Screened Alternatives LOD determination process and general avoidance and minimization protocols of natural resource features.

C. Mitigation

As part of the permitting process, a detailed Final Compensatory Wetlands and Waterways Mitigation Plan (CMP), including final nontidal wetlands and waterways mitigation design, has been developed and will require approval by the USACE and MDE prior to permit issuance. All nontidal wetlands and waterways mitigation measures employed to compensate for unavoidable project impacts to Waters of the US or Waters of the State would follow the federal Compensatory Mitigation Rule (33 CFR Parts 325 and 40 CFR Part 230), and other state nontidal wetlands and waterways compensatory mitigation guidelines, as well as other recommendations from federal and state resource agencies. When practicable measures have been taken to avoid and minimize impacts to aquatic resources, mitigation may be required in the form of establishment/creation, enhancement, or preservation to replace the loss of wetland, stream, and/or other aquatic resource functions. Nontidal wetlands and waterways mitigation options under both the federal Compensatory Mitigation Rule and state mitigation guidelines would follow a watershed approach.

For further information regarding the nontidal wetlands and waterways compensatory mitigation process, refer to the DEIS, Appendix L, Section 2.3.4.C.

In Maryland, nontidal wetland mitigation requirements were developed based on MDE's *Maryland Nontidal Wetland Mitigation Guidance, Second Edition January 2011*. The MDE guidelines include standard replacement ratios based on the wetland type (e.g., emergent, forested, etc.) being impacted. Waterway (stream) mitigation requirements in Maryland were determined based on the USACE's *Maryland Stream Mitigation Framework Calculator Beta Version May 11, 2020* (MSMF). The MSMF is a new method that was developed primarily as a tool for the USACE in Maryland to promote minimization and avoidance of impacts to streams and provide an accounting tool when unavoidable impacts occur and must be mitigated, with the goal of achieving "no net loss." The new method provides a consistent and transparent process for stream impacts and mitigation quantification based on resource type, reach length, stream quality, drainage area, site sensitivity, and several other input values, resulting in a stream mitigation requirement that is recorded in functional feet. While all streams within the permanent LOD are considered impacted, they are not all filled or placed in culverts. Some streams will be relocated or altered as part of the Preferred Alternative. A conservative assessment of the final condition of each stream considered permanently impacted was used to determine the stream quality after construction in the MSMF.

Based on the Preferred Alternative impacts, the current mitigation requirement estimate in Maryland includes 4.38 acres of wetland mitigation credits and 7,511 functional feet of stream credits. No mitigation bank credits, or in-lieu fee programs were identified in Maryland when MDOT SHA initiated the project in 2018, and therefore MDOT SHA decided to pursue permittee-responsible nontidal wetlands and waterways mitigation for the requirements. For further details on the permittee-responsible nontidal wetlands and waterways mitigation site selection process refers to the Final Compensatory Wetlands and Waterways Mitigation Plan (CMP) (FEIS, Appendix O).

Off-site nontidal wetland and waterway compensatory mitigation in Maryland consists of two permittee-provided mitigation sites including a total of 4.61 acres of potential wetland mitigation credits and 6,304 functional feet of potential stream mitigation credits. The remaining required stream mitigation credits will be provided by purchasing credits from a mitigation bank that will have an initial credit release in the fall of 2022. Details on the Preferred Alternative impacts, nontidal wetland and waterway mitigation requirements, proposed mitigation sites, and Phase II mitigation plans will be included in the Final CMP.

Based on the Preferred Alternative impacts, in Virginia, wetland mitigation requirements were determined based on replacement ratios in the Virginia Administrative Code (9VAC25-680-70), and stream mitigation requirements were developed based on the USACE's *Unified Stream Methodology for use in Virginia, January 2007*. Privately-owned mitigation banks will be used to fulfill the current mitigation requirement estimate of 472 riverine mitigation credits in the Fairfax County Middle Potomac-Catoctin watershed. There are no permanent wetland impacts requiring mitigation in Virginia. MDOT SHA has identified specific mitigation bankers and confirmed credit availability in the Final CMP.

There will be temporary and some permanent wetlands and waterways impacts associated with the Section 404 nontidal wetland and waterway compensatory mitigation sites. However, these impacts will be compensated for onsite, since the mitigation site will result in overall function and value uplift.

NPS requires avoidance, minimization, and compensation for unavoidable adverse impacts to NPS wetlands via restoration of degraded wetlands on NPS property at a minimum of a 1:1 restoration/replacement ratio that can be adjusted upward to ensure functional replacement. NPS requires that a wetland SOF be prepared in accordance with the Procedural Manual #77-1: Wetland Protection (NPS, 2016) during NEPA documenting compliance with D.O. #77-1 for proposed actions that would result in adverse impacts to wetlands. A Draft SOF was included in the SDEIS, Appendix G, and a final signed SOF will be attached to the ROD as a separate document.

The current NPS wetland mitigation requirement estimate includes a total of 0.90 acres of NPS wetland mitigation based on the functional impact replacement ratios that are described in the Final SOF. MDOT SHA worked with NPS to identify one mitigation site (CHOH-13) that includes approximately 1.49 acres of potential wetland mitigation. The site was identified in the NPS *Environmental Assessment (EA) for the Wetland Restoration Action Plan (WRAP) for Catoctin Mountain Park, Chesapeake & Ohio Canal National Historical Park, Harpers Ferry National Historical Park, Monocacy National Battlefield, April 2017* and is considered a high priority site due to its location within one of the NPS wetlands being impacted by the project. The CHOH-13 mitigation site is not included in the proposed MDE and USACE mitigation credit totals and has been identified for the sole purpose of fulfilling the NPS mitigation requirement. A concept design of the proposed mitigation site is included in the draft SOF (SDEIS, Appendix G) and will also be included in the Final SOF.

2.4 Watersheds and Surface Water Quality

2.4.1 Regulatory Context and Methods

A. Surface Waters and Watershed Characteristics

Surface waters include rivers, streams, and open water features such as ponds and lakes. Streams are generally defined as water flowing in a channel with defined bed and bank and an ordinary high water mark. Section 401 and Section 402 of the Federal CWA (33 U.S.C. 1341 and 1342) regulate water quality and the introduction of contaminants to waterbodies. Section 401 of the CWA prohibits any applicant for a federal permit or license "to conduct any activity that may result in any discharge into waters of the United States, unless the State or authorized Tribe where the discharge would originate either issues a Section 401 water quality certification finding compliance with applicable water quality requirements or certification is waived" (40 CFR Part 121). The I-495 & I-270 Managed Lanes Study requires a Section 401 water quality certification from MDE and VDEQ indicating that anticipated discharges from the I-495 & I-270 Managed Lanes Study will comply with state water quality standards. MDE and VDEQ are the regulatory agencies responsible for ensuring adherence to water quality standards in Maryland and Virginia, respectively. In general, the National Pollutant Discharge Elimination System (NPDES) stormwater program requires permits for discharge from construction activities that disturb one or more acres, and discharges from smaller sites that are part of a larger common plan of development. Individual permits for erosion and sediment control approval will be submitted and approved as contract packages are developed.

Under the COMAR: Title 26 Department of the Environment, Subtitle 08 Water Pollution, Chapter 02 Water Quality (26.08.02), the State of Maryland has adopted water quality standards to enhance and protect water resources and serve the purposes of the Federal CWA. Similarly, all of Virginia's surface waters are classified by VDEQ according to designated uses promulgated in Virginia's water quality standards (9VAC 25-260). The water quality standards serve this purpose by designating uses to the waters of the state and setting criteria by which these uses are protected. Water quality in Maryland and Virginia shall be protected and maintained for these "Designated Uses." Coordination with the MDNR Environmental Review Program (ERP) and online research through the MDE and VDEQ websites was conducted to determine designated uses and regulations for the waters crossed by the Phase 1 South portion of the corridor study boundary.

MDE has also designated certain surface waters of the state as Tier II (High Quality) waters, based on monitoring data that documented water quality conditions that exceeded the minimum standard necessary to meet designated uses. In accordance with federal antidegradation regulations (40 CFR 131.12), these waters are afforded additional antidegradation protections to ensure that these high-quality waters are maintained (COMAR 26.08.02.04-1). Impacts to Tier II waters are reviewed by MDE for certain state permits and approvals (including Wetlands and Waterways permits and authorizations), with the purpose of preventing degradation to high quality waters as a result of permitted activities. The review process would identify Tier II impacts associated with the Preferred Alternative, and then determine if there are opportunities to avoid these impacts, as well as potentially requiring additional minimization measures to further protect water quality.

Included in this review is an evaluation of the assimilative capacity of the Tier II waters. Assimilative capacity is defined as the difference between the Tier II water quality of the stream segment at the time it was designated as Tier II and the overall state-wide Tier II water quality listing threshold. Impacts to Tier II waters determined to have no remaining assimilative capacity will trigger additional steps and permit requirements, such as additional Best Management Practices (BMPs) or mitigation, during the review process.

In compliance with CWA Sections 303(d), 305(b), and 314 and the Safe Drinking Water Act (SDWA), states develop a prioritized list of waterbodies that currently do not meet water quality standards. The 303(d) prioritized list includes those waterbodies and watersheds that exhibit levels of impairment requiring further investigation or restoration. MDE and VDEQ use monitoring data to compare stream conditions to water quality standards and determine which streams should be listed. Parameters monitored include: temperature, dissolved oxygen (DO), pH, Escherichia coli (E. coli), enterococci, total phosphorus, chlorophyll a, benthic macroinvertebrates, as well as metals and toxics in the water column, sediments, and fish tissues. The waterbodies on this list may be subject to a total maximum daily load (TMDL) of these constituents under Section 303(d) of the CWA. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Waterbodies can also be listed under Category 5 on the 303(d) list for impairment, which indicates that the waterbody is impaired, does not meet the water quality standard, and that a TMDL is required.

Like all surface waters, surface drinking water supplies are protected under Section 401 and Section 402 of the Federal CWA (33 U.S.C. 1341 and 1342), which regulate water quality and the introduction of contaminants to waterbodies based on designated use classes. Surface drinking water supplies are also protected under the SDWA, which was enacted to protect public health by regulating the nation's public drinking water supply. The SDWA sets enforceable maximum contaminant levels and post-treatment testing requirements that are enforced during water treatment and delivery. It also sets up a framework for source water protection and prevention to provide multiple barriers to pollution of waterways that provide raw water for drinking water use.

Information on surface water resources and water quality within the Phase 1 South portion of the corridor study boundary was primarily gathered from available published sources through background research, online sources, and agency coordination. This review involved consultation with various state and local agencies including MDE, MDNR's Maryland Biological Stream Survey (MBSS), Montgomery County Department of Environmental Protection (MCDEP), VDEQ, and Fairfax County Department of Public Works and Environmental Services (FCDPWES). These agencies and monitoring groups use a broad range of data to assess overall watershed health and condition, including data on chemical water quality, fish and benthic macroinvertebrate communities, aquatic habitat, land use characteristics, riparian buffer conditions, and impervious surface coverage. Data collected on aquatic habitat conditions and fish and benthic macroinvertebrate communities are often used to summarize existing water quality conditions based on an overall narrative rating (e.g., Very Poor, Poor, Fair, Good, etc.), using established methodologies. These methodologies and rating criteria are detailed in **Section 2.9, Aquatic Biota**.

B. Scenic and Wild Rivers

The federal Wild and Scenic Rivers system was created to protect "rivers of the nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values." The system is administered by four lead federal agencies—the Bureau of Land Management (BLM), NPS, US Forest Service (USFS) and US Fish and Wildlife Service (USFWS). "Rivers included in the National System at the request of a governor and designated by the Secretary of the Interior (under Section 2(a)(ii) of the Act) are administered by their respective state(s), with the NPS or another of the three lead agencies making determinations under Section 7 of the Act" (IWSRCC, 2018).

The Maryland Scenic and Wild Rivers Act of 1968 established the Maryland Scenic and Wild Rivers System to preserve and protect the natural values and enhance the water quality of rivers, or segments of rivers, which possess outstanding scenic, geologic, ecologic, historic, recreational, agricultural, fish, wildlife, cultural, and other similar resource values. A Scenic River is a "free-flowing river whose shoreline and related land are predominantly forested, agricultural, grassland, marshland, or swampland with a minimum of development for at least two miles of the river length." A Wild River is a "free-flowing river whose shoreline and related land are undeveloped, inaccessible except by trail, or predominantly primitive in a natural state for at least four miles of the river length" (Md. Code Ann., Nat. Res. § 8-402). The Scenic and Wild Rivers Act mandates the preservation and protection of natural values associated with rivers designated as Scenic and/or Wild. Each unit of state and local government, in recognizing the intent of the Act and the Scenic and Wild Rivers Program, is required to take whatever action is necessary to protect and enhance the qualities of a designated river. Potential effects to scenic and wild rivers are reviewed and coordinated by the MDNR.

The Virginia Scenic Rivers Act of 1970 established the Virginia Scenic Rivers Program with the intent to identify, designate, and help protect rivers and streams that "possess superior natural and scenic beauty, fish and wildlife, and historic, recreational, geologic, cultural, and other assets." River segments are evaluated based on 13 criteria, including water quality, corridor development, recreational access, historic features, natural features, visual appeal, quality of fisheries, and the presence of unique habitats or species. If a waterway qualifies for designation, the Virginia Department of Conservation and Recreation (VDCR) prepares a report including supporting comments by local governments and state agencies. For the designation to take effect, it must be passed by the General Assembly and receive final approval by the governor.

Environmental scientists accessed online information on behalf of MDOT SHA from the National Wild and Scenic River System website, the VDCR Scenic Rivers Program website, and the MDNR Scenic and Wild Rivers Program to determine if any federally designated Wild and Scenic Rivers or state-designated Scenic and Wild Rivers were located within the Phase 1 south portion of the corridor study boundary (IWSRCC, 2018; MDNR, 2018a; VDCR, 2018a). These results are summarized in **Section 2.4.2.B, Scenic and Wild Rivers**.

C. Surface Water Quality

For the purposes of this document, discussions of water chemistry include both in-situ multi-probe sampling and chemical grab sampling. In-situ data are defined as data collected with field measurement techniques such as water quality meters, while chemical grab sampling is defined as sampling in which water samples were collected in the field and transported to a laboratory for detailed analysis.

For Maryland waterways, existing in-situ and chemical water grab sample quality data were gathered from MBSS, MCDEP, MDE, and various other organizations through the National Water Quality Monitoring Council (NWQMC) database. Primary data sources from the NWQMC database include: Chesapeake Bay Program, MDE, MDNR, NPS, and USGS. In general, water quality data collected within 1 mile of the Phase 1 South portion of the corridor study boundary were considered most relevant to characterize existing conditions and are summarized in this report. Available water quality data from 2007 through 2017 were summarized for all Maryland data sources, except for the NWQMC database, which included data collected through August of 2018.

In Maryland, MDE established acceptable standards for several parameters under each designated stream use classification. The Use Class designation for streams within the Maryland portion of the Phase 1 South portion of the corridor study boundary are shown in **Table 2-15** below. All Maryland streams within the Phase 1 South portion of the corridor study boundary are classified as nontidal.

Table 2-15. Maryland COMAR Stream Designated Use Classifications

Use Class	Description	Applicable Watersheds
I	Water Contact Recreation and Protection of Nontidal Warmwater Aquatic Life	All waters within the Rock Creek watershed.
I-P	Water Contact Recreation, Protection of Nontidal Warmwater Aquatic Life, and Public Water Supply	All waters within the Potomac River/Rock Run watershed, Cabin John Creek watershed, Watts Branch watershed, and Muddy Branch watershed.

Source: Maryland COMAR

The Maryland standards for the use classes of streams are listed in COMAR 26.08.02.03-3–Water Quality and are shown in **Table 2-16.** Each parameter measured by in-situ sampling and regulated by the State of Maryland can have an impact on the aquatic communities of streams. In general, data on pH, DO, conductivity, temperature, and turbidity data are collected during in-situ sampling, often as part of biological sampling efforts by state and county monitoring groups.

Table 2-16. Maryland COMAR Stream Use Water Quality Criteria

Parameter	Use I and I-P
Temperature	Maximum of 90°F (32°C) or ambient temperature, whichever is greater
pH	6.5 to 8.5 Standard Units (SU)
Dissolved Oxygen	Minimum of 5 mg/L
Turbidity	Maximum of 150 Nephelometric Turbidity Units (NTU) and maximum monthly average of 50 NTU

Source: Maryland COMAR

Some of the sampled parameters have associated Maryland state and federal standards for the protection of aquatic life. EPA established aggregate reference condition values, based on ecoregions, for total nitrogen and total phosphorus (EPA, 2000). These reference condition values were developed to be used by state agencies as guidelines for developing criteria and have no standalone regulatory importance. Ranges for other parameters indicative of anthropogenic stress were determined for the state by MBSS. These benchmarks developed by MBSS are only used as a management guideline and do not carry the same weight as the regulatory standards set by the state and federal governments. These parameters include ammonia, nitrate, nitrite, phosphorus, and sulfate. These benchmark levels, as well as the state and federal standards and recommendations, are found in **Table 2-17**.

Excess levels of these metals and nutrients have negative effects on fish and macroinvertebrate communities. According to the EPA, acute effects are those that show up in zero to seven days, while chronic effects can take years or lifetimes to be seen. Each of the following parameters was determined to have negative effects by the EPA "Gold Book" of water quality criteria (EPA, 1986).

Table 2-17. Maryland Criteria and Federal Water Quality Recommendations

Parameter Tested	Maryland		EPA Recommendations	
	Acute	Chronic	Acute	Chronic
Ammonia (mg/L)	>0.03*		None	
Alkalinity (mg/L)	None		None	20
Chromium (mg/L)	0.570	0.074	0.570	0.074
Chloride (mg/L)	None		860	230
Copper (mg/L)	0.013	0.009	0.013	0.009
Lead (mg/L)	0.065	0.0025	0.065	0.0025
Nickel (mg/L)	0.470	0.052	0.470	0.052
Selenium (mg/L)	0.020	0.005	None	0.005
Silver (mg/L)	0.0032	None	0.0032	None
Zinc (mg/L)	0.120	0.120	0.120	0.120
Biochemical Oxygen Demand (mg/L)	None		8.41	
Total Suspended Solids (mg/L)	None		None	
Nitrate Nitrogen (mg/L)	>1*		0.89	
Nitrite Nitrogen (mg/L)	>0.0025*		0.01	
Nitrogen (Total) (mg/L)	>1.5*		0.69	
Phosphorus (Total) (mg/L)	>0.025*		0.037	
Orthophosphate (mg/L)	>0.008*		None	

* Threshold level used by MBSS as an indication of anthropogenic stress.

Source: Maryland COMAR regulation 26.08.02.03-2, EPA Ambient Water Quality Criteria Recommendations, 2000, and MBSS 2000-2004 Volume II Ecological Assessment of Streams Sampled in 2001.

For Virginia waterways, existing in-situ and chemical grab sample water quality data were gathered from VDEQ and FCDPWES, as well as from the USGS through the NWQMC database. In general, water quality data collected within 1 mile of the Phase 1 South portion of the corridor study boundary were considered most relevant to characterize existing conditions and are summarized in this report. Available water quality data from 2007 through 2017 were summarized for all Virginia data sources, except for the NWQMC database, which included data collected through March of 2019.

All waters in Virginia are designated for recreational uses; the propagation and growth of a balanced, indigenous population of aquatic life, wildlife; and the production of edible and marketable natural resources. VDEQ established acceptable standards for ambient water quality parameters for seven different classifications of waters (e.g., tidal waters, nontidal waters, natural trout streams) to determine whether a waterbody is attaining the aquatic life use, and these standards are listed in the VAC 9VAC25-260-50–Numerical criteria for dissolved oxygen, pH, and maximum temperature. All Virginia streams within the Phase 1 South portion of the corridor study boundary fall under the nontidal waters classification. The standards for the Virginia nontidal waters in the Phase 1 South portion of the corridor study boundary are shown in **Table 2-18**. In addition to aquatic life protections, Virginia also designated the nontidal waters within the Phase 1 South portion of the corridor study boundary for the protection of public water supply.

Table 2-18. Virginia Stream Class Water Quality Criteria

Class of Waters	Description	Dissolved Oxygen (mg/L)		pH (SU)	Maximum Temperature (C°)
		Min.	Daily Av.		
III	Nontidal Waters	4.0	5.0	6.0-9.0	32

Source: Virginia Administrative Code

Some of the sampled parameters have associated Virginia state and federal standards for the protection of aquatic life. As described above, EPA established aggregate reference condition values, based on ecoregions, for nutrient parameters (EPA, 2000). These reference condition values were developed to be used by state agencies as guidelines for developing criteria and have no standalone regulatory applicability. VDEQ has also established threshold values for other water quality parameters for use as benchmarks in selecting reference sites, which are considered to be least-degraded within the state (VDEQ, 2006). These benchmarks used by VDEQ do not carry the same weight as the regulatory standards set by the state and federal governments but are useful for characterizing relative impairment. These parameters include conductivity, nitrogen, and phosphorus. The benchmark levels, as well as the state and federal standards and recommendations, are found in **Table 2-19.**

Table 2-19. Virginia Criteria and Federal Water Quality Recommendations

Parameter Tested	Virginia	EPA Recommendations
Ammonia (mg/L; varies based on pH)	1.32 – 48.8	None
Conductivity (µS/cm)	250*	None
Nitrate Nitrogen (mg/L)	None	0.89
Nitrite Nitrogen (mg/L)	None	0.01
Nitrogen (Total) (mg/L)	1.5*	0.69
Phosphorus (Total) (mg/L)	0.05*	0.037
Orthophosphate (mg/L)	None	None
E. coli (cfu/100mL; monthly geometric mean)	126	None

* Threshold level used by VDEQ as a cutoff for reference, or least-degraded, stream conditions.

Source: 9VAC25-260 Water Quality Standards, EPA Ambient Water Quality Criteria Recommendations, 2000, and VDEQ 2006 Using Probabilistic Monitoring Data to Validate the Non-Coastal Virginia Stream Condition Index.

2.4.2 Existing Conditions

A. Surface Waters and Watershed Characteristics

Within Virginia, the Phase 1 South portion of the corridor study boundary crosses the Potomac River drainage basin in Fairfax County. More specifically, the Phase 1 South portion of the corridor study boundary crosses the Middle Potomac watersheds, comprised of the Bull Neck Run, Scotts Run, Dead Run, Turkey Run, and Pimmit Run subwatersheds (FCDPWES, 2008). For the purposes of this document, only streams within the Fairfax County Middle Potomac watersheds that cross the Phase 1 South portion of the corridor study boundary are discussed. These subwatersheds include the Scotts Run and Dead Run watersheds. Characteristics of the Fairfax County Middle Potomac watersheds are detailed below and summarized in **Table 2-20**.

Table 2-20. Virginia Watershed Characteristics Summary

Watershed	Drainage Area (Square Miles)	Class	303(d) Impairments Listings	
			Completed TMDL (Category 4a)	TMDL Potentially Needed (Category 5)
Fairfax County Middle Potomac Watersheds	9[1]	III	None	Unknown pollutants in Dead Run (based benthic IBIs)

[1]Drainage area for the Scotts Run and Dead Run subwatersheds

Within Maryland, the Phase 1 South portion of the corridor study boundary crosses the Potomac River drainage basin, and within this basin, the Phase 1 South portion of the corridor study boundary crosses the state-designated Washington Metropolitan watershed (MDE 6-digit watershed), encompassing the Potomac River-Montgomery County, Cabin John Creek, and Rock Creek, subbasins (MD 8-digit watersheds). Each subbasin that crosses the Phase 1 South portion of the corridor study boundary in Maryland contains numerous smaller watersheds (MD 12-digit). For the purposes of this document, only streams with watersheds that cross the Phase 1 South portion of the corridor study boundary are discussed. These watersheds include Potomac River/Rock Run, Cabin John Creek, Rock Creek, Watts Branch, and Muddy Branch. Characteristics of Maryland watersheds are detailed below and summarized in **Table 2-21**. Watershed locations are shown in **Appendix K**.

The Potomac River is classified as Use I-P and is protected for Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply due to its role as the primary source of drinking water for the District of Columbia, and many of the surrounding communities. The Washington Aqueduct, which is operated by the U.S. Army Corps of Engineers, withdraws and treats approximately 150 million gallons of water per day on average from the Potomac River to provide drinking water to the District of Columbia, as well as Fairfax and Arlington Counties, Virginia. The Aqueduct's primary water intake is located above Great Falls, several miles upstream of the Preferred Alternative's crossing of the Potomac on the American Legion Bridge. However, the Aqueduct system also has an intake at the dam at Little Falls, approximately 3 miles downstream of the Preferred Alternative, and is used intermittently for drinking water supplies according to the National Pollution Discharge Elimination System (NPDES) permit for the Aqueduct (NPDES Permit No. DC0000019). In addition, the Preferred Alternative crosses the Source Water Protection Area for the Aqueduct and the delineated Community Water System Areas for the City of Rockville and Washington Suburban and Sanitary Commission. Delineated as the entire watershed upstream of the water intake point, the Community Water System Areas largely mirror the Source Water Protection Area for the Aqueduct. Within the Preferred Alternative, the Source Water Protection Area includes the river itself and the landward area on either side of the river to the watershed boundary, but overall encompasses the entire Potomac River watershed in Maryland and Virginia.

Table 2-21. Watershed Characteristics Summary

MD Watershed		MD Watershed	Drainage Area (Square Miles)	Designated Use	303(d) Impairments Listings	
6-digit Name	8-digit Name	12-digit Name (Number)[1]			Completed TMDL (Category 4a)	TMDL Potentially Needed (Category 5)
Potomac River – Washington Metropolitan	Potomac River – Montgomery County	Potomac River/Rock Run (021402020845)	15	I-P	Total suspended solids	Chlorides and sulfates in first through fourth order streams; pH[2] and polychlorinated biphenyls in fish tissue in the Potomac River mainstem
	Cabin John Creek	Cabin John Creek (021402070841)	26	I-P	Total suspended solids; Escherichia coli	Chlorides; sulfates
	Rock Creek	Rock Creek (021402060836)	18	I	Total suspended solids; phosphorus; Enterococcus	None
	Potomac River – Montgomery County	Watts Branch (021402020846)	22	I-P	Total suspended solids	Chlorides and sulfates in first through fourth order streams
		Muddy Branch (021402020848)	20	I-P; III-P[3]	Total suspended solids	Chlorides and sulfates in first through fourth order streams

[1] 12-digit watersheds are listed by their location relative to the Phase 1 South portion of the corridor study boundary from west to east along I-495 and south to north along I-270.
[2] The Category 5 impairment listing for high pH is based on data collected well upstream of the 12-digit Potomac River/Rock Run watershed.
[3] The only portion of the 12-digit Muddy Branch watershed that contains Use III-P waters is located near Blockhouse Point Conservation Park and does not receive drainage from the Phase 1 South portion of the corridor study boundary.

Sources: MDE, 2018a; MDE, 2018b

a. Fairfax County Middle Potomac Watersheds

The Fairfax County Middle Potomac watersheds drain approximately 26 square miles in Fairfax County, Virginia and are comprised of the Bull Neck Run, Scotts Run, Dead Run, Turkey Run, and Pimmit Run subwatersheds (FCDPWES, 2008). The Scotts Run and Dead Run subwatersheds are crossed by the Phase 1 South portion of the corridor study boundary. Within Virginia, the majority of the Phase 1 South portion of the corridor study boundary crosses the Scotts Run subwatershed, which drains the I-495 corridor from Leesburg Pike to the Potomac River. A small section of the Phase 1 South portion of the corridor study boundary, just north of Georgetown Pike, crosses the Dead Run subwatershed to the east. Characteristics of these two Fairfax County Middle Potomac watersheds are summarized in **Table 2-20**.

The Scotts Run subwatershed drains approximately 6 square miles, with its headwaters beginning slightly outside of the Phase 1 South portion of the corridor study boundary in Tysons Corner (FCDPWES, 2008). Flowing northeast, the Scotts Run mainstem parallels I-495 and gradually turns north to intersect Georgetown Pike, eventually joining the Potomac River on the western side of Scott's Run Nature Preserve. The subwatershed is 25 percent impervious, and 9 percent of the land use is vacant/undeveloped (USGS, 2019). Dominant land uses include residential, open space/parks/recreational areas, road ROWs, and commercial. The 2008 Fairfax County Middle Potomac Watersheds Management Plan describes the majority of the in-stream habitat quality in the Scotts Run subwatershed as Fair. Scotts Run was also noted as having inadequate riparian buffers that are less than 100 feet wide or with non-native, non-diversified, or insufficient vegetation. Several unnamed tributaries drain directly into the Potomac River between the Scotts Run mainstem and I-495. These tributaries drain approximately 1 square mile within the Scotts Run Nature Preserve, bound by Georgetown Pike to the south and I-495 to the east. For these unnamed Potomac River direct tributaries, the land use is 46 percent open space/parks/recreational areas, with other dominant land uses including residential, commercial, and vacant/undeveloped (FCDPWES, 2008).

The Dead Run subwatershed drains an area of approximately 3 square miles, entirely to the east of the I-495 corridor (FCDPWES, 2008). The headwaters begin just upstream of McLean Central Park, north of the intersection of Dolley Madison Boulevard and Old Dominion Drive. The Dead Run mainstem flows north, intersecting Georgetown Pike and George Washington Memorial Parkway and joining the Potomac River to the east of I-495. The Dead Run subwatershed is 25 percent impervious and 3 percent vacant/undeveloped. Dominant land uses include open space/parks/recreational areas, residential, commercial, and road right-of-way. The 2008 Fairfax County Middle Potomac Watersheds Management Plan describes the majority of the habitat quality in the Dead Run subwatershed as Fair, while having inadequate riparian buffers that are less than 100 feet wide or with non-native, non-diversified, or insufficient vegetation.

Within the vicinity of the Phase 1 South portion of the corridor study boundary, all streams in the Fairfax County Middle Potomac watersheds are designated as Class III waters (nontidal waters). In addition to aquatic life protections, Virginia has also designated the waters within the vicinity of the Phase 1 South portion of the corridor study boundary for the protection of public water supply. There are no completed TMDLs for the Fairfax County Middle Potomac watersheds within the vicinity of the Phase 1 South portion of the corridor study boundary, but Dead Run has a Category 5 impairment listing for aquatic life based on benthic macroinvertebrate bioassessments (VDEQ, 2016).

b. Potomac River/Rock Run

The Potomac River/Rock Run watershed (MD 12-digit: 021402020845), hereafter referred to as Rock Run, is located within the Piedmont Plateau physiographic province, within and extending south of Potomac, Maryland. The Phase 1 South portion of the corridor study boundary crosses the Rock Run watershed from the Potomac River to just east of Seven Locks Road. The MD 12-digit watershed drains an area of 15 square miles, entirely within Montgomery County (MDE, 2018b). Within the vicinity of the Phase 1 South portion of the corridor study boundary, Rock Run and several unnamed tributaries drain into the Chesapeake and Ohio Canal or directly into the Potomac River near the head of tide.

Near the headwaters of the Rock Run watershed is a major commercial area, Potomac Village, and the rest of the watershed is dominated by low-density, large-lot residential development and steep, wooded stream valleys (M-NCPPC, 2002). Impervious surfaces, primarily roads and rooftops, comprise approximately 11 percent of the Rock Run watershed, and are mostly located along the Potomac River south of Great Falls, Maryland, and within the Avenel Farm in Potomac, Maryland (MCDEP, 2011). The watershed is 38 percent forested with much of the contiguous forest cover located within public parks or along waterways (MCDEP, 2011; M-NCPPC, 2002). As of 2011, at least 60 percent of the Rock Run watershed had a minimum riparian buffer of 100 feet; however, only a small portion is protected by park land (MCDEP, 2011; M-NCPPC, 2002).

Aquatic habitat within the Rock Run watershed is generally Good due to forested stream valleys and relatively recent development (MCDEP, 2011). Despite generally Good habitat, a 2011 MCDEP report indicated that fish and benthic macroinvertebrate communities were generally Fair or Poor (MCDEP, 2011). While the Rock Run watershed is predominantly residential land use, historic land uses were associated with gold-mining practices. Legacy sediments from this historic land use and runoff from recent development have resulted in impaired stream conditions (MCDEP, 2011).

All Rock Run watershed streams in the vicinity of the Phase 1 South portion of the corridor study boundary are classified as Use I-P (water contact recreation, protection of aquatic life, and public water supply). As part of the greater Potomac River-Montgomery County watershed, the Rock Run watershed currently has a TMDL for total suspended solids and Category 5 impairment listings for chlorides and sulfates in first through fourth order streams and for polychlorinated biphenyls in fish tissue in the Potomac River mainstem. Upstream of the 12-digit Rock Run watershed, the Potomac River Montgomery County watershed also has a Category 5 listing for high pH on the Potomac River mainstem (MDE, 2018a).

c. Cabin John Creek

The Cabin John Creek watershed (MD 12-digit: 021402070841) runs parallel to the Phase 1 South portion of the corridor study boundary, with its headwaters beginning just south of MD 28 and continuing until it joins the Potomac River at the intersection of Cabin John Parkway and Clara Barton Parkway. The MD 12-digit Cabin John Creek watershed drains approximately 26 square miles, entirely within Montgomery County (MDE, 2018b). Of the major tributaries to Cabin John Creek, Bogley Branch, Old Farm Creek, Thomas Branch, and Booze Creek flow within the vicinity of the Phase 1 South portion of the corridor study boundary.

Because of its proximity to the Phase 1 South portion of the corridor study boundary, land use within the Cabin John Creek watershed has been subject to urban development and is comprised of approximately 21 percent impervious surfaces. Over 70 percent of the land cover is residential, followed by 13 percent municipal/institutional, and seven percent roadway (MCDEP, 2012a). Due to the presence of Montgomery County's stream valley park system, some riparian zone protection exists throughout the watershed, but only five percent of the land cover is considered forest (MCDEP, 2012a).

The mainstem of Thomas Branch was assessed and delineated from River Road to just North of Democracy Boulevard. The headwaters of the stream is located outside of the Phase 1 South portion of the corridor study boundary, northeast of the Democracy Boulevard and I-270 interchange. Thomas Branch is a highly-restricted stream system confined by concrete trapezoidal channels; bedrock; sheet pile soundwalls; high, steep valley walls; and residential development. I-495 was constructed in the center of the narrow, steep-sided Thomas Branch stream valley and a large portion of the stream was relocated to build the current alignment of I-495. The majority of Thomas Branch is characterized by a high level of bank erosion where the banks are not armored; a shallow, wide channel incised in some areas with sheer 15-foot banks; bedrock blockages to aquatic life passage; little instream habitat; low head dams; concrete trapezoidal channels, integrated concrete weirs, and riprap; and sheet pile walls abutting the stream or at the top of its banks.

Inorganic pollutants are present in roughly 95 percent of the Cabin John Creek stream miles and have led to the degradation of the watershed's biological communities (MDE, 2012a). With respect to stream resources, around 83 percent of the stream miles in the Cabin John Creek watershed were assessed as Fair, and the remaining 17 percent were assessed as Poor (MCDEP, 2012a). All Poor stream resource conditions were found in the Booze Creek and Thomas Branch subwatersheds, in the vicinity of the Phase 1 South portion of the corridor study boundary. Other anthropogenic influences, such as channelization and flow/sediment impacts, have led to degraded water quality and current TMDL impairments. Over half of the degraded stream miles in the Cabin John Creek watershed are channelized (MDE, 2012a).

All streams within the Cabin John Creek watershed are classified as Use I-P waters (MDE, 2012a). Cabin John Creek currently has TMDLs for total suspended solids and Escherichia coli concentrations, and Category 5 impairment listings for chlorides and sulfates (MDE, 2018a).

d. Rock Creek

The greater MD 8-digit Rock Creek watershed (MD 8-digit: 02140206) begins in Laytonsville, Maryland and flows approximately 21 miles through the Piedmont Plateau physiographic province before entering Washington, DC and eventually joining the Potomac River. The MD 12-digit Rock Creek watershed (021402060836) is located entirely within Montgomery County and has a drainage area of 18 square miles (MDE, 2018b). The Phase 1 South portion of the corridor study boundary crosses the Rock Creek watershed from approximately MD 187 eastward to MD 97. Note that while the Preferred Alternative LOD impacts the Rock Creek watershed (021402060836), the stream of Rock Creek is not within the Preferred Alternative LOD and is not impacted by the build improvements included in the Preferred Alternative.

Impervious surfaces, including primarily rooftops, paved roads, and parking lots, comprise approximately 21 percent of the greater Rock Creek watershed within Maryland (MDE, 2012b; MCDEP, 2012c). The Maryland portion of the watershed is heavily developed, with 75 percent urban land use and 16 percent forested cover (MDE, 2012b). The greatest development densities occur in the lower portions of the watershed in southern Montgomery County, within and adjacent to the Phase 1 South portion of the corridor study boundary. Within the vicinity of the Preferred Alternative, the majority of the forested area exists as a riparian corridor around waterways, within protected county stream valley parks.

In 2012, 53 percent of Rock Creek was rated as having Fair overall stream conditions, based on assessments of physical and biological parameters (MCDEP, 2012c). The least degraded portion of the greater Rock Creek watershed is upstream of MD 28, where development densities are lower and stream conditions range from Fair to Good (MCDEP, 2012c). Downstream of MD 28, in the vicinity of the Phase 1 South portion of the corridor study boundary, the watershed is highly developed, densely populated, and stream quality is more degraded, with stream conditions ranging from Fair to Poor (MCDEP, 2012c). Many of the developed areas in the southern portion of the watershed lack stormwater BMPs, leading to unmitigated flows that have negatively impacted Rock Creek and its tributaries. Other anthropogenic influences including dams and old sanitary sewer pipes have created barriers to aquatic life passage and prevent Rock Creek from fully functioning in a natural state (DDOE, 2010; MDNR, 2016a).

In the vicinity of the Preferred Alternative, all streams within the Rock Creek watershed are classified as Use I waters (water contact recreation and protection of nontidal warmwater aquatic life). The Rock Creek watershed currently has TMDLs for phosphorus, Enterococcus, total suspended solids, and no Category 5 impairment listings (MDE, 2018a).

e. Watts Branch

The Watts Branch watershed (MD 12-digit: 021402020846) has a drainage area of 22 square miles and begins east of I-270 in the City of Rockville, Maryland, continuing southwest until it crosses under MD 190 and flows into the Potomac River, south of Travilah, Maryland (MDE, 2018b). The Watts Branch headwaters cross the Phase 1 South portion of the corridor study boundary, with all major tributaries joining the mainstem well downstream of the Preferred Alternative. Watts Branch is located entirely within the Piedmont Plateau physiographic province in Montgomery County.

According to 2011 National Land Cover Data, urban development comprises 64 percent of land use in the Watts Branch watershed, with 15 percent impervious surface and 23 percent forested cover (USGS, 2018). Within the City of Rockville, land use is 79 percent residential and commercial/industrial development, and 19 percent open space, which includes forest, water, and farmland. Rockville's impervious surfaces comprise over 40 percent of the Watts Branch watershed, and within City of Rockville limits, 16.6 stream miles of Watts Branch have highly eroded banks, widened stream channels, piped/straightened channels, and/or little riparian buffer (City of Rockville, 2015). Overall, the Watts Branch headwaters are highly developed and have been impacted by runoff from impervious areas, leading to over-widened channels with little floodplain connectivity (MCDEP, 2012b).

The lower portions of the watershed, downstream of the Phase 1 South portion of the corridor study boundary, are dominated by lower density residential land use and still support more diverse aquatic communities (MCDEP, 2012b). Piney Branch, a major tributary to Watts Branch downstream of the

Preferred Alternative, was designated as a Special Protection Area by the MCDEP in 1995 and is largely forested (MCDEP, 2012b).

All streams within the Watts Branch watershed are classified as Use I-P waters. Watts Branch currently has a TMDL for total suspended solids and Category 5 impairment listings for chlorides and sulfates in first through fourth order streams (MDE, 2018a).

f. Muddy Branch

The Muddy Branch watershed (MD 12-digit: 021402020848) originates upstream of MD 355 in Gaithersburg, Maryland, and flows southwest to the Potomac River within Blockhouse Point Conservation Park. The watershed crosses the northwest portion of the corridor study boundary of Phase 1 South, bound by MD 124 to the north and Shady Grove Road to the south, and falls entirely within the Piedmont Plateau physiographic province. The Muddy Branch watershed has a drainage area of approximately 20 square miles (MDE, 2018b).

The Muddy Branch watershed is approximately 67 percent developed and 21 percent forested (USGS, 2018). Impervious surfaces comprise approximately 18 percent of the overall watershed (USGS, 2018). The upper watershed, in the vicinity of the Phase 1 South portion of the corridor study boundary, falls within the City of Gaithersburg, where development is highly concentrated, while the lower portions of the watershed are considerably less developed. Within the City of Gaithersburg, Muddy Branch is comprised of 37 percent impervious surfaces (URS, 2014). Within the vicinity of the Phase 1 South portion of the corridor study boundary, the mainstem of Muddy Branch is primarily forested as it flows through Morris Park and Malcolm King Park adjacent to the I-270 corridor. The lower portions of the Muddy Branch mainstem are largely forested due to a series of stream valley parks downstream of the Phase 1 South portion of the corridor study boundary. In 2012, Good water quality conditions were observed in the lower Muddy Branch watershed, while Fair water quality conditions were observed in the upper Muddy Branch watershed (MCDEP, 2012b; URS, 2014).

All Muddy Branch watershed streams in the vicinity of the Phase 1 South portion of the corridor study boundary are classified as Use I-P waters. One unnamed tributary in the lower portion of Muddy Branch, well downstream of the Phase 1 South portion of the corridor study boundary is classified as Use III-P waters (nontidal coldwater and public water supply). Muddy Branch currently has a TMDL for total suspended solids and Category 5 impairment listings for chlorides and sulfates in first through fourth order streams (MDE, 2018b).

B. Scenic and Wild Rivers

Based on review of available information on the National Wild and Scenic River System website, there are no federally designated Wild and Scenic Rivers in Maryland or Virginia (IWSRCC, 2018). No waterways within the Virginia portion of the Phase 1 South portion of the corridor study boundary are state-designated as Scenic Rivers (VDCR, 2018a). The Potomac River in Montgomery County is state-designated as Scenic under the Maryland Scenic and Wild Rivers Program (MDNR, 2018a; Md. Code Ann., Nat. Res. § 8-402). All Maryland streams within the Preferred Alternative, with the exception of tributaries to Rock Creek, are regulated under the Maryland Scenic and Wild Rivers Act, as they drain to the Montgomery County portion of the Potomac River. It is anticipated that most aesthetic impacts would be temporary, during construction activities. However, replacement or major modification of the ALB could have a longer-term aesthetic effect on the designated river and would therefore be designed to protect the scenic value of the resource. MDNR will assist the project team with coordination for Maryland Scenic Rivers.

C. Surface Water Quality

Existing conditions for surface water quality are discussed by watershed, as defined in **Section 2.4.2.A**, above. For both in-situ and chemical grab sample parameters, state and federal standards and recommendations, as well as benchmark levels used to indicate anthropogenic stress, are presented in **Section 2.4.2.C**.

a. Fairfax County Middle Potomac Watersheds

Within the vicinity of the Phase 1 South portion of the corridor study boundary, recent chemical grab sample data for the Fairfax County Middle Potomac watersheds were available for Dead Run from NWQMC (**Table 2-22**). At the single monitoring site located just north of Whann Avenue, individual chemical grab sample parameter values varied across sampling events. Ammonia values were generally low and did not exceed Virginia state standards. Although E. coli levels were reported in different units than the Virginia state criterion, E. coli levels within Dead Run were well below state standards based on the magnitude of reported values. All nutrient parameters were also variable among sampling events, but values frequently exceeded the state and federal benchmarks used to indicate anthropogenic stress.

In-situ water quality data were available for the Fairfax County Middle Potomac watersheds from FCDPWES. In-situ data were available for the Scotts Run mainstem, Unnamed Tributary 1 to Scotts Run, Unnamed Tributary 2 to Scotts Run, the Dead Run mainstem, and Unnamed Tributary 1 to Dead Run. Unnamed Tributary 1 and Unnamed Tributary 2 to Scotts Run both enter the Scotts Run mainstem downstream of I-495. Unnamed Tributary 1 to Dead Run joins the Dead Run mainstem to the east of I-495, at the southern end of Turkey Run Park. With the exception of pH, all in-situ water quality parameters met Virginia standards for Class III waters (**Table 2-23**). One pH value, collected in the spring on Unnamed Tributary 2 to Scotts Run, had a pH value of 5.8, which is slightly below the Virginia minimum threshold. For the Scotts Run and Dead Run mainstems, conductivity values exceeded the benchmark used by VDEQ to categorize streams as least-degraded.

Table 2-22. Summary of Chemical Grab Sample Water Quality Data for the Fairfax County Middle Potomac Watersheds

Waterway	Dead Run
Source Data	NWQMC
Year[1]	2008 – 2019
Number of Sampling Sites	1
Ammonia (mg/L)	0.016 – 0.255
E. coli (MPN/100 mL)	0.393 – 2.500
Nitrate Nitrogen (mg/L)	0 – 3.7
Nitrite Nitrogen (mg/L)	0.35 – 6.70
Nitrogen (Total) (mg/L)	0 – 6.3
Orthophosphate (mg/L)	0.004 – 9.000
Phosphorus (Total) (mg/L)	0 – 2,350

[1]Sampling may not have been conducted during all years within year ranges.

Table 2-23. Summary of In-situ Water Quality Data for the Fairfax County Middle Potomac Watersheds

Waterway	Scotts Run	Unnamed Tributary 1 to Scotts Run	Unnamed Tributary 2 to Scotts Run	Dead Run	Unnamed Tributary 1 to Dead Run
Source Data	FCDPWES	FCDPWES	FCDPWES	FCDPWES	FCDPWES
Year[1]	2012-2014	2009	2014	2010-2015	2008
Number of Sampling Sites	3	1	1	4	1
DO (mg/L)	8.1-13.1	11.5	10.3	6.2-14.0	12.1
pH	6.8-9.0	--	5.8	6.8-7.4	8.0
Conductivity (µS/cm)	331-650	168	96	178-456	212
Water Temp. (°C)	12.0-23.3	9.0	11.3	6.7-22.4	9.0

[1]Sampling may not have been conducted during all years within year ranges.

b. Potomac River/Rock Run

No recent chemical grab sample data were available for the Potomac River/Rock Run watershed within the vicinity of the Phase 1 South portion of the corridor study boundary; however, MCDEP collected in-situ water quality data along Rock Run, upstream of the Phase 1 South portion of the corridor study boundary. With the exception of pH, all in-situ water quality parameters met COMAR criteria for Use I-P streams (**Table 2-24**). One pH value of 9.0, collected in spring, exceeded the COMAR criterion of 8.5.

Table 2-24. Summary of In-situ Water Quality Data for the Rock Run Watershed

Waterway	Rock Run
Source Data	MCDEP
Year[1]	2010-2014
Number of Sampling Sites	1
DO (mg/L)	7.1 – 13.5
pH (SU)	7.2 – 9.0
Conductivity (µS/cm)	211 – 308
Water Temp. (°C)	14.0 – 24.5

[1]Sampling may not have been conducted during all years within year ranges.

c. Cabin John Creek

Within the vicinity of the Phase 1 South portion of the corridor study boundary, recent chemical grab sample data for the Cabin John Creek watershed were available for Booze Creek, Cabin John Creek, Ken Branch, Thomas Branch, and Unnamed Tributary 1 to Snakeden Branch from MBSS and NWQMC (**Table 2-25**). Ammonia concentration was only assessed along Cabin John Branch and Ken Branch, and all concentrations fell below the threshold of 0.03 mg/L used by MBSS to indicate anthropogenic stress. Alkalinity levels were only monitored along Cabin John Creek, with all values exceeding the chronic exposure criterion of 20 mg/L recommended by EPA for freshwater aquatic life. Conductivity and chloride levels were highly variable across all waterways and generally fluctuated between sampling events. While no state or federal ambient surface water quality criteria exist for conductivity, most sampled waterways exceeded EPA's recommended aquatic life criterion for chronic chloride exposure. Booze Creek, Cabin John Creek, and Thomas Branch also exceeded criteria for acute chloride exposure. High conductivity and chloride levels in the spring are often associated with deicing procedures, as runoff from roadways can transport deicing compounds into nearby waterbodies. Two recent pH readings along Booze Creek fell below the minimum COMAR criterion of 6.5 SU for Use I-P streams. Alternatively, one recent pH reading within Unnamed Tributary 1 to Snakeden Branch exceeded the maximum COMAR criterion.

Turbidity measurements were also variable among sites and sampling events. Although the COMAR monthly average turbidity criterion of 50 Nephelometric Turbidity Units (NTU) was frequently exceeded within the watershed, the instantaneous turbidity criterion of 150 NTU was only exceeded at Cabin John Creek. Nutrient compounds (those containing nitrogen and phosphorus) across the watershed generally exceeded thresholds used by state and federal agencies to indicate anthropogenic stress. All other chemical water quality parameters, including all heavy metals, met state and federal criteria.

Within the Cabin John Creek watershed, in-situ water quality data are available for Booze Creek, Cabin John Creek, Ken Branch, Old Farm Creek, Thomas Branch, Unnamed Tributary 1 to Cabin John Creek, and Unnamed Tributary 1 to Old Farm Creek (**Table 2-26**). Several pH readings at Cabin John Creek exceeded COMAR criterion for Use I-P streams and one recent reading in Old Farm Creek fell below COMAR criterion. All other in-situ water quality parameters within the Cabin John Creek watershed met COMAR criteria. During several sampling events, conductivity levels along the Cabin John Creek mainstem and Unnamed Tributary 1 to Cabin John Creek were notably elevated. Conductivity levels as low as 247 and

469 µS/cm, have been documented to correlate with impaired benthic macroinvertebrate and fish communities in Maryland, respectively (Morgan et al., 2007).

Table 2-25. Summary of Chemical Grab Sample Water Quality Data for the Cabin John Creek Watershed

Waterway	Booze Creek	Cabin John Creek		Ken Branch		Thomas Branch	Unnamed Tributary 1 to Snakeden Branch
Source Data	NWQMC	NWQMC	MBSS	NWQMC	MBSS	NWQMC	NWQMC
Year[1]	2008 – 2016	2007 – 2017	2008 – 2017	2008 – 2016	2008	2008 – 2016	2016
Number of Sampling Sites	2	8	3	2	1	2	1
Ammonia (mg/L)	--	--	0.006 – 0.009	--	0.009	--	--
Alkalinity (mg/L)	--	22 – 96	--	--	--	--	--
Biochemical Oxygen Demand (mg/L)	--	0.1 – 8.2	--	--	--	--	--
Chloride (mg/L)	28 – 3,333	16 – 4,558	105 – 161	29 – 752	50	65 – 2,503	149 – 203
Conductivity (µS/cm)	287 – 11,200	124 – 13,473	516 – 720.5	227 – 3,084	337	283 – 12,890	275 – 2,952
Copper (µg/L)	--	--	3.8	--	--	--	--
DO (mg/L)	5.3 – 15.2	6.7 – 16.4	--	7.6 – 15.1	--	7.9 – 15.9	12.3 – 14.6
Nitrate Nitrogen (mg/L)	--	--	0.79 – 1.41	--	1.14	--	--
Nitrite Nitrogen (mg/L)	--	--	0.0029 – 0.0115	--	0.0022	--	--
Nitrogen (Total) (mg/L)	--	0.49 – 2.36	0.95 – 1.67	--	1.22	--	--
Orthophosphate (mg/L)	--	--	0.001 – 0.005	--	0.002	--	--
pH	5.1 – 8.4	6.5 – 8.7	7.3 – 8.1	7.2 – 8.4	7.6	6.5 – 8.4	7.6 – 8.7
Phosphorus (Total) (mg/L)	--	--	0.007 – 0.019	--	0.008	--	--
Total Suspended Solids (mg/L)	--	0 – 932	--	--	--	--	--
Turbidity (NTU)	0 – 89	0 – 1,185	--	0 – 83	--	0 – 88	0 – 25
Zinc (µg/L)	--	--	17.0	--	--	--	--

[1]Sampling may not have been conducted during all years within year ranges.

Table 2-26. Summary of In-situ Water Quality Data for the Cabin John Creek Watershed

Waterway	Booze Creek	Cabin John Creek			Ken Branch	Old Farm Creek	Snakeden Branch	Unnamed Tributary 1 to Cabin John Creek	Unnamed Tributary 1 to Old Farm Creek
Source Data	MCDEP	MCDEP	MBSS	NWQMC	MBSS	MCDEP	MCDEP	NWQMC	MCDEP
Year[1]	2008	2008 – 2014	2008	2008 – 2017	2008	2008 – 2014	2008 – 2014	2015	2015 – 2017
Number of Sampling Sites	1	4	3	8	1	1	1	1	1
DO (mg/L)	6.9 – 11.5	6.1 – 16.8	9.9 – 11.7	7.8 – 15.2	8.8	8.5 – 11.5	9.9 – 12.1	12.3	6.9 – 9.5
pH	7.6 – 8.4	6.5 – 8.8	7.4 – 7.5	7.0 – 8.7	7.3	6.4 – 7.7	7.4 – 7.6	7.7 – 8.0	7.4 – 7.5
Conductivity (µS/cm)	530 – 563	202 – 649	402 – 403	79 – 3,752	289	224 – 631	354 – 444	873 – 1,984	605 – 830
Water Temp. (°C)	14.7 – 19.9	11.5 – 23.5	21.9 – 24.5	--	22.7	12.4 – 20.1	12.6 – 13.1	--	10.0 – 14.5
Turbidity (NTU)	--	--	1.6 – 1.8	--	1.5	--	--	--	--

[1]Sampling may not have been conducted during all years within year ranges.

d. Rock Creek

No recent chemical grab sample data were available for the Rock Creek watershed within the vicinity of the Preferred Alternative; however, in-situ water quality data were collected by MBSS and MCDEP along Alta Vista Tributary, Luxmanor Branch, and Rock Creek (**Table 2-27**). All in-situ water quality parameters met COMAR criteria for Use I streams, except for one DO reading at Luxmanor Branch. Several conductivity measurements were notably elevated throughout the watershed.

Table 2-27. Summary of In-situ Water Quality Data for the Rock Creek Watershed

Waterway	Alta Vista Tributary	Luxmanor Branch	Rock Creek
Source Data	MCDEP	MCDEP	MCDEP
Year[1]	2011 – 2013	2008 – 2017	2008 – 2017
Number of Sampling Sites	2	4	2
DO (mg/L)	4.6 – 12.7	3.6 – 8.3	4.6 – 12.7
pH	6.7 – 8.0	6.8 – 7.6	6.7 – 8.0
Conductivity (µS/cm)	375 – 761	279 – 654	159 – 761
Water Temp. (°C)	6.4 – 24.1	15.0 – 26.0	6.4 – 24.7

e. Watts Branch

No recent chemical grab sample data were available for the Watts Branch watershed within the vicinity of the Phase 1 South portion of the corridor study boundary; however, in-situ water quality data were collected by MCDEP along Watts Branch, downstream of I-495. All water quality parameters met COMAR criteria for Use I-P streams (**Table 2-28**).

Table 2-28. Summary of In-situ Water Quality Data for the Watts Branch Watershed

Waterway	Watts Branch
Source Data	MCDEP
Year[1]	2007 – 2014
Number of Sampling Sites	2
DO (mg/L)	6.8 – 14.1
pH	6.8 – 7.7
Conductivity (µS/cm)	395 – 790
Water Temp. (°C)	11.6 – 24.2

[1]Sampling may not have been conducted during all years within year ranges.

f. Muddy Branch

No recent chemical grab sample data were available for the Muddy Branch watershed within the vicinity of the Phase 1 South portion of the corridor study boundary; however, in-situ water quality data were collected by MCDEP along Muddy Branch and Decoverly Tributary, downstream of I-495. All water quality parameters met COMAR criteria for Use I-P streams. Although no state or federal criteria exist, conductivity was somewhat elevated at Muddy Branch, approaching 1,000 µS/cm (**Table 2-29**).

Table 2-29. Summary of In-situ Water Quality Data for the Muddy Branch Watershed

Waterway	Decoverly Tributary	Muddy Branch
Source Data	MCDEP	MCDEP
Year[1]	2007	2007 – 2014
Number of Sampling Sites	1	2
DO (mg/L)	6.9 – 7.1	6.5 – 11.9
pH	6.6 – 7.4	6.7 – 7.7
Conductivity (µS/cm)	477 – 497	440 – 996
Water Temp. (°C)	17.0 – 22.2	9.1 – 23.7

[1]Sampling may not have been conducted during all years within year ranges.

2.4.3 Environmental Effects

A. Surface Waters and Watershed Characteristics

The Preferred Alternative LOD will affect surface waters and watershed characteristics due to direct and indirect impacts to ephemeral, intermittent, and perennial stream channels. Impacts to jurisdictional surface waters are discussed in **Section 2.2.3** and the impacts to jurisdictional surface waters by MD 12-digit watershed are included in **Table 2-13**. Watersheds would also be impacted by increasing impervious surface area. SWM controls will be included in the final design to reduce velocity of runoff flow and negative impact to water quality. **Section 2.4.3.C** includes more information regarding environmental effects to water quality. Additional information regarding SWM assumptions are discussed in FEIS, Chapter 3, Section 3.1.6. No Tier II waters were identified within the Preferred Alternative LOD, no waterways within the Preferred Alternative LOD drain to Tier II waters, and the Preferred Alternative LOD does not cross any Tier II watershed boundaries.

B. Scenic and Wild Rivers

Based on review of available information on the National Wild and Scenic River System website, there are no federally-designated Wild and Scenic Rivers in Maryland or Virginia (IWSRCC, 2018). No waterways within the Virginia portion of the Preferred Alternative LOD are state-designated as Scenic Rivers (VDCR, 2018a). The Preferred Alternative LOD will affect the Potomac River and its tributaries which are designated as Scenic under the Maryland Scenic and Wild Rivers Program (MDNR, 2018a). It is anticipated that most aesthetic impacts would be temporary, during construction activities. However, replacement of the ALB could have a longer-term aesthetic effect and will be designed to protect the scenic value of the resource. MDNR will assist the project team with coordination for Maryland Scenic Rivers.

C. Surface Water Quality

The Preferred Alternative LOD may affect surface water quality in the project area due to direct and indirect impacts to ephemeral, intermittent, and perennial stream channels and increases in impervious surface in their watersheds.

Impacts during construction include physical disturbances or alterations, accidental spills, and sediment releases. These impacts can affect aquatic life through the potential to contaminate waterways in the vicinity of the Preferred Alternative LOD and could potentially increase contaminants in the raw water for the drinking water supply. Direct stream channel impacts associated with the Preferred Alternative LOD are quantified in **Section 2.3.3**. The potential negative water quality results of these impacts are discussed below.

During construction, large areas of exposed soil can be severely eroded by wind and rain when the vegetation and naturally occurring soil stabilizers are removed. Erosion of these exposed soils can considerably increase the sediment load to receiving waters (Barrett et al., 1993). Sediment loads caused by construction could eventually enter the intermittent drinking water intake at Little Falls dam if not controlled. These increased sediment loads can destroy or damage fish spawning areas and macroinvertebrate habitat and could increase maintenance and sediment removal cycles for the drinking water supply system. An accidental sediment release in a stream can clog the respiratory organs of fish, macroinvertebrates, and the other members of their food web (Berry et al., 2003). Additional suspended sediment loads have also been shown to cause stream warming by reflecting radiant energy (CWP, 2003).

An additional impact associated with the initial construction phase of roadway improvements is the removal of trees and other riparian buffer vegetation. The removal of riparian vegetation greatly reduces the buffering of nutrients and other materials and allows unfiltered water to enter a stream channel directly (Trombulak and Frissell, 2001). Tree removal during the construction process can reduce the amount of shade provided to a stream and thereby raise the water temperature of that stream. In addition to tree removal, stormwater discharges also have the potential to increase surface water temperatures in nearby waterways. The effect of the temperature change depends on stream size, existing temperature regime, the volume and temperature of stream baseflow, and the degree of shading.

Impacts associated with the use of the road after construction are mainly based on the potential for contamination of surface waters and related drinking water supplies by runoff from new impervious roadway surfaces. Potential contaminants to surface waters include heavy metals, deicing compounds, organic pollutants, contaminants of emerging concern, hazardous chemical spills, pathogens, and sediment.

The most common heavy metal contaminants are lead, aluminum, iron, cadmium, copper, manganese, titanium, nickel, zinc, and boron. Most of these contaminants are related to gasoline additives and regular highway maintenance. Other sources of metals include mobilization by excavation, vehicle wear, combustion of petroleum products, historical fuel additives, and catalytic-converter emissions. Generally, heavy metals from highways found in streams are not at concentrations high enough to cause acute toxicity (CWP, 2003).

Deicing compounds that are used during the winter for highway safety maintenance also pose a threat to water quality. Sodium chloride is the most common deicing compound, but it can also be blended with calcium chloride or magnesium chloride. Urea and ethylene glycol are also sometimes used to deice. MDOT SHA most commonly uses rock salt (sodium chloride), a salt brine, and magnesium chloride as deicing agents. Chlorides from these salts can cause acute and chronic toxicity in fish, macroinvertebrates, and plants. The effect of chlorides in streams is dependent on the amount that is applied and the dilution of the receiving waters. Runoff containing road salts, among other things, can cause elevated conductivity in streams, especially during the spring. Applications of deicing materials can also cause several issues with drinking water systems including altered taste and odor, pipe corrosion, modification of treatment, mobilization of harmful nutrients, and potential loss or need to mitigate drinking water sources.

Organic pollutants, including dioxins and PCBs, have been found in higher concentrations along roadways. Sources of these compounds include runoff derived from exhaust, fuel, lubricants, and asphalt (Buckler and Granato, 1999). These organic pollutants are known to accumulate in concentrations that can cause mortality and affect growth and reproduction in aquatic organisms (Lopes and Dionne, 1998).

New impervious surfaces may result in an increase in the presence of contaminants of emerging concern in surface waters, including the downstream water supply. These include contaminants such as pharmaceuticals and personal care products (PPCPs), endocrine disrupting chemicals (EDCs), organic wastewater contaminants (OWCs), persistent organic pollutants (POPs), microconstituents, and nanomaterials. There is evidence indicating that even low levels of some contaminants of emerging concern in the environment may affect wildlife, but no indication that they pose a threat to human health from consuming water treated to current EPA standards. According to DC Water, the levels at which these chemicals have currently been detected in water treated from the Washington Aqueduct are very small.

Surface water contamination may also occur due to sudden hazardous spills on new impervious surfaces from the Preferred Alternative that could affect aquatic life and the water supply. The Potomac River Basin Drinking Water Source Protection Partnership Early Warning and Emergency Response Workgroup works with the local utilities and response agencies to prepare, practice, and respond to spills of hazardous materials to minimize effects from hazardous spills on Potomac River drinking water sources.

Sediments are also a primary pollution concern associated with an increase in impervious areas. The Preferred Alternative LOD would add the most impervious surface to the Cabin John Creek MD 12-digit watershed, with 77 acres added. The least additional impervious surface would be added to the Rock Creek watershed, with less than 0.8 acres added. See **Section 2.3.4** for a discussion of jurisdictional surface water impacts and **Table 2-30** below for additional impervious surface for the Preferred Alternative LOD. Additional impervious surface includes all new impervious surface outside of the existing roadway footprint.

Table 2-30. Additional Impervious Surfaces by Watershed

MD 12-Digit Watershed Name	MD 12-Digit Watershed	USGS 12-digit HUC Name	USGS 12-digit HUC Number	AC	SF
Potomac River/Rock Run	21402020845	Nichols Run-Potomac River	20700081003	15.0	654,707
Cabin John Creek	21402070841	Cabin John Creek	20700081003	77.0	3,355,862
Rock Creek	21402060836	Lower Rock Creek	20700100102	0.8	32,670
Muddy Branch	21402020848	Muddy Branch	20700081001	7.2	313,196
Watts Branch	21402020846	Watts Branch	20700081002	3.2	137,214

Note: Part of the additional impervious surface area is in the Nichols Run-Potomac River HUC12 Watershed in Virginia and is not associated with an MD 12-digit Watershed.

2.4.4 Avoidance, Minimization and Mitigation

A. Surface Waters and Watershed Characteristics

Impacts to surface waters from the Preferred Alternative will be unavoidable. However, efforts to avoid and minimize impacts have occurred throughout the planning process and will continue in final design. MDOT SHA has worked with regulatory agencies and resource managers to identify sensitive aquatic resources and determine further avoidance and minimization possibilities. Agency recommendations have been evaluated and implemented wherever practicable. Efforts to avoid and minimize direct impacts to stream channels to date have included alignment shifts, alteration of roadside ditch design, addition of retaining walls, shifting the locations of noise barriers, and revision of preliminary SWM locations to avoid streams.

Avoidance and minimization efforts to reduce impacts to surface waters, including wetlands, involve a two-tiered approach. The first tier occurred during the planning stage where every reasonable effort was made to avoid wetlands and waterways to the maximum extent practicable at that stage of design. The second tier of avoidance and minimization occurred as the P3 Developer reduced impacts to wetlands and streams wherever practicable and their design was incorporated into the FEIS LOD. Impacts to wetlands and waterways will continue to be reduced wherever practicable as design is refined and finalized.

Any unavoidable impacts will be regulated under state and federal wetlands and waterways permits that would be issued for the project. Detailed information regarding avoidance and minimization of direct impacts to waterways for the I-495 & I-270 Managed Lanes Study can be found in **Section 2.3.4** and is further detailed in the AMR (FEIS, Appendix N). In addition, detailed information regarding avoidance and minimization with respect to surface water quality can be found in **Section 2.4.4.C.**

B. Scenic and Wild Rivers

Maryland Scenic Rivers and/or their tributaries within the Preferred Alternative LOD include the Montgomery County portion of the Potomac River and its tributaries. Impacts to the Wild and Scenic Potomac River and its tributaries have been avoided and minimized to the maximum extent practicable during preliminary design. Coordination with MDNR and efforts to reduce impacts further will continue throughout future project design phases. Specifically, the ALB over the Potomac River will be designed in coordination with MDNR to ensure that the scenic and wild values of the Potomac River would not be negatively affected. Typically, protection of tributaries to state-designated Scenic Rivers is achieved through application of BMPs and avoidance and minimization measures to reduce impacts to water quality that are already being applied to waterways within the Preferred Alternative LOD. Detailed information regarding avoidance and minimization for impacts to wetlands and waterways within the Preferred Alternative LOD can be found in **Section 2.3.4** and is further detailed in the AMR (FEIS, Appendix N).

C. Surface Water Quality

The I-495 & I-270 Managed Lanes Study requires a Section 401 water quality certification from MDE and VDEQ indicating that anticipated discharges from the I-495 & I-270 Managed Lanes Study will comply with federally-mandated water quality standards. In support of the water quality certification requirements, avoidance and minimization measures would be further evaluated through each design phase of the I-495 & I-270 Managed Lanes Study. Minimization efforts for potential water quality impacts that could result from road crossings may include the proper maintenance of flood-prone flows through proposed structures using flood relief culverts to avoid increased scour and sedimentation. Most of the stream systems within the Preferred Alternative LOD currently have floodplain access; this should be retained as much as possible to preserve benefits such as velocity dissipation, storage, and sedimentation/stabilization. Other efforts should consider retaining or adding riparian buffers, as well as aquatic life passage through structures. Post-construction SWM and compliance with TMDLs will be accounted for in the stormwater design and water quality monitoring to comply with required permits.

Erosion and sediment control, as well as SWM techniques, are the most important minimization efforts in relation to chemical water quality. Impacts to chemical water quality would be minimized through strict adherence to erosion and sediment control procedures and MDE stormwater management regulations. In 2012, MDE revised erosion and sediment control regulations in adherence with the 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control (MDE, 2014a). These revisions include the establishment of a grading unit criteria, along with stricter stabilization requirements to more thoroughly protect water quality.

Potential organic (e.g., PCBs and dioxins) and heavy metal pollutants are generally sediment-bound or behave like sediment with respect to runoff and transport. Current research is limited; however, settling and filtering urban BMP removal mechanisms have been shown to achieve reductions of 50 to 90 percent with respect to toxic contaminants (Schueler and Youngk, 2015). Therefore, SWM techniques aimed at reducing erosion and sediment transport would also reduce the transport of toxic contaminants into downstream waterways. The International Stormwater BMP Database 2020 Summary Statistics also indicate that commonly used stormwater BMPs reduce total suspended solids, total nitrogen, total phosphorous, and heavy metals such as copper, lead, and zinc from stormwater before it enters streams (Water Research Foundation, 2020).

SWM will be developed in compliance with all applicable MDE regulations and guidance and designed in accordance with MDE's 2000 Maryland Stormwater Design Manual (MDE, 2009) and MDE's SWM Act of 2007. The 2007 SWM Act requires establishing a comprehensive approach to SWM through the implementation of Environmental Site Design (ESD) to the maximum extent practicable, and only using structural practices where necessary. The SWM Design Manual requires small-scale SWM practices, nonstructural techniques, and better site planning to mimic natural hydrologic runoff characteristics. Micro-scale practices, such as water quality swales, would be used to capture and treat runoff closer to the source, as well as increase recharge by infiltrating some or all of the storage volume. The practicability of diverting bridge scupper drainage into SWM areas would be investigated as part of the future planning process, on a structure-by-structure basis. Structural SWM techniques such as underground vaults are proposed to attenuate water flow from stormwater runoff. Due to the importance of protecting water quality in the study area, MDOT SHA has undertaken initial analysis of SWM needs for the project in preliminary planning rather than in later phases of the project.

This early analysis ensures that the feasibility of providing effective SWM has been considered throughout the planning process and allowed for identification of ROW needs for the most effective SWM solutions, and avoidance of additional natural resource impacts from SWM to the maximum extent practicable. Water quantity treatment will be met onsite or through waiver requests in specific areas. The project will attempt to meet water quality treatment requirements onsite, where practicable. Where this is not practicable, water quality requirements will be met off-site in accordance with MDE regulations. The Compensatory Stormwater Management Plan details off-site stormwater quality treatment and is included as Appendix D of the FEIS. Other measures may also be considered in particularly sensitive watersheds after further coordination with resource agencies, such as redundant erosion and sediment control measures in especially sensitive watersheds and/or providing on-site environmental monitors during construction to provide extra assurance that erosion and sediment control measures are fully implemented and functioning as designed. These measures will also minimize potential impacts of contaminants on downstream drinking water supplies. Contaminants entering the Washington Aqueduct are also treated by the Dalecarlia and McMillan treatment plants, which must meet EPA's drinking water standards prescribed in the Aqueduct's NPDES Permit.

2.5 Groundwater and Hydrology

2.5.1 Regulatory Context and Methods

In 1974, Congress passed the SDWA to regulate the public drinking water supply (EPA, 2004). The SDWA Amendments of 1986 require each state to develop Wellhead Protection Programs to assess, delineate, and map source protection areas for their public drinking water sources, and determine potential risks to those sources (42 U.S.C. 300h-7). Wellhead Protection specifically manages the land surface around a well where activities might affect water quality (MDE, 2018c). Source water protection is not specifically mandated by the SDWA, though it does mandate source water assessments, as described below. This allows for flexibility in the delineation and development of source water protection areas to fit the needs of the state (42 U.S.C. 300j-13). States, tribes, and communities are encouraged to use SDWA guidance to protect their public water sources from pollution of major concern and to pass local regulations (EPA, 2004). The EPA approved Maryland's Wellhead Protection Program in June of 1991, and Maryland's Source Water Assessment Program in November of 1999. The EPA approved Virginia's Source Water Assessment Program in October 1999, and their Wellhead Protection Program in 2005 (VDH, 1999; VDEQ, 2005). Both Virginia's and Maryland's program provides technical assistance, information, and funding to local governments to aid in water supply protection. The SDWA does not regulate private wells serving fewer than 25 individuals (EPA, 2004).

The EPA, as authorized by Section 1424(e) of the SDWA, is responsible for the Sole Source Aquifer (SSA) Program, which allows the EPA to designate an aquifer as a sole source of drinking water and establish a review area for any federally-funded projects that fall within the area (42 U.S.C. 300h-6). SSAs are defined as providing at least 50 percent of the drinking water for its service area, and where that service area has no reasonably available alternative drinking water sources. No SSAs cross the Phase 1 South portion of the corridor study boundary.

Data on wells and groundwater conditions within the Phase 1 South portion of the corridor study boundary were gathered from online sources from the USGS, Maryland Geological Survey (MGS), Virginia Department of Health (VDH), and the EPA. Groundwater well data were gathered from the USGS National Water Information System (USGS, 2017).

2.5.2 Existing Conditions

The hydrogeology of the Phase 1 South portion of the corridor study boundary is largely defined by the geology of the area. According to USGS and MGS, the Phase 1 South portion of the corridor study boundary is underlain by the crystalline-rock and undifferentiated sedimentary-rock aquifer, one of the three primary aquifers of the Piedmont and Blue Ridge Physiographic Province (USGS, 2017; MGS, 2018).

Most of the Piedmont and Blue Ridge Physiographic Province is underlain by dense impermeable bedrock that yields water from secondary porosity and permeability provided by fractures. Recharge is highly variable in these aquifers because it is determined by local precipitation and runoff, which are influenced by topographic relief, roadway infrastructure, land use, and the infiltration rates of the available land surface (USGS, 1997). The crystalline-rock and undifferentiated sedimentary-rock aquifers are composed of mainly crystalline metamorphic and igneous rocks. An unconsolidated, permeable material called regolith overlies these aquifers. The regolith consists of saprolite, colluvium, alluvium, and soil. The hydraulic properties of the regolith vary greatly due to its variation in thickness, composition, and grain size. The recharge and discharge process occurs in these aquifers through instream areas where precipitation enters the regolith and then moves laterally through the material, discharging into nearby streams. However, some water moves downward through the regolith until it reaches bedrock, where it enters fractures in crystalline rocks. Base flow ranges from 33 to 67 percent of stream flow in the Maryland drainage basins underlain by crystalline rocks, which is consistent with flow ranges in other states with crystalline rock basins (USGS, 1997). The majority of these aquifers are unconfined, allowing contaminants to enter the aquifers. Common contaminants include nitrate from fertilizers and chloride from road salts. Because water relies on fractures for movement, availability for groundwater usage is limited and well rates are usually only a few gallons per minute. Wells are often drilled deep and left open to allow water to infiltrate from fractures along the drill hole (MGS, 2014).

As mentioned above, the crystalline-rock and undifferentiated sedimentary-rock aquifers consist primarily of metamorphic and igneous rocks, but also include small areas of sedimentary rocks, principally conglomerate, sandstone, and shale. These rocks consist mostly of silica and silicate minerals that are not readily dissolved. Dissolved-solids concentrations in water from these aquifers average about 120 milligrams per liter. The water is soft; hardness averages about 63 milligrams per liter. The median hydrogen ion concentration, which is measured in pH units, is 6.7, meaning the water is slightly acidic. The median iron concentration is 0.1 milligram per liter, but concentrations as large as 25 milligrams per liter have been reported. Typical groundwater is comprised of dissolved calcium bicarbonate and magnesium bicarbonate ions (USGS, 1997).

Groundwater contaminants can come from a variety of sources, but the type of contaminant is often tied to the pollution source. Common highway runoff contaminants that impact both surface and groundwater are listed in **Table 2-31** (Kobringer and Geinopolos, 1984; Barrett et al., 1995). The EPA's National Primary Drinking Water Standards regulate the allowable amounts of these listed compounds within drinking water due to concerns over human and environmental health (EPA, 2009). The Secondary Drinking Water Standards recommend acceptable levels of compounds that can cause cosmetic effects or aesthetic effects to drinking water, such as poor taste or smell (EPA, 2009). This designation is listed in the table where applicable, as well as the origin of these pollutants within the scope of highway activities.

USGS groundwater well data were reviewed to establish water quality trends within the vicinity of the Phase 1 South portion of the corridor study boundary. Three USGS groundwater wells with recent water quality data were identified within the Piedmont and Blue Ridge crystalline-rock and unconsolidated sedimentary-rock aquifer. The specific well information is presented in **Table 2-32.**

Table 2-31. Common Highway Runoff Contaminants

Contaminant	Primary Source on Roadways	Primary or Secondary Pollutant*	EPA Maximum Contaminant Limit (MCL)*	Units
Arsenic	Fossil fuel combustion	Primary	10	ug/L
Cadmium	Exhaust, tire wear	Primary	5	ug/L
Chromium	Wear of engine parts, brake lining wear	Primary	100	ug/L
Lead	Exhaust, tire wear, fossil fuels	Primary	15	ug/L
Nitrate (measured as Nitrogen)	Roadside fertilizer	Primary	10,000	ug/L
Nitrite (measured as Nitrogen)	Roadside fertilizer	Primary	1,000	ug/L
Turbidity	Sediment runoff, pavement wear, highway maintenance	Primary	1	NTU
Copper	Vehicle fluids and fuel	Primary/Secondary	1,300/1,000	ug/L
Total Dissolved Solids	Includes salts from roadway deicing.	Secondary	500,000	ug/L
Iron	Auto body rust, metal roadway components (bridges, guardrails, etc.), wear of engine parts	Secondary	300	ug/L
Manganese	Wear of engine parts	Secondary	50	ug/L
Zinc	Tire wear, motor oils	Secondary	5,000	ug/L
Sulfate	Pavement, fuel, deicing salts	Secondary	250,000	ug/L
Nickel	Fossil fuels, metal plating, brake wear, asphalt paving	N/A	N/A	
Ammonia	Roadside fertilizer	N/A	N/A	
Phosphorus	Roadside fertilizer	N/A	N/A	

*N/A = No EPA Primary or Secondary Drinking Water Standard, but still a known constituent of highway runoff with potential environmental effects.

Source: Kobringer and Geinopolos,1984; Barrett et al., 1995; EPA, 2009.

Table 2-32. USGS Groundwater Wells Representing Aquifers that Underlie the Phase 1 South Portion of the Corridor Study Boundary

USGS Code	Well Name	Latitude	Longitude	National Aquifer	Local Aquifer
390533077125201	MO De 52	39°05'33.18"	77°12'52.32"	Piedmont and Blue Ridge crystalline-rock	Upper Pelitic Schist of Wissahickon Formation
385929077020901	WW Ac 8	38°59'29.3"	77°02'08.6"	Piedmont and Blue Ridge crystalline-rock	NR*
385644077061101	WW Ba 28	38°56'44"	77°06'11"	Piedmont and Blue Ridge crystalline-rock	Sykesville Formation

*Not reported.
Source: USGS, 2017

Groundwater quality data was reviewed within these three wells to provide a snapshot of existing conditions relative to the pollutants listed in **Table 2-31**. As shown in **Table 2-33**, chemical constituents vary across all wells (USGS, 2017). At the time of sampling, two of the three wells showed total dissolved solids above Secondary Drinking Water Standards. These elevated values could indicate impacts from current road salting operations, the existing geology, or a combination of both geologic components and human activities in the surrounding area. Levels of manganese, which is naturally occurring within the surrounding geology of these aquifers, was elevated slightly above the Secondary Drinking Water pollutant levels in two of the three wells.

Table 2-33. Groundwater Quality Data for Selected Pollutants

Well Name	MO De 52	WW Ac 8	WW Ba 28
pH	7.2	5.0	7.2
Arsenic (ug/L)	0.53	0.37	1.6
Cadmium (ug/L)	<0.030	0.573	0.030
Chromium (ug/L)	1.7	0.65	<0.50
Lead (ug/L)	<0.040	0.046	0.020
Nitrate (ug/L as N)	2,010	7,060	14
Nitrite (ug/L as N)	<1	<1	<1
Turbidity (NTU)	0.8	NR*	0.3
Total Dissolved Solids (ug/L)	**590,000**	**741,000**	266,000
Copper (ug/L)	<0.80	<0.80	<0.20
Iron (ug/L)	<4.0	<4.0	31.8
Manganese (ug/L)	2.84	**152**	**470**
Zinc (ug/L)	<2.0	3.4	8.2
Sulfate (mg/L)	32.6	53.5	41,200
Nickel (ug/L)	34.9	2.6	3.6
Ammonia (ug/L as N)	<10	<10	10
Ortho-phosphate (ug/L as P)	140	28	17

Bold values indicate a concentration higher than the established water quality standards (Table 2-31. Common Highway Runoff Contaminants).
Source: USGS, 2016

As discussed above, the aquifers beneath the Phase 1 South portion of the corridor study boundary are used for groundwater withdrawals. MDE has documented numerous groundwater wells within Montgomery County, although the majority of these are located far from the Phase 1 South portion of the corridor study boundary where homes still use well water (MDE, 2015). MDE does not release the exact locations of groundwater wells for landowner privacy and security, therefore the exact location of most wells within the Phase 1 South portion of the corridor study boundary cannot be determined.

The EPA's Drinking Water Mapping Application to Protect Source Waters (DWMAPS) contains information on Wellhead Protection Areas across the country. These data are presented at the HUC12 scale as the percentage of each HUC12 watershed that falls within a Wellhead Protection Area. Of the HUC12 watersheds crossed by the Phase 1 South portion of the corridor study boundary, 17% (4 drinking water wells) and 21% (12 drinking water wells) of the Watts Branch (HUC12: 020700081005) and Nichols Run-Potomac River (HUC12: 020700081002) watersheds are identified as being within a Wellhead Protection Area, respectively. No other HUC12 watershed crossed by the Phase 1 South portion of the corridor study boundary are located within a Wellhead Protection Area (EPA, 2021). However, the EPA mapping is presented at a broad watershed scale and does not provide specific well or well-head protection locations. Based on more detailed information provided by MDE, there are no Maryland Wellhead Protection Areas located in the vicinity of the Phase 1 South portion of the corridor study boundary (MDE, 2019). In Maryland, the Phase 1 South portion of the corridor study boundary falls within the service area of the Washington Suburban Sanitary Commission (WSSC), which receives its water from the Potomac River and the Patuxent River. WSSC provides all drinking water within the Phase 1 South portion of the corridor study boundary. Similarly, in Virginia, the Fairfax County Water Authority serves the areas immediately surrounding the Phase 1 South portion of the corridor study boundary and receives its water from the Potomac River via the Washington Aqueduct (Fairfax Water, 2018). Less than 20 percent of the population in Fairfax County is served by private wells (VDH, 2019). Groundwater wells within the Phase 1 South portion of the corridor study boundary that are still in use are generally for commercial and industrial usage, and not used as drinking water.

2.5.3 Environmental Effects

The Preferred Alternative LOD may affect groundwater and hydrology in the project area, mainly due to highway runoff impacts from stormwater infiltration. Groundwater can be contaminated by roadway runoff including substances such as gasoline, oil, and road salts that can seep into the soil and enter the groundwater flow. Soil composition affects how readily contaminants may reach groundwater sources. For example, contaminants are more likely to reach groundwater in sandy soils, which allow more infiltration, than clay soils, which have low infiltration rates. The entire Preferred Alternative LOD falls within the service area of the WSSC in Maryland and Fairfax County Water Authority in Virginia, which receive their drinking water supply from the Potomac River and/or the Patuxent River. Groundwater wells within the Preferred Alternative LOD that are still in use are generally for commercial and industrial usage, and not for drinking water. Consequently, drinking water impacts from groundwater sources are not anticipated. Groundwater impacts are highly geographically variable, based on local soil types, slope variability, impervious area, and widespread construction throughout the region. Therefore, groundwater impacts are difficult to quantify and attribute to one source.

2.5.4 Avoidance, Minimization and Mitigation

During construction activities within the Preferred Alternative LOD, erosion and sediment control plans with the most appropriate BMPs will be in place to mitigate potential impacts to groundwater and hydrology by capturing sediment and pollutants before they are released to the surrounding environment. As described in **Section 2.4.4.C**, ESD SWM will be developed to maintain current infiltration rates to the greatest extent practicable. This will ensure that recharge of the local water table and shallow aquifers is maintained, to preserve local groundwater quantities. The use of the latest SWM BMPs in the Preferred Alternative LOD, including wet ponds and bioswales that filter pollutants through vegetation and soil mediums, would also help to reduce the potential for contamination of shallow groundwater resources, while promoting infiltration.

2.6 Floodplains

Floodplains provide numerous natural and beneficial functions including: flood moderation; water impurity and sediment filtration; groundwater recharge; habitat for fish, terrestrial wildlife, and plants; outdoor recreation space; and open space for agriculture, aquaculture, and forestry (USDOT, 1979). Floodplains naturally and economically help to maintain water quality and reduce flood property damage by providing floodwater storage and decreasing water flow velocity and sedimentation. Floodplains also provide protected environments for plants to grow and for fish and other wildlife to breed and forage. In addition to the advantage of flood damage reduction, humans also benefit from floodplains through the agricultural and recreational space they provide (FEMA, 2018).

2.6.1 Regulatory Context and Methods

Executive Order 11988, US Department of Transportation (USDOT) Order 5650.2, and the National Flood Insurance Act of 1968 govern the construction and fill of floodplains to ensure proper consideration to the avoidance, minimization, and mitigation of floodplain development and associated adverse effects. In addition to enforcing floodplain regulations, the National Flood Insurance Act and its National Flood Insurance Program (NFIP) provide affordable flood insurance to property owners (FEMA, 2018). Work within floodplains on NPS lands must adhere to NPS Floodplain Management D.O. #77-2 (NPS, 2002), as developed by NPS to comply with E.O. 11988 Floodplain Management, unless exempted.

Floodplains are governed by local Flood Insurance Programs and supervised by Federal Emergency Management Agency (FEMA) (FEMA, 2015). MDE houses Maryland's Coordinating Office for the NFIP and is responsible for coordination of all state floodplain programs in Maryland under the Maryland Model Floodplain Management Ordinance (MDE, 2014b). Impacts to 100-year floodplain must be included in the Joint federal/State Permit Application for the Alteration of any Floodplain, Waterway, Tidal or Nontidal Wetland in Maryland and coordinated through MDE's Water Management Administration – Regulatory Services Coordination Office and the USACE. Regulatory authority for floodplain impacts includes Section 404 of the CWA; Environment Article Title 5, Subtitle 5-501 through 5-514; and COMAR 26.17.04 (Waterway and 100-year Flood Plain) (MDOT, 2015). Floodplain approvals will be obtained by the appropriate jurisdiction.

The VDCR floodplain management program and Virginia Department of Transportation (VDOT) construction specifications for roadways also address roadway construction within floodplains. Sections 107 and 303 of VDOT's Road and Bridge Specifications require the use of SWM practices to address issues such as post-development storm flows and downstream channel capacity (VDOT, 2018). These standards require that SWM be designed to reduce stormwater flows to preconstruction conditions for up to a ten-year storm event. As part of these regulations, the capture and treatment of the first half-inch of runoff in a storm event is required, and all SWM facilities must be maintained in perpetuity.

Fairfax County Floodplain Regulations are more stringent than the federal minimum requirements of the NFIP. Activities within their floodplains may require written approval from the Fairfax County Department of Public Works and Environmental Services, or a Special Exception approval issued by the Board of Supervisors (Fairfax County, 2018b).

Floodplains within the Phase 1 South portion of the corridor study boundary were identified using Maryland iMap and the FEMA Effective Floodplain GIS layer. Acreage of the 100-year floodplains within the Preferred Alternative LOD was calculated using GIS. No floodplain fieldwork was conducted.

Section 14 of the Rivers and Harbors Act of 1899, as amended and codified in 33 US Code (USC) 408 (Section 408) regulates alteration of USACE civil work's projects, such as dams, levees, or flood channels. The I-495 & I-270 Managed Lane Study coordinated with USACE to determine applicability of Section 408 to the proposed study. The Section 408 review process typically includes review of engineering, environmental, legal, and safety issues associated with the requested alteration(s). USACE Engineering Circular No. 1165-2-220 issued on September 10, 2018, provides procedural guidance for processing Section 408 requests.

2.6.2 Existing Conditions

The Phase 1 South portion of the corridor study boundary crosses the FEMA 100-year floodplains of several large streams in Montgomery County, Maryland, including: Muddy Branch, Watts Branch, an unnamed tributary to Watts Branch, Cabin John Creek, Booze Creek, an unnamed tributary to Old Farm Creek, Thomas Branch, the Potomac River, Rock Run, Rock Creek, and an unnamed tributary to Muddy Branch. The Phase 1 South portion of the corridor study boundary in Fairfax County crosses the FEMA 100-year floodplains of the Potomac River and Dead Run. The Phase 1 South portion of the corridor study boundary overlaps the FEMA 100-year floodplains of these stream systems to varying degrees. **Table 2-34** lists each stream and the location where its associated floodplain crosses or enters the Phase 1 South portion of the corridor study boundary, and all FEMA 100-year floodplains within the Phase 1 South portion of the corridor study boundary are depicted on the Natural Resources Inventory Maps in **Appendix B**.

USACE identified one Section 408 resource near the Phase 1 South portion of the corridor study boundary, the Washington Aqueduct, located adjacent to Clara Barton Parkway near the Potomac River.

Table 2-34. Waterways and Associated Floodplains within the Phase 1 South portion of the Corridor Study Boundary

Name of Associated Waterway	Location Where Floodplain Crosses Phase 1 South portion of the Corridor Study Boundary
Muddy Branch	Crosses I-270, north of I-370 interchange and enters SE of I-270/Muddy Branch Road intersection
Watts Branch	Crosses I-270, NW of W Montgomery Ave interchange
Unnamed Tributary to Watts Branch	Small area between I-270 and Watts Branch Pkwy near Fallswood Ct
Cabin John Creek	Enters NE portion of I-270/Montrose Rd interchange, enters south of the I-495/Cabin John Parkway, crosses the I-495/Cabin John Parkway interchange, enters southwest of I-495/River Road interchange
Booze Creek	Southwest of the I-495/Cabin John Parkway
Unnamed Tributary to Old Farm Creek	Small area between I-270 and Windermere Court
Thomas Branch	Follows Thomas Branch from I-270 Spur S at Democracy Blvd (starting at NE corner of interchange), south along I-495 to the River Road interchange where it meets Cabin John Creek
Potomac River	At the Maryland/Virginia border
Rock Run	Northwest of I-495/Clara Barton Parkway interchange
Rock Creek	Along 495 from I-270 to Jones Mill Road
Unnamed tributary to Muddy Branch	Northeast of I-270/I-370 interchange
Dead Run	George Washington Memorial Parkway, east of I-495

2.6.3 Environmental Effects

Development and fill in the floodplain alter flooding dynamics by reducing flood storage capacity and/or increasing the velocity of flood flows.

The 100-year floodplain impacts presented in **Table 2-35**[5] represent the estimated total footprint of construction activities in floodplains of the Preferred Alternative LOD. Actual analysis of potential project related changes to hydraulic function and elevation of floodplains would be determined using hydraulic and hydrologic floodplain modeling as part of the engineering process for each structure and fill in final phases of design. Construction of roadway improvements across drainageways and in floodplains may lead to increases in floodplain elevation and size, which must be addressed. Detailed analysis and design solutions will be required to accommodate increased flood volumes to eliminate impacts to insurable properties. MDOT SHA conducted an assessment to determine where culvert augmentations could affect floodplain elevation either from culvert extensions or increased capacity. The estimated area of potential effect was included in the Preferred Alternative LOD. Additional culvert pipes running alongside the existing culverts are proposed in those areas where flood risk potential was identified. Roadway expansion and augmented culverts associated with the Preferred Alternative may increase the size of existing floodplain encroachments but would not result in new significant encroachments into the floodplain as defined in CFR §650.105(q). The proposed expansion of the roadway would increase the size of existing encroachments but would not result in new significant encroachments.

Table 2-35. Impacts to FEMA 100-Year Floodplain in Acres

	Permanent	Temporary	Total
FEMA 100-Year Floodplain	24.16	7.42	31.58

Impacts to floodplains within NPS park land are detailed in **Appendix I** and the Final SOF. One Section 408 resource was identified by USACE near the Preferred Alternative LOD, the Washington Aqueduct, adjacent to the Clara Barton Parkway near the Potomac River. The USACE determined that the Preferred Alternative would not result in an adverse effect to this resource and further coordination is not needed.

2.6.4 Avoidance, Minimization, and Mitigation

FEMA 100-year floodplain impacts were avoided and minimized to the greatest extent practicable while also minimizing increases to flooding levels. Impacts to large, vegetated floodplains such as Rock Creek were avoided and minimized to maintain hydrologic function as well as wildlife habitat. A detailed hydrologic and hydraulic (H&H) study will be prepared during final design to identify the existing storm discharge and floodplain extent. All construction occurring within the FEMA designated floodplains must comply with FEMA-approved local floodplain construction requirements. These requirements consider structural evaluations, fill levels, and grading elevations. SWM will be provided, and all hydraulic structures will be designed to accommodate flood volumes without causing substantial impact. MDOT SHA will employ BMPs within the 100-year floodplain as required by MDE permits, including but not limited to, restricting the stockpiling or storage of construction debris within the floodplain and placing equipment on mats to prevent damage within the floodplain.

[5] For reference, impact tables presented in the report are also included in Appendix A.

Culverts and bridges will be designed to limit the increase of the regulatory flood elevation to protect structures from flooding risks, and the use of standard hydraulic design techniques for all waterway openings will be used where feasible to maintain current flow regimes, limit upstream flooding, and preserve existing downstream flow rates (COMAR 26.17.04). The use of state-of-the-art erosion and sediment control techniques and SWM controls will also minimize the risks or impacts to beneficial floodplain values due to encroachments.

If H&H studies find that the flood elevation would change, floodplain storage mitigation or other actions will be required in accordance with floodplain regulations. MDOT SHA will submit project plans to MDE for approval of structural evaluations, fill volumes, proposed grading evaluations, structural flood-proofing, and flood protection measures in compliance with FEMA requirements, USDOT Order 5650.2, "Floodplain Management and Protection," and Executive Order 11988. Improvements at existing culverts are required to maintain existing 100-year flood high water elevations. At new culverts, 100-year high water elevation is required to be contained within either right-of-way or permanent easement. Culvert improvements and new culvert design will ensure that flood risk to adjacent properties is not increased, a requirement of COMAR 26.17.04.11.

23 CFR § 650.115(a) will be consulted when determining design standards for flood control measures. The requirement set forth in 23 CFR § 650.111 will be complied with at later stages of design to complete location hydraulic studies for floodplain encroachment areas.

Floodplain mitigation will not be required for the unavoidable impacts to floodplains on NPS land resulting from the Preferred Alternative. The I-495 & I-270 Managed Lanes Study will comply with the NIFP and will not increase flooding on NPS land.

2.7 Vegetation and Terrestrial Habitat

2.7.1 Regulatory Context and Methods

Terrestrial habitats identified within the Phase 1 South portion of the corridor study boundary include: forests, urban and maintained areas, open fields, and barren lands. While some wetlands have adjacent terrestrial zones, they are considered a separate and distinct habitat type for the purposes of this document and are discussed in **Section 2.3**.

Forest is the most common terrestrial habitat within the Phase 1 South portion of the corridor study boundary. COMAR (2016) defines a forest as, "a biological community dominated by trees and other woody plants covering a land area of 10,000 SF or larger. It includes areas that have at least 100 trees per acre with at least 50 percent of those having a two-inch or greater diameter at breast height (DBH), and forest areas that have been cut but not cleared (08.19.03.01, Article 2.17)." State funded highway construction projects that involve cutting and clearing of forests are regulated under Maryland Reforestation Law, a regulation created to protect Maryland forests and mitigate for the loss of forest cover. Forest impacts must be replaced on an acre-for-acre or one-to-one basis on public lands, within two years or three growing seasons of project completion (MDNR, 2013a).

Virginia Department of Forestry (VDOF) regulates the use of state forests. No state forests exist within the Virginia portion of the Phase 1 South portion of the corridor study boundary. The only forest resources within the Phase 1 South portion of the corridor study boundary in Virginia are on NPS property. Any impact to forests on NPS lands must be coordinated directly with the NPS.

Forest conservation easements are often required as a condition of development to preserve forested land in perpetuity and to mitigate impacts to forests at the state and county level. Montgomery County Category I easements protect existing and future forested areas from being cleared for construction, paving, or grading. Montgomery County Category II easements prohibit construction activities but are also designed to protect large specimen trees in non-forested areas (M-NCPPC, 2016). Deeds of Conservation Easements are also administered at the state level through the MDNR MET (MET, 2016). Existing county and state forest conservation easement locations within the Phase 1 South portion of the corridor study boundary were determined using data provided by Montgomery County. No Virginia Outdoors Foundation (VOF) open space easements or Agricultural/Forestal Districts are located within the study area.

Individual forest stand characterization data was not able to be collected in the field for the Study due to the extent of the study area. However, GIS forest cover data from the Chesapeake Conservancy Conservation Innovation Center's High Resolution Land Cover Data for tree canopy cover and the VDOF 2005 Virginia Forest Cover dataset (VDOF, 2014) were used to identify forest coverage within the Phase 1 South portion of the corridor study boundary. Data from the 2006 MDOT SHA Draft Capital Beltway Study Natural Environmental Technical Report (NETR) and the 2017 MDOT SHA I-270 ICM Project provide vegetation cover type information that remains applicable within the Maryland portions of the Phase 1 South portion of the corridor study boundary. Land cover types were identified according to the Anderson Land Use Classification System (Anderson et al., 1976). Forests were classified by cover types in the 2006 and 2017 studies in accordance with "Forest Cover Types of the United States and Canada" (Eyre, 1980) and associations in accordance with the "Vegetation Map of Maryland" (Brush et al., 1976). The aerial extent of vegetation cover within the Phase 1 South portion of the corridor study boundary was identified using GIS data obtained from the Chesapeake Conservancy Conservation Innovation Center's High Resolution Land Cover Data for tree canopy cover and the VDOF 2005 Virginia Forest Cover dataset (VDOF, 2014).

Since the DEIS was published, a tree inventory and four-season RTE plant survey were conducted on NPS property. The RTE surveys are discussed in **Section 2.10**. The tree survey was conducted on NPS property within the extent of the DEIS Alternative 9 LOD plus 50-feet, to ensure that all critical root zones within the LOD would be included. Following the guidance in the *Forest Inventory and Analysis National Core Field Guide. Volume I: Field Data Collection Procedures for Phase 2 Plots. Version 9.0, October 2019*, an inventory of all trees and standing dead trees ≥ 5 inches diameter at breast height (4.5 feet, DBH) was completed, including the identification of all significant trees (trees ≥ 24 inches DBH < 30 inches) and specimen trees (≥ 30 inches DBH or 75% of the size of the state champion).

Since the DEIS was published, M-NCPPC requested a tree inventory on their property within the Preferred Alternative LOD plus a 50-foot buffer. An inventory of all trees and standing dead trees > 6 inches DBH (4.5 feet, DBH) was completed within the survey limits, including the identification of all significant trees (trees ≥ 24 inches DBH < 30 inches) and specimen trees (≥ 30 inches DBH or 75% of the size of the state champion).

2.7.2 Existing Conditions

The following land cover types were identified within the Phase 1 South portion of the corridor study boundary: residential; commercial and services; industrial; transportation, communication, and utilities; industrial and commercial complexes; mixed urban or built-up land; cropland and pasture; orchards, groves, vineyards, nurseries, and ornamental horticultural areas; strip mines, quarries, and gravel pits; open fields/meadows/grasslands, scrub/shrub lands, and deciduous, evergreen, and mixed forests. Wetlands and streams, while classified under the Anderson hierarchy, are discussed in **Section 2.3**. Descriptions of land cover included below were adapted from the Draft Capital Beltway Study NETR (MDOT SHA, 2006) and the I-270 ICM Program field investigation. Although the Draft Capital Beltway Study NETR information was collected in 2006, the land cover is still generally the same based on windshield survey and aerial review; therefore, the data collected for this purpose remains valid.

A. Urban/Built-up and Maintained Areas

Urban and built-up land covers most of the Phase 1 South portion of the corridor study boundary, including dense clusters of old and new residential, commercial, and industrial land cover types on formerly forested areas. Vegetation in these areas is dominated by tulip poplar (*Liriodendron tulipifera)* forest, landscaped areas and lawns, and ornamental and non-native shrubs and trees. Consequently, most wildlife within the Phase 1 South portion of the corridor study boundary is adapted to human-modified environments, especially where development occurred near existing forest or where wildlife has been displaced. Many wildlife species can be found in older residential developments with mature landscape plantings, a variety of fruit or seed producing vegetation, established forest corridors, or food in feeders. See **Section 2.8 Terrestrial Wildlife** for more detail.

B. Agricultural Land, Open Fields, Meadow, and Grassland

Anderson et al. (1976) defines agricultural land as areas that are tilled for crops or mowed or grazed so few woody species can establish. No agricultural land was identified within the Phase 1 South portion of the corridor study boundary in Montgomery County or Fairfax County.

The Phase 1 South portion of the corridor study boundary also includes meadow habitats and open fields. Anderson et al. (1976) defines the old field/meadow cover type as abandoned land that has a large portion of shrubs, a few trees, and an extensive herbaceous layer containing a mix of grasses and other plants. The majority of meadow habitat within the Phase 1 South portion of the corridor study boundary consists of meadow “edge” habitats, which occur in strips along roadways, trails, and fields and were historically mowed (MDNR, 2017). MDOT SHA commonly uses seed mixes that promote pollinator species on roadsides and edges and will continue this practice within the Phase 1 South portion of the corridor study boundary.

C. Barren Land

Barren land within the Phase 1 South portion of the corridor study boundary is composed entirely of quarries and gravel pits. Active and recently abandoned sand and gravel mines occur in Montgomery County at the I-495/MD 190 interchange. Soil in these areas has been excavated to varying depths, and vegetation typically consists of pioneer herbaceous species and early successional forest dominated by Virginia pine (*Pinus virginiana*).

D. Forested Areas

Forested land within the Phase 1 South portion of the corridor study boundary occurs predominantly as small strips along roadsides and interchanges, stream valleys, and steep slopes, with larger tracts occurring on undeveloped park lands. Individual forest stands in Montgomery County are typically smaller and fragmented, most likely due to a high level of development adjacent to I-495 and I-270 in Montgomery County (MDOT SHA, 2006). The only forest resources within the Phase 1 South portion of the corridor study boundary in Virginia are on NPS property.

Large tracts of contiguous forest are necessary to support Forest Interior Dwelling Species (FIDS) and Green Infrastructure (GI) habitats. FIDS habitats are specifically discussed in **Section 2.8** and GI habitats are discussed in **Section 2.11.**

NPS Tree Survey limits include NPS properties located in Chesapeake and Ohio Canal National Historical Park, Clara Barton Parkway, George Washington Memorial Parkway, Baltimore Washington Parkway/Greenbelt Park and Suitland Parkway. Species, DBH, and condition was recorded for each of the inventoried trees. A total of 22,598 trees were inventoried across the entire study area (the DEIS Alternative 9 LOD plus 50 feet). The Preferred Alternative LOD includes Chesapeake and Ohio Canal National Historical Park, Clara Barton Parkway, and George Washington Memorial Parkway NPS properties. Living and standing dead inventoried trees and the total DBH recorded are included in **Table 2-36**. See the NPS Tree Inventory Report (**Appendix I**) for more information.

Table 2-36. NPS Property Tree Survey Results

NPS Property	Number of Live Individual Trees	Number of Standing Dead Trees	Total inches of DBH
Chesapeake and Ohio Canal	1,544	244	19,345
Clara Barton Parkway	756	114	10,098
George Washington Memorial Parkway	2,175	154	31,900
Total	**4,475**	**512**	**61,343**

The M-NCPPC tree inventory included Cabin John Regional Park, Cabin John SVP Unit 6, Cabin John SVP Unit 2, Old Farm NCA, and Tilden Woods SVP properties within the Preferred Alternative LOD plus 50 feet. Species DBH and condition were recorded for each of the inventoried trees. Living and standing dead inventoried trees and the total DBH recorded are included in **Table 2-37**. The M-NCPPC tree inventory is included in **Appendix S**.

Table 2-37. M-NCPPC Property Tree Survey Results

M-NCPPC Property	Number of Live Individual Trees	Number of Standing Dead Trees	Total inches of DBH
Cabin John Regional Park	1,727	100	23,918
Cabin John SVP, Unit 6	364	28	5,041
Cabin John SVP, Unit 2	681	83	9,473
Old Farm NCA	30	3	725
Tilden Woods SVP	116	4	2,060
Total	**2,918**	**218**	**41,217**

Forest associations commonly found in central Maryland and northern Virginia and their general descriptions are provided below.

a. Red Maple Association

The Red Maple Association grows in a wide variety of locations over an extensive range in the Eastern US and is comprised mostly of red maple (*Acer rubrum*). There has been an increased presence of red maple in forest stands in the Mid-Atlantic, most likely due to changes in forest composition resulting from clearcutting, removal of other more desirable trees for lumber, and the decline of American elm (*Ulmus americana*) due to Dutch elm disease. Due to the adaptable nature of red maple, this association can be found on sites ranging from extremely wet to dry. The Red Maple Association is generally considered an early to mid-successional forest type.

The Red Maple Association occurs throughout the Phase 1 South portion of the corridor study boundary (MDOT SHA, 2006). The Montgomery County-Prince George's County line roughly matches the Atlantic Seaboard Fall Line, which separates the Piedmont and Atlantic Coastal Plain Physiographic Provinces. Associated species include sycamore (*Platanus occidentalis*), tulip poplar, silver maple (*Acer saccharinum*), box elder (*Acer negundo*), black cherry (*Prunus serotina*), ash (*Fraxinus sp*.), slippery elm (*Ulmus rubra*), sweetgum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), black locust (*Robinia pseudoacacia*), spicebush (*Lindera benzoin*), flowering dogwood (*Cornus florida*), southern arrowwood (*Viburnum dentatum*), and poison ivy (*Toxicodendron radicans*).

b. Tulip Poplar Association

The Tulip Poplar Association is typically found in the Eastern US at lower elevations and can occur in large, uninterrupted stands. Soils in this association tend to be moderately deep to deep, moist, well-drained, and medium to fine in texture, and are derived primarily from sandstones or shales.

The Tulip Poplar Association comprises the majority of the mid to late-successional forest stands within the I-495 portion of the Phase 1 South portion of the corridor study boundary. This association is common in Montgomery County most likely due to the County's location within the drier moisture regime of the Piedmont Physiographic province (MDOT SHA, 2006). Associated species commonly include: red maple, sycamore, American beech (*Fagus grandifolia*), oaks (*Quercus sp.*), hickory (Carya sp.), black locust, sassafras (*Sassafras albidum*), spicebush, flowering dogwood, southern arrowwood, American hornbeam (*Carpinus caroliniana*), viburnum (*Viburnum sp.*), American holly (*Ilex opaca*), greenbrier (*Smilax rotundifolia*), blackberry (*Rubus sp*.), poison ivy, Virginia creeper (*Parthenocissus quinquefolia*), wintercreeper (*Euonymus fortunei*), Christmas fern (*Polystichum acrostichoides*), and scattered false solomon's seal (*Maianthemum racemosum*).

c. Black Locust Association

The Black Locust Association is a pioneer forest type that is found extensively throughout the Eastern US, most often in highly-disturbed areas such as mines and recently cleared areas. Common associate species are extremely variable due to the early successional nature of this forest type, and could include: red maple, box elder, silver maple, black cherry, ash, American elm, staghorn sumac (*Rhus typhina*), winged sumac (*Rhus copallinum*), Eastern red-cedar (*Juniperus virginiana*), black walnut (*Juglans nigra*), sassafras, blackberry, Virginia creeper, and grapevine (*Vitis sp*.).

d. White Oak-Black Oak-Northern Red Oak Association

The White Oak-Black Oak-Northern Red Oak Association occurs over a wide range of areas within the I-495 portion of the Phase 1 South portion of the corridor study boundary, with dominant canopy species including white oak (*Quercus alba*), black oak (*Quercus velutina*), and red oak (*Quercus rubra*) (MDOT SHA, 2006). This forest association occurs on glaciated and non-glaciated soils, and most of the stands are mid-successional. White oak is present over the greatest range of sites from moist to dry, northern red oak is more common on moist lower and middle slopes, and black oak is more common on drier, upper slopes. Northern red oak is the most common species in the association, followed by white oak, and then black oak. Other common associate species include: hickory, tulip poplar, American beech, black gum, American hornbeam, and Christmas fern.

e. Northern Red Oak Association

The Northern Red Oak Association occurs infrequently in the northeastern US and is most common on sites with intermediate moisture regimes. Several Northern Red Oak Associations occur along I-495 within the Montgomery County portion of the Phase 1 South portion of the corridor study boundary (MDOT SHA, 2006). Common associate species include: tulip poplar, red maple, American beech, white oak, green ash (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*), southern red oak (*Quercus falcata*), and flowering dogwood.

f. Sycamore-Green Ash-Box Elder-Silver Maple Association

The Sycamore-Green Ash-Box Elder-Silver Maple Association is typically found in wetter areas and common associate species include sassafras, elm (*Ulmus sp.*), ash, white oak, box elder, black cherry, American hornbeam, spicebush, Virginia creeper, poison ivy, and grapevine. Ash trees are one of the most common landscaping and native forest trees in Maryland, however the emerald ash borer (EAB) (*Agrilus planipennis*), an invasive beetle species native to Asia, has killed millions of ash trees in the central and northeastern US resulting in millions of dollars of losses to municipalities, property owners, nurseries, and other forest-related industries. EAB larvae tunnel into and feed on ash trees, stopping nutrient and water movement, which kills large trees within three years after infestation (University of Maryland, 2018). The species composition of the Sycamore-Green Ash-Box Elder-Silver Maple Association forests within Maryland will continue to evolve as the EAB infestation results in mortality of ash trees statewide.

g. River Birch-Sycamore Association

The River Birch-Sycamore Association is typically found along rivers and streams in eastern North America and includes dominant species of river birch (*Betula nigra*) and sycamore. The association typically appears in the earlier stages of floodplain establishment and is most well-suited to generally moist, periodically drained alluvial areas. Common associate species include box elder, red maple, tulip poplar, black walnut, elm, sweet gum, cottonwood (*Populus deltoides*), black cherry, white oak, overcup oak (*Quercus lyrata*), spicebush, American hornbeam, American holly, sassafras, southern arrowwood, and poison ivy.

h. White Oak Association

The White Oak Association is found on dry to moderately wet sites, occasionally occurring on poorly-drained bottomland soils with high clay content. White oak is a common species within several parts of the Phase 1 South portion of the corridor study boundary, but the White Oak Association is not very common. Commonly associated species include: northern red oak, tulip poplar, hickory, and flowering dogwood.

i. Cottonwood Association

The Cottonwood Association is commonly found along rivers and streams and quickly establishes in areas with bare, moist soils. This forest type is typically classified as early successional, as it establishes very quickly within the floodplain following disturbance. Associate species include sycamore, box elder, and black locust.

j. Pioneer/Invasive Areas

Forested areas dominated by the non-native species tree of heaven (*Ailanthus altissima*) and occurring in highly-disturbed areas were grouped as Pioneer/Invasive. Associate species include black walnut, Eastern red-cedar, staghorn sumac, multiflora rose, Japanese knotweed (*Polygonum cuspidatum*), porcelain berry, oriental bittersweet, Japanese honeysuckle, poison ivy, and Callery (Bradford) pear.

k. Chestnut Oak Association

Chestnut Oak Association forests are typically found on dry, upland sites with steep, rocky slopes and outcrops with thin soils. Common associate species include hickory, white ash, and flowering dogwood

l. Tulip Poplar-White Oak-Northern Red Oak Association

The Tulip Poplar-White Oak-Northern Red Oak Association is commonly observed at higher elevations in the eastern US and can be found on drier sites in the Piedmont Plateau. Common associate species include hickory and Christmas fern.

m. Virginia Pine Association

The Virginia Pine Association is most often identified as early-successional, as it tends to be relatively short-lived. Virginia pine is tolerant of poor site conditions and typically invades old fields or disturbed areas. Common associate species include various oak species, Eastern red-cedar, sassafras, greenbrier, blackberry, and poison ivy.

E. Invasive and Exotic Species

Invasive and exotic plants thrive in vegetative edge and fragmented forest environments, competing with and often displacing native plant species. This results in a reduction in diversity of native plant and animal species and overall health of the ecological community (Swearingen et al., 2002). The Phase 1 South portion of the corridor study boundary contains miles of linear vegetative edges along the roadway, as well as extensive forest fragments within highway interchanges. **Table 2-38** lists the most common invasive species identified within these areas during the IRVM program.

MDOT SHA began management of invasive species within the I-495 ROW in May 2016 as part of the IRVM program. This vegetation management included cutting, removal, and chemical control of invasive tree, shrub, and herbaceous species along I-495 in Montgomery County, from south of the Chesapeake and Ohio Canal to the Prince George’s County line.

Table 2-38. Common Invasive Species within the Phase 1 South Portion of the Corridor Study Boundary

Common Name	Scientific Name	Stratum	Ecological Threat
Norway maple	*Acer platanoides*	Tree	Norway maple spreads rapidly by seed, and shades out native trees and shrubs.
Tree-of-Heaven	*Ailanthus altissima*	Tree	Tree of heaven invades urban areas, where it can cause damage to man-made structures, and natural habitats, where it displaces native plants and produces toxins, which prevent nearby plants from establishing and/or surviving.
Silktree	*Albizia julibrissin*	Tree	Tolerant of a wide variety of conditions, silktree is prolific and displaces native trees and shrubs.
Princesstree	*Paulownia tomentosa*	Tree	Princesstree is highly adaptable and can be found in a wide variety of habitats, where it displaces native vegetation.
Callery (Bradford) Pear	*Pyrus calleryana* Dcne.	Tree	Callery pear forms dense thickets that push out other plants including native species that can't tolerate the deep shade or compete with pear for water, soil, and space. It produces copious amounts of seeds that are readily dispersed by animals, grows rapidly in disturbed areas, and lacks natural controls like insects and disease.
Privet	*Ligustrum sp.*	Shrub	Privets form dense thickets, thereby outcompeting and eventually excluding native vegetation.
Morrow's honeysuckle; Twinsisters; other bush honeysuckles	*Lonicera morrowi and Lonicera tatarica; other Lonicera species*	Shrub	Bush honeysuckles compete with and eventually displace native shrubs, thereby altering the natural habitat. These shrubs also outcompete native shrubs for pollinators and seed-dispersing animals, such as birds.
Multiflora rose	*Rosa multiflora*	Shrub	Multiflora rose can invade a wide range of habitats, and displaces native shrubs and herbs, possibly decreasing nesting areas for native birds.
Amur peppervine	*Ampelopsis brevipedunculata*	Vine	Spreading vine, which invades disturbed and open areas, threatens native vegetation by shading out herbs, trees, and shrubs.
Asian bittersweet	*Celastrus orbiculatus*	Vine	Spreading vine, which is tolerant of a wide range of conditions and threatens native vegetation by shading out herbs, trees, and shrubs, or girdling native trees and shrubs or uprooting them due to added weight.
Winter creeper	*Euonymus fortunei*	Vine	Spreading evergreen vine, which is tolerant of a wide range of conditions and threatens native vegetation by shading out herbs, trees, and shrubs; especially common in forest openings.

Common Name	Scientific Name	Stratum	Ecological Threat
English ivy	*Hedera helix*	Vine	Evergreen spreading vine, which threatens native vegetation by shading out herbs, trees, and shrubs, or girdling native trees and shrubs or uprooting them due to added weight.
Japanese honeysuckle	*Lonicera japonica*	Vine	Evergreen spreading vine, which threatens native vegetation by shading out herbs, trees, and shrubs, or girdling young trees and shrubs.
Asiatic tearthumb	*Persicaria perfoliata*	Vine	Spreading vine, which invades disturbed and open areas threatens native vegetation by shading out herbs, trees, and shrubs.
Kudzu	*Pueraria montana var. lobata*	Vine	Spreading vine, which threatens native vegetation by shading out herbs, trees, and shrubs, and possibly girdling native trees and shrubs or uprooting them due to added weight. Kudzu can grow up to one foot per day.
Garlic-mustard	*Alliaria petiolata*	Herb	Extremely shade tolerant, garlic mustard invades forested areas and shades out native wildflowers, eventually displacing them.
Bamboo	*Bambusa, Phyllostachys, and Pseudosasa species*	Herb	Bamboo is widely planted by humans as a landscape plant, but if not controlled, forms dense, spreading thickets, which will displace native vegetation.
Japanese stilt grass	*Microstegium vimineum*	Herb	Japanese stiltgrass is tolerant of a wide range of conditions, and invades both full sun and shaded areas, eventually shading out native vegetation.
Common reed	*Phragmites australis*	Herb	Grass species, which invades wet areas, such as marshes, drainage areas, and riverbanks. Forms expansive monocultures, which threaten biodiversity in these areas.
Japanese knotweed	*Polygonum cuspidatum*	Herb	Knotweed is tolerant of a wide range of conditions, but is most commonly found on stream and riverbanks, where it spreads quickly, outcompeting native vegetation.

F. Reforestation Areas

MDOT SHA planted trees within the Phase 1 South portion of the corridor study boundary under the Chesapeake Bay TMDL Tree Program and the Intercounty Connector (ICC) Project Mitigation Program, with the goal of establishing new forested areas to mitigate for stormwater runoff and project construction impacts. The EPA developed the Chesapeake Bay TMDL to establish the maximum amount of nitrogen, phosphorus, and sediment that the Chesapeake Bay can receive and still meet water quality standards as required by the Federal CWA. MDOT SHA is required to meet the reductions in the Bay TMDL as a condition of its NPDES Municipal Separate Storm Sewer System (MS4) Permit 11-DP-3313 issued on October 9, 2015. The MS4 permit requires MDOT SHA to treat or offset pollutants from stormwater runoff from 20 percent of MDOT SHA's untreated impervious surfaces using BMPs approved by the MDE by October 8, 2020.

Tree planting in state road rights-of-way or state-owned properties is one of the most cost-effective and widely implemented MDOT SHA strategies for meeting the MS4 permit requirements, and TMDL tree planting sites are located in interchanges throughout the Phase 1 South portion of the corridor study boundary.

The ICC is an 18.8-mile-long six-lane toll highway that connects Gaithersburg in Montgomery County to Laurel in Prince George's County. In accordance with Maryland Reforestation Law, reforestation areas were established within the MDOT rights-of-way along I-495 and I-270 to mitigate for forest impacts associated with ICC construction. One reforestation site (REF-6D1) is located in Montgomery County in the eastern clover leaf of the I-270/Shady Grove Road interchange.

No reforestation areas were identified by VDOT within the Virginia portion of the Phase 1 South portion of the corridor study boundary.

G. Forest Conservation Easements

A total of 61 local forest conservation easements fall within the Phase 1 South portion of the corridor study boundary, according to MD iMap data. These protected forest areas are described in **Table 2-39** below with location and category information. There are no state held forest conservation easements within the Phase 1 South portion of the corridor study boundary according to available GIS data from MD DNR. No Virginia Department of Forestry open space easements or Agricultural/Forestal Districts are located within the Phase 1 South portion of the corridor study boundary.

Table 2-39. Forest Conservation Easements Within the Phase 1 South Portion of the Corridor Study Boundary

Property	Category[1]	Location
M-NCPPC	I	West of I-495, east of Tammy Court
M-NCPPC	I	Southeast of the I-270/Old Georgetown Road interchange (1)
M-NCPPC	I	Southwest of the I-270/Old Georgetown Road interchange (2)
M-NCPPC	I	South of I-270, north of Aubinoe Farm Drive
M-NCPPC	I	West of I-270, east of Snow Point Drive
M-NCPPC	I	East of I-270, west f Grosvenor Place
M-NCPPC	I	North of I-495, east of Greentree Road
M-NCPPC	I	South of I-495, west of Fernwood Road
M-NCPPC	I	South of I-495, north of Maplewood Park Drive
M-NCPPC	I	East of I-495, north of Bradley Boulevard
M-NCPPC	I	East of I-495, west of Armat Drive
M-NCPPC	I	East of I-495, south of Bradley Boulevard
M-NCPPC	I	West of I-495, north of MacArthur Boulevard
M-NCPPC	I	West of I-495, north of Cindy Lane
M-NCPPC	I	West of I-495, northeast of Lonesome Pine Road (1)
M-NCPPC	I	West of I-495, northeast of Lonesome Pine Road (2)
M-NCPPC	I	West of I-495, northeast of Old Seven Locks Road
M-NCPPC	I	Northwest of the I-495/River Road interchange (1)
M-NCPPC	I	Northwest of the I-495/River Road interchange (2)

Property	Category[1]	Location
M-NCPPC	I	Northeast of the I-495/River Road interchange (1)
M-NCPPC	I	Northeast of the I-495/River Road interchange (2)
M-NCPPC	I	South of I-495, north of Endicott Court
M-NCPPC	I	North of I-495, west of Persimmon Tree Road
M-NCPPC	I	East of I-270, west of Earlsgate Lane
M-NCPPC	I	East of I-270, south of Tuckerman Lane
M-NCPPC	I	East of I-270, north of Tuckerman Lane (1)
M-NCPPC	I	East of I-270, north of Tuckerman Lane (2)
M-NCPPC	I	East of I-270, north of Tuckerman Lane (3)
M-NCPPC	I	West of I-270, south of Montrose Road
Rockville		East of I-270, north of Montrose Road
Wheel of Fortune II	Individual Tree	East of I-270, south of Tower Oaks Boulevard
M-NCPPC	I	East of I-270, south of Preserve Parkway
M-NCPPC	I	West of I-270, south of Fortune Terrace
Rockville	-	West of I-270, south of Wooton Parkway (1)
Rockville	-	West of I-270, south of Wooton Parkway (2)
Rockville	-	West of I-270, south of Wooton Parkway (3)
Rockville	-	East of I-270, south of Wooton Parkway (1)
Rockville	-	East of I-270, south of Wooton Parkway (2)
Rockville	-	East of I-270, north of Wooton Parkway (1)
Rockville	-	East of I-270, north of Wooton Parkway (2)
Rockville	-	East of I-270, north of Wooton Parkway (3)
Rockville	-	West of I-270, south of Falls Road
Rockville	-	East of I-270, west of Tower Oaks Boulevard
Rockville	-	East of I-270, northwest of Great Falls Road
Rockville	-	East of I-270, west of Blaze Cumber Way
Bou Property	Individual Tree	East of I-270, west of Blue Hosta Way
Rockville	Individual Tree	West of I-270, east of W Montgomery Avenue (1)
Research Row	Individual Tree	West of I-270, east of W Montgomery Avenue (2)
National Capital Research Park	Individual Tree	West of I-270, east of Research Boulevard
Rockville	-	West of I-270, east of Research Boulevard
Rockville		East of I-270, west of Carnation Drive
1330 Piccard Drive	Individual Tree	East of I-270, west of Piccard Drive
4 Research Place	Individual Tree	West of I-270, north of Research Place
1 Research Court	Individual Tree	West of I-270, east of Research Court (1)
Crown Plaza Hotel	Individual Tree	West of I-270; east of Research Court (2)
Rockville	-	East of I-270, west of Redland Boulevard
Rockville	-	West of I-270, east of Shady Grove Road
Upper Rock Blocks A, B, C, G, H	Individual Tree	East of I-270, east of Shady Grove Road
M-NCPPC	II	South of Y-split of I-270, northwest of Rockledge Drive

Property	Category[1]	Location
Gaithersburg	I	Northwest of the I-270/I-370 interchange
Gaithersburg	I	Northeast of the I-270/I-370 interchange

[1] Montgomery County Category I easements protect existing and future forested areas from being cleared for construction, paving, or grading. Montgomery County Category II easements protect large specimen trees in non-forested areas.

Other forest conservation easements exist within close proximity to the Phase 1 South portion of the corridor study boundary, and any changes to the Preferred Alternative Phase 1 South limits could impact forest conservation easements not listed here.

In Virginia, the resource protection areas (RPAs) within the corridor study boundary include the land within 100 feet of the Potomac River and Dead Run, some of which will be affected by the project. Vegetation within RPAs is subject to regulation under the Chesapeake Bay Protection Act.

2.7.3 Environmental Effects

Forested areas naturally filter ground water, reduce runoff from impervious surfaces, contribute to lower stream temperatures, supply necessary habitat for wildlife, sequester carbon, and contribute to air filtration and cooling (M-NCPPC, 1992). Construction of the Preferred Alternative LOD for the I-495 & I-270 Managed Lanes Study will involve the removal and disturbance of vegetated areas, including forests, within the LOD due to clearing and grading of land needed for construction of highway travel lanes; highway interchanges, ramps, and service roads; construction of noise barriers; and construction of required SWM BMPs. Fewer impacts will occur to non-forested areas, such as managed lawns, landscaped areas, and cropland or pastures within interchanges, along the roadside, and within adjacent parcels to the existing roadway rights-of-way.

Larger forested areas within the Preferred Alternative LOD are found on parkland and within stream valleys, with smaller areas of mostly disturbed vegetation occurring in residential and commercial areas. Total forest canopy and conservation easement impacts from the Preferred Alternative LOD are shown in **Table 2-40**[5] below. Temporary forest canopy impacts are areas in which forest will be cleared that will not be permanently acquired or altered by roadway construction and will be replanted.

Table 2-40. Impacts to Forests in Acres

	Perm	Temp	Total
Forest Canopy[1]	438.47	16.49	454.96
Forest Conservation Act Easements	10.43	0.67	11.10
NPS Forest Canopy	1.96	7.82	9.78

[1]Tree cover removed where wetlands overlapped.

Impacts to trees surveyed on NPS properties within the DEIS Alternative 9 LOD plus 50 feet are included in **Table 2-41**. The NPS Tree Survey Report is included in **Appendix I**.

[5] For reference, impact tables presented in the report are also included in Appendix A.

Table 2-41. Impacts to Surveyed Trees on NPS Properties

NPS Property	Live Tree Impacts[1] (#/DBH)	Standing Dead Tree Impacts[1] (#/DBH)
Chesapeake and Ohio Canal	813/10,117	115/1,317
Clara Barton Parkway	270/3,429	45/569
George Washington Memorial Parkway	76/1,113	9/113
Total	**1,159/14,659**	**169/1,999**

Notes: [1] Impacts to trees are only considered permanent totals; there are no temporary impacts.

Impact to trees surveyed on M-NCPPC properties within the Preferred Alternative LOD plus 50 feet are included in **Table 2-42**. The M-NCPPC Tree Survey Report is included in **Appendix S**.

Table 2-42. Impacts to Surveyed Trees on M-NCPPC Properties

M-NCPPC Property	Live Tree Impacts[1] (#/DBH)	Standing Dead Tree Impacts[1] (#/DBH)
Cabin John Regional Park	531 / 6,873	34 / 350
Cabin John SVP, Unit 6	63 / 962	8 / 57
Cabin John SVP, Unit 2	57 / 853	5 / 57
Old Farm NCA	3 / 64	1 / 15
Tilden Woods SVP	24 / 385	2 / 26
Total	**678 / 9,137**	**50 / 505**

Notes: [1] Impacts to trees are only considered permanent totals; there are no temporary impacts.

Direct forest and tree impacts would include tree removal, critical root zone (CRZ) disturbance, tree canopy/limb damage, soil compaction, changes in soil moisture regimes due to grading operations and other construction-related activities, and sunscald and windthrow of individual trees growing along the newly exposed edges of retained forested areas. Indirect impacts to vegetated areas could result from increased roadway runoff, sedimentation, and the introduction of non-native plant species within disturbed areas. These indirect impacts could lead to terrestrial habitat degradation within the Preferred Alternative LOD, and ultimately a decrease in plant and animal species that inhabit these areas.

Impacts to contiguous forest areas, such as FIDS habitat, increase habitat fragmentation and edge to interior ratio, which has the potential to negatively impact wildlife species that rely on these forested corridors as habitat. Many wildlife species in the Washington D.C. metropolitan region rely on forested corridors to move safely within an otherwise urbanized environment. Impacts to potential FIDS habitat would be due to widening of the existing highway, resulting in slightly contracted forest interiors required by FIDS species. Increased edge habitat supports species common to developed areas such as deer and red-tailed hawks, but impacts populations that rely on mature forests such as barred owls and scarlet tanagers, thereby reducing biodiversity. Increased deer habitat within an urbanized setting promotes unhealthy population growth and can pose a roadway hazard by increasing deer-related automobile accidents. Increased edge to interior ratio in forests also results in increased introduction of invasive plant species, resulting in lower plant biodiversity and fewer native plant species that support native wildlife. Impacts to the TMDL and ICC reforestation sites are summarized in **Table 2-43** below.

Table 2-43. Impacts to TMDL and ICC Reforestation Sites in Acres

	Permanent	Temporary	Total
TMDL Reforestation Sites	0.88	0.00	0.88
ICC Reforestation Sites	2.77	0.00	2.77

2.7.4 Avoidance, Minimization, and Mitigation

Avoidance and minimization efforts to reduce forest impacts will involve a two-tiered approach. The first level occurred during the planning stage where every reasonable effort was made at this level of design to minimize disturbance to or removal of forest and trees by minimizing the Preferred Alternative LOD. The second level of additional avoidance and minimization will occur at the Public-Private Partnership (P3) design/build stage, with advancement of the design and further refinements to the LOD. Cost reduction related to tree removal and replacement provide incentive to refine the LOD and reduce impacts to resources, but due to the fixed nature of the highway corridor, opportunities for avoidance and minimization of impacts to roadside forest and tree resources are limited. The Developer will continue to look for opportunities to avoid and minimize impacts throughout the remainder of the design process to the greatest extent practicable. Monetary incentives have been added to the Section Developer's Technical Provisions to encourage further avoidance and minimization of impacts to forest.

Unavoidable impacts to forest from construction of the Preferred Alternative in Maryland will be regulated by MDNR under Maryland Reforestation Law. Forest impacts must be replaced on an acre-for-acre or one-to-one basis on public lands, within two years or three growing seasons of project completion (MD Natural Resources Code Ann. §5-103). The Maryland Reforestation Law hierarchy for mitigation options is on-site planting, then off-site planting on public lands within the affected county and/or watershed. If planting is not feasible, there is the option to purchase credits from forest mitigation banks, or to pay into the state Reforestation Fund at a rate of ten cents per square foot or $4,356 per acre. As such, MDOT SHA would first be required to find available public land to be reforested within the affected county and/or watershed. If this is not possible, MDOT SHA could purchase credits in a forest mitigation bank or pay into the MDNR Reforestation Fund that is used by MDNR to plant replacement trees. Forest mitigation banking must be conducted in accordance with the Maryland Forest Conservation Act (MD Natural Resources Code Ann. §5-1601-1613).

A reforestation mitigation site search was conducted from June 2019 to December 2020 to identify potential off-site mitigation opportunities on public lands for the entire corridor study boundary in Maryland, prior to the identification of the Preferred Alternative. The site search included outreach to public property owners in the affected counties (Montgomery and Prince George's Counties) and watersheds (Washington Metropolitan and Patuxent River MDE 6-Digit Watersheds) to identify potential reforestation sites. MDOT excess lands were also reviewed for potential reforestation sites and to identify opportunities for creation of forest retention mitigation banks that could be used for mitigation based on a 1:2 credit ratio. Nearly 240 off-site reforestation mitigation opportunities were reviewed on public lands in the affected counties and watersheds, resulting in 79 recommended off-site reforestation mitigation sites that could provide 352.6 acres of credit, including 295.3 acres of reforestation planting on public lands and 114.6 acres (57.3 credit acres) of forest retention on MDOT SHA excess lands. The methodology and results of this site search are documented in the *I-495/I-270 MLS Maryland Reforestation Law*

Mitigation Site Search Report, which was submitted to MDNR for review in December 2020 and is included in **Appendix T**.

The Maryland 2021 Legislative Session House Bill 991 (HB0991; *Tree Solutions Now Act*) passed on May 30, 2021 and enacted June 1, 2021 updates the Maryland Forest Conservation Act to allow for "qualified conservation" as a form of "forest mitigation banking," but defines "qualified conservation" as conservation of existing forest that "was approved on or before December 31, 2020 by the appropriate State or local forest conservation program for the purpose of establishing a forest mitigation bank." Approved forest mitigation banks that protect existing forest may continue to sell credits until June 30, 2024, but no new banks can be established via conservation of existing forest. Therefore, the retention sites previously proposed as MLS forest mitigation bank sites are no longer viable and have been removed from the proposed mitigation approach.

MDOT SHA revised the proposed forest mitigation approach in August 2021 based on the identification of the Preferred Alternative, passage of HB0991, and identification of additional reforestation sites on MDOT SHA excess lands. The revised site search results include 68 recommended off-site mitigation sites that could provide 39.96 acres of reforestation planting on public lands within the affected county and watersheds. An additional 268.48 acres of potential reforestation could be planted outside of the affected county and watershed but would require a variance from DNR. MDOT SHA has committed to planting any approved planting sites on MDNR property within 5 years of the initial Maryland Reforestation Law approval for the project. In addition, forest impacts may be mitigated by purchasing credits from approved forest mitigation banks in the affected county and/or watershed. Any remaining mitigation required may be fulfilled through payment into the Reforestation Fund, as approved by MDNR. The results of the revised site search are documented in the addendum to the *I-495/I-270 MLS Maryland Reforestation Law Mitigation Site Search Report* dated August 2021 included in **Appendix T**.

The Developer will be responsible for non-native invasive species control within the project limits and will develop a Landscape Maintenance Plan for review and approval by MDOT SHA and affected governmental agencies or landowners that will describe the required landscape maintenance types, frequencies, integrated pest management ("IPM") procedures, schedules and timelines, including plant establishment periods and the long-term plant maintenance period.

Impacts to forest canopy in Virginia on NPS property will be mitigated as described above based on NPS requirements. Vegetation within RPAs in Virginia has been avoided and minimized to the maximum extent practicable and any unavoidable impacts will be mitigated through onsite planting to the extent feasible. There is no overarching state law that regulates tree/forest impacts in Virginia; therefore, there are no mitigation requirements for the remaining forest impact area and currently no additional mitigation is proposed.

The final forest mitigation plan will be developed and implemented by the P3 Developer in conjunction with MDOT SHA and the affected jurisdictions and landowners during the final design phase of the project.

2.8 Terrestrial Wildlife

2.8.1 Regulatory Context and Methods

Terrestrial wildlife in the Phase 1 South portion of the corridor study boundary is protected under several state and federal provisions. The protection of all migratory birds is governed by the Migratory Bird Treaty Act (16 U.S.C. 703-712)**,** under which it is illegal to "take, kill, possess, transport, or import migratory birds or any part, nest, or egg of any such bird" unless authorized by a valid permit (16 U.S.C. 703). A list of migratory birds protected by the Migratory Bird Treaty Act (MBTA) is included in 50 CFR 10.13 and includes most of the species found within Maryland and Virginia.

Although the bald eagle (*Haliaeetus leucocephalus*) is no longer a listed species under the Endangered Species Act (ESA), it is still protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c). The Bald and Golden Eagle Protection Act prohibits the take, possession, sale, purchase, barter, transport, export, or import of any bald or golden eagle (alive or dead), including any part (such as feathers), nest, or egg without a valid permit issued by the Secretary of the Interior (50 CFR 22.3). The Act prohibits disturbance of any bald or golden eagle. As defined in 50 CFR 22.3, to "disturb" includes agitating or bothering "to a degree that causes, or is likely to cause, based on scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

In an e-mail from USFWS dated May 13, 2020, the USFWS stated that bald eagle nest surveys were annually conducted by MDNR, but the last comprehensive efforts ended in 2004. Recently, the Maryland Bird Conservation Partnership established a Bald Eagle Nest Monitoring Program with the support of volunteers to monitor nests and collect information. These data are entered into an electronic database and used by the USFWS Chesapeake Bay Field Office to make determinations on project impacts that may impact eagle nests.

In the same e-mail correspondence, the USFWS stated that peregrine falcons began nesting at the American Legion Bridge in 2007 (USFWS, 2007a). When MDOT SHA initiated a contract for bridge painting and maintenance it became apparent that the falcon nesting attempts would fail. In response, MDOT SHA formed a partnership with the USFWS and MDNR to protect and promote more favorable conditions for nesting falcons on the Bridge. Through this partnership, MDOT SHA constructed and installed a nest box platform to ensure long term protection for nesting falcons on the ALB. The e-mail correspondence documenting both the bald eagle and peregrine falcon information is located in **Appendix N**.

The conservation of terrestrial wildlife is managed in both Maryland and Virginia through the implementation of state wildlife action plans (SWAPs). SWAPs were initiated by the USFWS in 2005, requiring all 50 states and the District of Columbia to create a conservation plan for wildlife species and to determine those species of greatest conservation need (SGCN) as a condition for receiving funding through the State and Tribal Wildlife Grants program. The states participating in the SWAP program were then eligible to receive funding through the state and Tribal Wildlife Grants program to assist with the conservation of at-risk species before they become threatened or endangered. The SWAP program must be updated every 10 years, and Maryland and Virginia each updated their initial SWAP in 2015 (MDNR, 2016b; VDGIF, 2015). These documents identify each state's SGCN and identify conservation goals to keep these species from becoming threatened or endangered.

The NPS manages the Potomac Gorge Conservation Area, a 15-mile-long riparian corridor along the Potomac River running downstream from Great Falls. This biologically diverse area that crosses the Phase 1 South portion of the corridor study boundary contains at least 30 distinct natural vegetation communities that support numerous rare plant and animal species (The Nature Conservancy, 2005). State and federally listed plant species within the Potomac Gorge are addressed in **Section 2.10**. Targeted animal surveys have also been conducted within the Potomac Gorge by the NPS, with the primary focus being on invertebrate species. Many of these surveys have documented first state records or species new to science (See **Section 2.10, Rare, Threatened, and Endangered Species**).

In Maryland, Colonial Water Bird Nesting Areas and FIDS are regulated as protected resources within the Chesapeake Bay Critical Area (Critical Area) (COMAR 27.01.09.04). Additionally, the MDNR and USFWS track these species to ensure their populations remain viable and do not become threatened or endangered. Examples of colonial water birds include herons, egrets, and terns. FIDS require larger forest patches to successfully maintain viable populations. FIDS habitat typically includes contiguous forest of at least 50 acres with at least 10 acres of forest interior habitat or riparian forests at least 50 acres in size with a width of at least 300 feet (Jones et al., 2000). Forest interior habitat is defined as forest at least 300 feet from the nearest forest edge (Jones et al., 2000). Regulated FIDS habitat includes documented FIDS breeding areas within existing riparian forests that are at least 300 feet in width and that occur adjacent to streams, wetlands, or the Chesapeake Bay shoreline, and other forest areas used for breeding by FIDS (Jones et al., 2000). There are no designated Critical Areas within the Phase 1 South portion of the corridor study boundary, and FIDS are not specifically regulated outside of the Critical Area; however, MDNR encourages avoidance of impacts to FIDS habitat throughout the state, including those associated with transportation improvements.

Several types of amphibians are obligate vernal pool species, meaning that they must use temporary pools during a portion of their life stage. The presence of vernal pool amphibian species discussed in **Section 2.8.2** is based upon the availability of vernal pool habitat within the Phase 1 South portion of the corridor study boundary, as observed and mapped during fieldwork for the I-495 & I-270 Managed Lanes Study, and information gathered from Cunningham and Nazdrowicz (2018). In Maryland, vernal pools may or may not be regulated by the USACE under Section 404, depending upon their position within the landscape, duration of inundation, and connection or lack thereof to Waters of the US. Because vernal pools are necessarily ephemeral in nature, they may not hold water long enough to create hydric soil conditions. However, the MDE regulates most naturally occurring vernal pools in Maryland regardless of whether they are isolated or maintain hydric soils.

Data on wildlife habitat and documented wildlife species within the I-495 & I-270 Managed Lanes Study Phase 1 South portion of the corridor study boundary were collected through analysis of aerial imagery of vegetative cover, incidental observations of wildlife species and related habitat made during various natural resource field investigations (e.g., wetland delineations, rare plant surveys), and data provided by the resource agencies. Information on the potential presence of colonial nesting waterbirds is provided by MDNR and the USFWS during the rare, threatened, and endangered species review process described in **Section 2.10**.

The MDNR FIDS habitat GIS layer, available via the MERLIN database, includes 2006 land cover data that is no-longer accurate, in some cases depicting FIDS habitat crossing roads. For the purposes of this study, the MDNR FIDS habitat layer represents historic FIDS habitat. To more accurately document the extent of the current FIDS habitat within the Phase 1 South portion of the corridor study boundary, environmental scientists, on behalf of MDOT SHA, used the MDNR FIDS data as a baseline and refined the data through an analysis of more current GIS forest cover data from the Chesapeake Conservancy Conservation Innovation Center's (CCCIC) High Resolution Land Cover Data for tree canopy cover that is based on 2013/2014 aerial imagery (CCCIC, 2016) and the VDOF 2005 Virginia Forest Cover dataset (VDOF, 2014). Those forest patches that met the definition of FIDS habitat, as defined by Jones, et al., 2000, were considered FIDS habitat for the purposes of this study. Total acreage of historic FIDS habitat within the Phase 1 South portion of the corridor study boundary was calculated to be approximately 32 acres based on the 2006 data and total acreage of current FIDS habitat within the Phase 1 South portion of the corridor study boundary is approximately 12 acres. The total acreage of historic FIDS habitat and current FIDS habitat within the Preferred Alternative LOD is discussed in **Section 2.8.3**.

2.8.2 Existing Conditions

Composition of terrestrial wildlife species is limited by the natural and man-modified environments within the Phase 1 South portion of the corridor study boundary. Because of the mostly built environment adjacent to the existing highway corridors, natural habitats along the corridors are comprised of a mix of scattered small, remnant patches of forest and disturbed old fields. Larger patches of forest habitat exist primarily where larger streams cross the Phase 1 South portion of the corridor study boundary, particularly within stream valley parks in Maryland and on NPS property in Maryland and Virginia along the Potomac River. These forested stream corridors occur on the I-495 portion of the Phase 1 South portion of the corridor study boundary at crossings of the Potomac River and Cabin John Branch. In the I-270 portion of the Phase 1 South portion of the corridor study boundary, these larger forested areas occur along Muddy Branch, Watts Branch, and Cabin John Creek. Many of these large forest tracts and forested stream corridors are also recognized by MDNR as Green Infrastructure (GI) hubs or corridors, which are important habitats for wildlife. GI is discussed in more detail in **Section 2.11**.

As noted in **Section 2.7, Vegetation and Terrestrial Habitat**, the smaller remnant forest patches and old fields within the Phase 1 South portion of the corridor study boundary are primarily disturbed and contain numerous invasive vines, shrubs, and trees. These disturbed remnant forests and old fields surrounded by development provide habitat for edge adapted and disturbance tolerant wildlife species. More disturbance tolerant species observed within the Phase 1 South portion of the corridor study boundary include white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), groundhog (*Marmota monax*), gray squirrel (*Sciurus carolinensis*), mourning dove (*Zenaida macroura*), blue jay (*Cyanocitta cristata*), Carolina wren (*Thryothorus ludovicianus*), northern cardinal (*Cardinalis cardinalis*), common gartersnake (*Thamnophis sirtalis sirtalis*), eastern ratsnake (*Pantherophis alleghaniensis*), and ring-necked snake (*Diadophis punctatus*). Where temporary and permanent water sources are also available within these habitats, the Phase 1 South portion of the corridor study boundary may also support various amphibians, including northern two-lined salamander (*Eurycea bislineata*), American toad (*Anaxyrus americanus*), spring peeper (*Pseudacris crucifer*), green frog (*Lithobates clamitans*), and American bullfrog (*Lithobates catesbeianus*). **Appendix L** provides a table of mammals, birds, reptiles, and amphibians observed within the Phase 1 South portion of the corridor study boundary during fieldwork conducted from 2018 to 2021.

In an e-mail dated May 13, 2020, USFWS stated that a search of the Maryland Bird Conservation Partnership by USFWS determined that no bald eagle nests are noted within the I-495 & I-270 Managed Lanes Study Phase 1 South portion of the corridor study boundary. The closest nests were noted at the Washington DC-Maryland border, over eight miles away. A peregrine falcon pair has been successfully using a nest box for 12 consecutive years installed by USFWS and MDOT SHA on the ALB (USFWS, 2019a), and the pair successfully fledged young from the bridge nest box in 2020. E-mail correspondence with USFWS regarding bald eagle and peregrine falcon presence and recommendations is included in **Appendix N**.

The above referenced NPS Potomac Gorge surveys noted numerous Virginia state first records or newly described species for various species of beetles (Johnson and Steury, 2021; Steury and Chandler, 2021; Steury and Steiner, Jr., 2021; Brattain et al., 2019; Steury, 2019; Steury et al., 2018; Steury and Leavengood, 2018a; Steury and Leavengood, 2018b; Steury, 2018a; Steury, 2018b; Steury, 2017; Steury and MacCrae, 2014; Steury and Messer, 2014; Cavey et al., 2013; Evans and Steury, 2012; Steury et al., 2012); moths (Steury et al., 2007); caddisflies (Flint, 2011; Flint and Kjer, 2011); grasshoppers, crickets, and katydids (Forrest and Steury, 2021); and flies (Barrows and Smith, 2014; Mathis and Zatwarnicki, 2010). Surveys of invertebrate taxa on Plummers Island by members of the Biological Society of Washington for more than a century, have documented 3,012 species of insects within 253 families (Brown et al., 2008). Recent surveys of leaf beetles on the island documented species that represent the only Maryland state records or first state records (Staines, 2008). All Maryland and Virginia rare invertebrate species are included in **Table 2-77** in **Section 2.10, Rare, Threatened, and Endangered Species**.

Only three SGCN were observed within the mostly disturbed I-495 & I-270 Managed Lanes Study Phase 1 South portion of the corridor study boundary, including eastern box turtle (*Terrapene carolina*) peregrine falcon (*Falco peregrinus*), and great blue heron (*Ardea herodias*) (See the list of observed wildlife in the Phase 1 South portion of the corridor study boundary during the I-495 & I-270 Managed Lanes Study in **Appendix L**). The great blue heron typically nests in colonies within large, somewhat remote beaver marshes with clumps of dead trees or on islands in the Potomac River; however, no active great blue heron rookeries were observed during the study fieldwork and no colonial nesting waterbird rookeries were documented by the MDNR and USFWS. Suitable habitat exists for the eastern box turtle within patches of forest within the Preferred Alternative. As noted, a pair of peregrine falcons has consistently nested on the ALB for the past 12 years. This species is also listed by MDNR as In Need of Conservation, or species whose populations are limited or declining such that they may become threatened in the foreseeable future.

Less disturbed and larger contiguous forests can provide habitat for FIDS, and MDNR recognizes 25 species of FIDS in Maryland. The Phase 1 South portion of the corridor study boundary contains some FIDS habitat and smaller areas of forest interior, particularly along the Potomac River, Old Farm Creek, Muddy Branch and Cabin John Creek. Areas of FIDS habitat are depicted in **Appendix B, Natural Resources Inventory Maps**. Four species of FIDS were observed within the Phase 1 portion of the corridor boundary during the study, including red-shouldered hawk (*Buteo lineatus*), hairy woodpecker (*Dryobates villosus*), pileated woodpecker (*Dryocopus pileatus*), and red-eyed vireo (*Vireo olivaceus*).

Vernal pool amphibians are another specialized group of wildlife potentially occurring within the phase 1 South portion of the corridor study boundary. Vernal pools are temporary pools that typically retain water only during winter and spring and are dry by mid-summer. Vernal pools do not support fish, allowing specialized frog and salamander species to exploit a predator-free breeding and early life stage environment. Species that rely completely on vernal pools for reproduction that could occur within the phase 1 South portion of the corridor study boundary include marbled salamanders (*Ambystoma opacum*), spotted salamanders, (*Ambystoma maculatum*) and wood frogs (*Lythobates sylvaticus*). Vernal pools are depressional wetlands that fill with rain each spring and then dry-up for a period of time in the summer. Two vernal pools were identified within the Phase 1 South portion of the corridor study boundary. No obligate vernal pool species were incidentally observed during the study.

2.8.3 Environmental Effects

There would be some wildlife impacts from the Preferred Alternative LOD construction, since it would involve widening along the same alignment as the existing highway. Therefore, clearing of forest fragments and encroachments on larger forest resources would result in displacements of some edge adapted species, but would not result in substantial loss of wildlife habitat. Typically, forests along the Preferred Alternative LOD are early- to mid-successional (MDOT SHA, 2006) and many areas would regain some functionality within 10 to 15 years due to replanting requirements. The Preferred Alternative LOD could potentially contribute contaminants to remaining wildlife habitat through pollutant runoff. The use of erosion and sediment control BMPs will help to minimize pollutant runoff into surrounding wildlife habitat. Disturbances during construction could also provide opportunities for invasive plant species colonization. Care should be taken to stabilize disturbed soils with native vegetation, and to treat areas of significant invasive species establishment.

Bald eagles are not expected to be negatively affected by the Preferred Alternative LOD, as no bald eagle nests have been identified by USFWS within the study corridor boundary. Since bald eagle populations are expanding, it is possible that additional nesting pairs may utilize areas near highways in the future. MDOT SHA commits to consulting with the USFWS when construction begins to confirm the presence/absence of bald eagle nests in the vicinity of the Preferred Alternative LOD. USFWS determined that the improvements to the ALB will require removal and replacement of the resident peregrine falcon nest box prior to and following construction. USFWS expects disruption of the falcons for multiple nesting seasons due to long term construction activities.

Most forest impacts would be to smaller, upland forest stands resulting in reductions in available edge habitat, rather than complete elimination of habitat. Therefore, some less motile wildlife could be killed during construction and other more motile species will be shifted away from the new construction, potentially into already occupied territories requiring further movement into unoccupied suitable habitat if available. It is also possible that these wildlife movements would be onto existing roadways resulting in potential mortality from vehicle strikes, posing threats to both wildlife and drivers. This effect would be most apparent within the smallest forest stands where remaining habitat areas may be too small to support permanent populations. The majority of wildlife-vehicle collisions reported in the US involve deer, as they are most likely to cause human injury and vehicle damage due to their size, use of edge habitats adjacent to roadways, and prevalence (FHWA, 2008).

The Preferred Alternation LOD is not located within a Critical Area; therefore, no Colonial Water Bird Nesting Areas are anticipated to appear or be affected within the Preferred Alternative LOD. Total acreage of historic FIDS habitat within the Preferred Alternative LOD was calculated to be approximately 32 acres based on the 2006 data and total acreage of current FIDS habitat within the Preferred Alternative LOD is approximately 11 acres. The impact to historic FIDS habitat (2006) is estimated within the area of the Preferred Alternative LOD to provide context for how quickly this type of habitat is being diminished within Montgomery and Fairfax Counties with increasing urbanization and development. The impacts to potential FIDS habitat, both historic DNR area and refined area, within the Preferred Alternative LOD, are summarized in **Table 2-44**. Impacts to potential FIDS habitat would be due to widening of the existing highway, resulting in slightly contracted forest interiors required by FIDS species.

Table 2-44. Impacts to Potential FIDS Habitat within the Preferred Alternative LOD in Acres

	Permanent	Temporary	Total
Potential FIDS Habitat: Historic DNR File	22.03	5.32	27.35
Potential FIDS Habitat: Developed by MDOT SHA	8.72	2.53	11.25

The two vernal pools identified within the Phase 1 South portion of the corridor study boundary are not within the Preferred Alternative LOD and will not be impacted by the project.

2.8.4 Avoidance, Minimization, and Mitigation

Some level of impact to terrestrial wildlife from the Preferred Alternative LOD would be unavoidable, primarily due to the associated reduction in the availability of vegetated habitat. Impacts to wildlife are anticipated to be minimal since the project will improve an existing roadway corridor primarily populated by edge and disturbance acclimated species.

As stated in **Section 2.8.3**, MDOT SHA will consult with the USFWS when construction begins to confirm the presence/absence of bald eagle nests in the vicinity of the Preferred Alternative LOD. To minimize potential impacts to the currently nesting peregrine falcons, USFWS recommends that MDOT SHA remove the existing peregrine falcon nest box on the ALB just prior to the nesting season when construction is scheduled to begin. Once construction activities are nearly complete near the former nest site, USFWS recommends that the nest box be reinstalled. MDOT SHA will follow the USFWS recommended protection measures for the peregrine falcons nesting on the ALB.

Impacts to potential FIDS habitat would result from slightly contracted forest interiors. Efforts to avoid and minimize forest impacts are discussed in **Section 2.7, Vegetation and Terrestrial Habitat**. To minimize vehicle collisions with large animals, MDOT SHA will also investigate options such as fencing and landscaping. In addition, the use of erosion and sediment control best management practices will help to minimize pollutant runoff into surrounding wildlife habitat.

2.9 Aquatic Biota

2.9.1 Regulatory Context and Methods

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), the Fish and Wildlife Coordination Act (FWCA), and MDNR Fishery Management Plans protect some of the fish and shellfish species that inhabit streams within the Phase 1 South portion of the corridor study boundary. Existing data on aquatic biota within the vicinity of the Phase 1 South portion of the corridor study boundary were gathered from MCDEP, MBSS, FCDPWES, Virginia Department of Game and Inland Fisheries (VDGIF), and VDEQ, all of which conduct periodic monitoring of stream habitat, benthic macroinvertebrates, and/or fish within the vicinity of the Phase 1 South portion of the corridor study boundary as part of long-term water quality monitoring efforts. The presence, abundance, and diversity of aquatic biota, along with physical and in-situ chemical characteristics of the stream, are used by all agencies to assess overall stream conditions and develop watershed management strategies for each watershed. As required by the CWA (Sections 305b and 303d), MDE and VDEQ use biological monitoring data in their determination of impaired waterbodies within Maryland and Virginia, respectively. According to MDE methodologies, Maryland watersheds are assessed using a multi-step process to categorize impaired waters for the Integrated Report (MDE, 2014c). A site is considered failing if Index of Biotic Integrity (IBI) scores do not meet the minimum allowable limit (MAL) of 2.5 for fish IBIs and 2.65 for benthic IBIs. Failing IBI scores are then compared to scores from reference watersheds and the watershed is categorized as impaired (Category 5) if the scores are significantly different. According to VDEQ methodologies, Virginia streams are considered biologically impaired (Category 5) based on benthic macroinvertebrate data if the Virginia Stream Condition Index (VSCI) score falls below 60 or if the Virginia Coastal Plain Macroinvertebrate Index (VCPMI) score falls below 40 (VDEQ, 2018).

For the purposes of this study, only data collected within the 10-year period from 2007-2017 and generally falling within 1 mile of the study corridors were considered representative of existing conditions in the Phase 1 South portion of the corridor study boundary. Substantial existing data on aquatic communities within the Phase 1 South portion of the corridor study boundary were obtained from 24 MCDEP sites, four MBSS sites, nine FCDPWES sites, and one VDEQ site within the watersheds crossed by the Phase 1 South portion of the corridor study boundary. The locations of the monitoring stations are shown in **Appendix K** and data from these stations are summarized below and provided in detail in **Appendix M**. Summary data are organized by watershed, as described in **Section 2.4.1.A,** and then presented per waterway as the range of values observed over the 10-year data review period provided.

As discussed in **Section 2.10,** MDOT SHA requested information from MDNR ERP and MDNR Wildlife and Heritage Service (WHS) regarding the presence of sensitive species and other natural resources within the Phase 1 South portion of the corridor study boundary. MDNR ERP provided feedback in a response letter dated January 10, 2019, that included a list of fish species likely to occur within the waterbodies crossed by the Phase 1 South portion of the corridor study boundary. The majority of the species noted by MDNR were also documented in the data obtained from MBSS and county agencies within the 2007 to 2017 timeframe and one-mile radius described above. However, some additional species were also noted in the MDNR letter, and it is likely that these additional species were documented outside of the physical and temporal boundaries used to collect existing data on aquatic biota for this document. These additional species are noted in the discussions below, and the full lists provided by MDNR can be found in **Appendix N**.

Methods for collection and analysis of existing data on aquatic habitat, macroinvertebrates, and fish often vary between agencies. Specific methods of collection and analysis are available from each contributing agency. Differences that affect interpretation and comparison of results between agencies are also broadly discussed to facilitate understanding of relative findings.

A. Aquatic Habitat

Several aquatic habitat scoring and narrative ranking processes are used by the agencies from which data were collected. MCDEP, FCDPWES, and VDEQ use the EPA Rapid Bioassessment Protocol (RBP) for aquatic habitat scoring, which rates the quality of velocity-depth regime, epifaunal substrate, embeddedness, sediment deposition, frequency of riffles, channel alteration, channel flow status, bank vegetative protection, bank stability, and riparian vegetative zones for high gradient streams. The narrative ranking criteria utilized by MCDEP, FCDPWES, and VDEQ based on RBP aquatic habitat scoring are shown in **Table 2-45**.

Table 2-45. EPA Rapid Bioassessment Protocol Aquatic Habitat Ranking Criteria

Score	Narrative
166 – 200	Excellent
154 – 165	Excellent/Good
113 – 153	Good
101 – 112	Good/Fair
60 – 100	Fair
54 – 59	Fair/Poor
0 – 53	Poor

Source: Van Ness et al., 1997; Stribling et al., 1999

The aquatic habitat assessment used by MBSS is based on the EPA RBP aquatic habitat assessment methodology and modified for use in Maryland streams. This protocol assigns a value and weight to each of eight parameters for Piedmont streams and six parameters for Coastal Plain systems. The following parameters are used for Piedmont systems: instream habitat, epifaunal substrate, embeddedness, number of rootwads and woody debris, remoteness, shading, bank stability, and riffle/run quality. The following parameters are used for Coastal Plain systems: instream habitat, epifaunal substrate, remoteness, shading, bank stability, and number of rootwads and woody debris. For each physiographic province, the parameter scores are combined into a physical habitat index (PHI), set on a scale of 0 to 100, and a narrative ranking is assigned, as shown in **Table 2-46**.

Table 2-46. MBSS Aquatic Habitat Ranking Criteria

Score	Narrative
81 – 100	Minimally Degraded
66 – 80	Partially Degraded
51 – 65	Degraded
0 – 50	Severely Degraded

Source: Paul et al., 2002

B. Benthic Macroinvertebrates

For Virginia streams, VDEQ and FCDPWES use different biotic indices for assessing the health of benthic macroinvertebrate communities. VDEQ uses the VSCI for non-coastal streams. The VSCI uses eight core metrics to compare biological conditions of a stream to reference (best available) conditions to identify impaired waterbodies (Burton and Gerritsen, 2003). FCDPWES has developed their own benthic IBI that compares the macroinvertebrate community within a given stream to reference macroinvertebrate communities in the least-impaired streams (FCDPWES, 2006). For the Piedmont physiographic province, the FCDPWES benthic IBI is based on state-wide reference streams and five community metrics found to characterize macroinvertebrate community health. VDEQ and FCDPWES benthic IBI scores are not directly comparable due to differences in benthic IBI metrics and overall scoring. **Table 2-47** and **Table 2-48** summarize how VDEQ and FCDPWES rank each benthic IBI score and how each of the scores and rankings relates to reference conditions.

Table 2-47. VDEQ VSCI Scores and Rankings

Score	Narrative Ranking
73 – 100	Excellent
60 – 72	Good
59 – 43	Stress
0 – 42	Severe Stress

Source: Burton and Gerrittsen, 2003

Table 2-48. FCDPWES Benthic IBI Scores and Rankings

Benthic IBI Score	Narrative Ranking	Characteristics
80 – 100	Excellent	Equivalent to reference conditions; high biodiversity and balanced community
60 – 80	Good	Slightly degraded site with intolerant species decreasing in numbers
40 – 60	Fair	Marked decrease in intolerant species; shift to an unbalanced community
20 – 40	Poor	Intolerant species rare or absent, decreased diversity
0 – 20	Very Poor	Degraded site dominated by a small number of tolerant species

Source: FCDPWES, 2006

For Maryland streams, MBSS and MCDEP methods were used for conducting benthic macroinvertebrate assessments within the Phase 1 South portion of the corridor study boundary. MBSS and MCDEP each developed their own benthic IBI that compares the macroinvertebrate community within a given stream to reference macroinvertebrate communities in the least-impaired streams. For the Piedmont physiographic province, the MBSS benthic IBI is based on state-wide reference streams and uses six community metrics found to characterize macroinvertebrate community health. The MCDEP benthic IBI was developed using reference streams from within Montgomery County and from other Piedmont streams in neighboring counties. This method uses the scoring of eight metrics tailored specifically to conditions within local Piedmont streams. MCDEP and MBSS benthic IBI scores were not comparable due to differences in benthic IBI metrics and lab protocols. **Table 2-49** and **Table 2-50** summarize how MBSS and MCDEP rank each benthic IBI score and how each of these scores and rankings relates to reference conditions.

Table 2-49. MBSS Benthic IBI Scores and Rankings

Benthic IBI Score	Narrative Ranking	Characteristics
4.00 – 5.00	Good	Comparable to reference streams considered to be minimally impacted, biological metrics fall within the upper 50 percent of reference site conditions.
3.00 – 3.99	Fair	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of minimally impacted streams.
2.00 – 2.99	Poor	Significant deviation from reference conditions, indicating some degradation. On average, biological metrics fall below the 10th percentile of reference site values.
1.00 – 1.99	Very Poor	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of minimally impacted streams, indicating severe degradation. On average, most or all metrics fall below the 10th percentile of reference site values.

Source: Stribling et al., 1998

Table 2-50. MCDEP BIBI Scores and Rankings

Benthic IBI Score	Narrative Ranking	Characteristics
> 35	Excellent	IBI scores within the upper 50 percent of reference site conditions are assigned to this highest attainable IBI class.
26 – 34	Good	Decreased number of sensitive species, decreased number of specialized feeding groups with some intolerant species present.
17 – 25	Fair	Intolerant and sensitive species are largely absent; unbalanced feeding group structure.
< 17	Poor	Top carnivores and many expected species are absent or rare; general feeders and tolerant species dominate.

Source: Roth et al., 2000; Van Ness, 1997

C. Fish

For Virginia streams, FCDPWES has developed their own Fish Index of Biotic Integrity (fish IBI). The fish IBI developed by FCDPWES uses seven community metrics to assess the health of fish communities, relative to Virginia's Piedmont streams (FCDPWES, 2006). **Table 2-51** summarizes how FCDPWES ranks each fish IBI score and how each of these scores and rankings relates to least-impaired, or reference, conditions.

Table 2-51. FCDPWES Fish IBI Scores and Rankings

Fish IBI Score	Narrative Ranking
> 29	Excellent
23 – 28	Good
18 – 22	Good
13 – 17	Poor
< 13	Very Poor

Source: FCDPWES, 2006

MBSS and MCDEP methods were used in Maryland to conduct fish assessments within the Phase 1 South portion of the corridor study boundary. MBSS and MCDEP have each developed a fish IBI that compares the fish community within a given stream to reference fish communities in the least-impaired streams. Both methods for assessing fish communities are based on the same principles of measuring a community using a suite of comparative metrics, but are considerably different in most other ways. These fish IBIs are calculated by assigning a score to each metric result based on their comparison to the distribution of values at a reference site. All of the metric scores are averaged and assigned a narrative value that varies between agencies. For the Piedmont province, the MBSS fish IBI is based on state-wide reference streams and uses six community metrics found to characterize fish community health in Maryland's streams (Stranko et al., 2007; Roth et al., 2000; Southerland et al., 2005). The MCDEP fish IBI uses nine different metrics and narrative rankings based on dominant soil type and stream order. Since MBSS and MCDEP use different narrative rankings and fish IBI metrics, the resulting scores and rankings are not directly comparable. Additionally, MCDEP reports fish IBI scores to the nearest tenth, while MBSS reports scores to the hundredths decimal place. **Table 2-52** and **Table 2-53** summarize how MBSS and MCDEP rank each fish IBI score and how these scores and rankings relate to reference conditions.

Table 2-52. MBSS Fish IBI Scores and Rankings

Fish IBI Score	Narrative Ranking	Characteristics
4.00 – 5.00	Good	Comparable to reference streams considered to be minimally impacted, biological metrics fall within the upper 50 percent of reference site conditions.
3.00 – 3.99	Fair	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of minimally impacted streams.
2.00 – 2.99	Poor	Significant deviation from reference conditions, indicating some degradation. On average, biological metrics fall below the 10th percentile of reference site values.
1.00 – 1.99	Very Poor	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of minimally impacted streams, indicating severe degradation. On average, most or all metrics fall below the 10th percentile of reference site values.

Source: Roth et al., 2000

Table 2-53. MCDEP Fish IBI Scores and Rankings

Fish IBI Score	Narrative Ranking	Characteristics
>4.5	Excellent	IBI scores within the upper 50 percent of reference site conditions are assigned to this highest attainable IBI class.
3.4 – 4.5	Good	Decreased number of sensitive species, decreased number of specialized feeding groups with some intolerant species present.
2.3 – 3.3	Fair	Intolerant and sensitive species are largely absent; unbalanced feeding group structure.
< 2.2	Poor	Top carnivores and many expected species are absent or rare; general feeders and tolerant species dominate.

Source: Roth et al., 1998; Van Ness, 1997

In addition to summarizing biological survey data, the Chesapeake Fish Passage Prioritization (CFPP) database was also reviewed for all watersheds in the vicinity of the Phase 1 South portion of the corridor study boundary. The CFPP project is a collaboration led by The Nature Conservancy (TNC) and is comprised of fish blockage data for the greater Chesapeake Bay watershed (Martin, 2019). This database includes historic blockages that have not been recently confirmed, as well as partial blockages and blockages with aquatic life passage facilities. Despite these limitations of the database, it provides useful context for the current status of fish movement and blockages within each watershed. In addition to blockage data, the CFPP project tool also includes data on migratory, or diadromous, fish habitat for American shad (*Alosa sapidissima*), hickory shad (*Alosa mediocris*), blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), striped bass (*Morone saxatilis*), and American eel (*Anguilla rostrata*).

Following additional coordination with the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) in 2021, migratory fish data was reviewed for watersheds crossed by the Preferred Alternative to determine if those six migratory species have the potential to occur in study area streams. The review was based on documented or potential presence of the six migratory fish species and their potential to use the stream for migratory purposes, spawning, or during other critical life stages. The potential current usage of stream segments by diadromous species is based on the connection to streams with documented occurrence and the expectation that they could be using a certain stream segment based on stream characteristics and a lack of barriers, as determined by the Chesapeake Fish Passage Workgroup. This data is summarized by watershed below.

Alewife and blueback herring have been designated as Species of Concern by NOAA due to drastic declines in their populations throughout much of their range since the mid-1960s (ASMFC, 2017). The MDNR Environmental Review response included in **Appendix N** identifies American eel as an important fisheries resource that may reside within the corridor study boundary on a long-term basis.

2.9.2 Existing Conditions

Perennial streams and rivers within the Preferred Alternative provide migratory, spawning, nursery, resting and foraging habitat for resident, anadromous, and catadromous fish species.

Streams and rivers within the Preferred Alternative support anadromous fish species such as alewife (*Alosa pseudoharengus*), blueback herring (*A. aestivalis*), and American shad (*A. sapidissima*), collectively known as alosines. These fish spend most of their lives at sea and then return to their natal streams and rivers to spawn. Cabin John Creek and the Potomac River are the migratory fish spawning grounds located within the Preferred Alternative LOD. These are important forage species and once supported the largest commercial and recreational fisheries throughout their range. Alosine populations are currently in decline throughout their range due to human impacts such as overfishing, habitat loss, spawning and nursing ground degradation, blocked access to habitat, increased erosion and sedimentation in streams and rivers, and loss of wetland buffers.

Streams and rivers within the Preferred Alternative also provide migration, nursery, and foraging habitat for the catadromous American eel (*Anguila rostrata*). This fish species spawns in the Sargasso Sea and then migrates to freshwater streams and rivers in the Chesapeake Bay region where they forage and grow until adulthood, at which time they return to the sea. The American eel population is depleted in US waters due to overfishing, habitat loss, food web alterations, predation, mortality from hydroelectric turbines, environmental changes, exposure to toxins and contaminants, and disease (ASMFC, 2012).

A number of resident fish species are also supported by the perennial streams and rivers within the Preferred Alternative. The following sections outline the aquatic habitat, benthic macroinvertebrates, and fish species supported by each watershed within the Preferred Alternative.

A. Fairfax County Middle Potomac Watersheds

a. Aquatic Habitat

FCDPWES assessed aquatic habitat at four sites within the Scotts Run subwatershed from 2009 through 2014. Habitat assessments were conducted at two sites on the mainstem and at two sites located on unnamed tributaries to Scotts Run. Both tributaries enter the mainstem of Scotts Run downstream of I-495. Aquatic habitat along the Scotts Run mainstem, both upstream and downstream of I-495, was rated as Fair. Aquatic habitat along both of the unnamed tributaries was rated as Good/Fair (**Table 2-54**).

Aquatic habitat conditions were assessed by FCDPWES at four sites throughout the Dead Run subwatershed from 2008 through 2015, three of which were on the mainstem and one of which was on an unnamed tributary. Unnamed Tributary 1 to Dead Run joins the mainstem at the southern end of Turkey Run Park. For the Dead Run mainstem and Unnamed Tributary 1 to Dead Run, aquatic habitat conditions were rated as Fair by FCDPWES. VDEQ also assessed aquatic habitat at one site on the Dead Run mainstem in 2009, located well downstream near George Washington Memorial Parkway. Aquatic habitat was rated as Good for the Dead Run mainstem, based on data collected by VDEQ (**Table 2-54**). Overall, habitat conditions were generally minimally to moderately degraded for the Fairfax County Middle Potomac watersheds.

Table 2-54. Range of Aquatic Habitat Scores for the Fairfax County Middle Potomac Watersheds

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Scotts Run	FCDPWES	2012 – 2014	63 – 99	Fair
Unnamed Tributary 1 to Scotts Run	FCDPWES	2009	108	Good/Fair
Unnamed Tributary 2 to Scotts Run	FCDPWES	2014	110	Good/Fair
Dead Run	FCDPWES	2008 – 2015	81 – 100	Fair
	VDEQ	2009	118 – 123	Good
Unnamed Tributary 1 to Dead Run	FCDPWES	2008	91	Fair

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

A summary of benthic macroinvertebrate sampling results for the Fairfax County Middle Potomac watersheds is presented in **Table 2-55**. According to existing data collected by FCDPWES in the Scotts Run subwatershed, benthic macroinvertebrate community conditions vary by watershed. The benthic IBI scores on the mainstem of Scotts Run ranged from Very Poor to Poor, indicating a substantially degraded benthic macroinvertebrate community. Unnamed Tributary 1 to Scotts Run had a rating of Poor for the benthic macroinvertebrate community, while the benthic macroinvertebrate community was rated as Good along Unnamed Tributary 2 to Scotts Run.

The Dead Run subwatershed was sampled between 2008 and 2018 by FCDPWES and VDEQ. Overall, the benthic community within the Dead Run subwatershed was severely degraded. Based on FCDPWES sampling, the benthic macroinvertebrate community along the Dead Run mainstem was rated as Very Poor to Poor. VDEQ VSCI scores indicated that the benthic macroinvertebrate community in the mainstem of Dead Run ranged from Severe Stress to Stress, also indicating severe stream degradation. The benthic macroinvertebrate community in Unnamed Tributary 1 to Dead Run was sampled in 2008 by FCDPWES with benthic IBI scores falling in the Poor range, similar to the mainstem.

Table 2-55. Range of Benthic IBI and VSCI Scores for the Fairfax County Middle Potomac Watersheds

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Scotts Run	FCDPWES	2012 – 2014	18.1 – 23.3	Very Poor – Poor
Unnamed Tributary 1 to Scotts Run	FCDPWES	2009	23.3	Poor
Unnamed Tributary 2 to Scotts Run	FCDPWES	2014	66.0	Good
Dead Run	FCDPWES	2008 – 2018	12.5 – 39.7	Very Poor – Poor
	VDEQ	2009	22.06 – 45.90	Severe Stress – Stress
Unnamed Tributary 1 to Dead Run	FCDPWES	2008	31.5	Poor

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

Eight fish species were recently documented by FCDPWES in the Fairfax County Middle Potomac watersheds, fewer than any other watershed within the Phase 1 South portion of the corridor study boundary in recent years (**Appendix O**). No intolerant or sensitive species were documented, and the only diadromous species observed was American eel, which was found in Dead Run. American eel is a catadromous fish species that lives the majority of its life in freshwater and migrates to the sea to spawn. Of the diadromous fish species, American eel is among the most successful at navigating fish blockages. According to the CFPP database, there are no fish blockages located within the Fairfax County Middle Potomac watersheds; however, Little Falls Dam is located downstream on the Potomac River mainstem and may limit movement of diadromous fish upstream (Martin, 2019). Results from sampling conducted by FCDPWES indicate that the fish communities in both the Scotts Run and Dead Run subwatersheds were severely degraded, with fish IBI scores falling in the Very Poor category (**Table 2-56**).

Based on review of the CFPP project tool, alewife, blueback herring, and American eel all potentially occur in Fairfax County Middle Potomac perennial streams within the vicinity of the Preferred Alternative. More specifically, all three species potentially occur throughout the Scotts Run and Dead Run systems, depending on the time of year. Alewife and blueback herring, collectively called river herring, are anadromous fish species that live most of their life in saltwater habitats but migrate to freshwater streams to spawn in the spring.

Table 2-56. Range of Fish IBI Scores for the Fairfax County Middle Potomac Watersheds

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Scotts Run	FCDPWES	2012 – 2014	--	Very Poor
Dead Run	FCDPWES	2013 – 2015	--	Very Poor

[1]Sampling may not have been conducted during all years within year ranges.

B. Potomac River/Rock Run Watershed

a. Aquatic Habitat

MCDEP assessed aquatic habitat conditions at one site along the Rock Run mainstem, which enters the Potomac River just upstream of the ALB and west of the Phase 1 South portion of the corridor study boundary. Results from assessments in 2010 and 2014 indicate that the waterway is generally minimally to moderately degraded, as aquatic habitat was rated as Good (**Table 2-57**).

Table 2-57. Range of Aquatic Habitat Scores for the Potomac River/Rock Run Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Rock Run	MCDEP	2010 – 2014	118 – 141	Good

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

A summary of benthic macroinvertebrate sampling results for the Potomac River/Rock Run watershed is presented in **Table 2-58**. The Rock Run mainstem was sampled by MCDEP between 2010 and 2014. The benthic macroinvertebrate community along the Rock Run mainstem was rated as Poor to Fair, indicating moderate to substantial degradation. No recent benthic macroinvertebrate data were readily available for the Potomac River mainstem within the vicinity of the Phase 1 South portion of the corridor study boundary.

MDNR ERP documented several mussel species in the Potomac River and Chesapeake and Ohio Canal within the vicinity of the Phase 1 South portion of the corridor study boundary, including eastern elliptio (*Elliptio complanata*), Atlantic spike (*Elliptio producta)*, *Lampsilis* sp., and paper pondshell (*Utterbackia imbecillis)*.

Table 2-58. Range of Benthic IBI Scores for the Potomac River/Rock Run Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Rock Run	MCDEP	2010 – 2014	16 – 22	Poor – Fair

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

In recent years, 11 different species have been documented along the Rock Run mainstem in the vicinity of the Phase 1 South portion of the corridor study boundary (**Table 2-59**). All of these species are found throughout Maryland and the adjacent watersheds in the Phase 1 South portion of the corridor study boundary. No intolerant or sensitive species or diadromous fish species were documented. According to the CFPP database, there are three fish blockages located within the Rock Run watershed (Martin, 2019).

One gamefish species, largemouth bass, was collected in the Phase 1 South portion of the corridor study boundary since 2007. All species documented in the Rock Run mainstem in recent years are widespread and capable of persisting in degraded conditions.

A summary of fish species documented during sampling in the Potomac River/Rock Run watershed by MCDEP from 2010 to 2014, is presented in **Appendix O**. The fish community along the Rock Run mainstem was rated as Fair to Good, indicating moderate degradation.

Based on review of the CFPP project tool, American shad, alewife, blueback herring, hickory shad, and American eel have been documented to currently use the Potomac River mainstem, depending on the time of year. American shad and hickory shad are both anadromous fish species that live most of their life in saltwater habitats but migrate to freshwater streams to spawn in the spring. American eel potentially occur in all Potomac River/Rock Run perennial streams within the vicinity of the Preferred Alternative. Alewife and blueback herring also potentially occur in one unnamed tributary to the Potomac River, which flows between 80th Street and 81st Street in Cabin John, Maryland and enters the Potomac River downstream of the ALB.

No recent fish data were readily available for the Potomac River mainstem, within the vicinity of the Phase 1 South portion of the corridor study boundary. However, the fish communities surrounding Plummers Island, located within the watershed immediately downstream of I-495, have been studied extensively (Starnes et al., 2011). Additional fish species that have not been recently documented along the Rock Run mainstem (**Appendix O**) but are likely to occur along the Potomac River and Chesapeake and Ohio Canal mainstem are presented in **Table 2-60.** For the purposes of this report, these species were considered likely to occur within the Potomac River and Chesapeake and Ohio Canal and not documented within the Phase 1 South portion of the corridor study boundary, as the exact locations of species occurrences are unknown.

Along the Potomac River and Chesapeake and Ohio Canal, 49 additional species that haven't been recently documented in Rock Run were reported. Of those species, eight are intolerant of degraded conditions. Black crappie, largemouth bass, muskellunge, smallmouth bass, striped bass, walleye, white perch, and yellow perch are all sought after gamefish species that are likely to occur in the Potomac River and Chesapeake and Ohio Canal. Blue catfish and northern snakehead are also likely to occur, both of which are invasive species that are often sought after by recreational fishermen. As noted in **Table 2-60**, nine diadromous or semi-diadromous fish species are likely to occur along the Potomac River and Chesapeake and Ohio Canal, despite the presence of Little Falls Dam downstream along the mainstem. Diadromous fish species spend portions of their life cycle in both fresh and salt water, typically migrating from one to the other to spawn.

Table 2-59. Range of Fish IBI Scores for the Potomac River/Rock Run Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Rock Run	MCDEP	2010 – 2014	3.2 – 3.7	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

Table 2-60. Additional Fish Species Likely to Occur within the Potomac River and Chesapeake and Ohio Canal

Species[1]	Species[1]	Species[1]	Species[1]
Alewife[2]	Channel catfish	Margined madtom	Spotfin shiner
American eel[2]	Creek chubsucker	Muskellunge	Spottail shiner
American shad[2]	Eastern silvery minnow	Northern hogsucker	Striped bass[2]
Banded killifish	Eastern mosquitofish	Northern snakehead	Swallowtail shiner
Black crappie	Gizzard shad[2]	Pumpkinseed	Walleye
Blue catfish	Golden redhorse	Quillback	White catfish
Blueback herring[2]	Golden shiner	Redbreast sunfish	White crappie
Bluntnose minnow	Goldfish	River chub	White perch[2]
Bowfin	Greenside darter	Rock bass	Yellow bullhead
Brown bullhead	Hickory shad[2]	Shield darter	Yellow perch[2]
Central stoneroller	Inland silverside	Shorthead redhorse	
Comely shiner	Longear sunfish	Silverjaw minnow	
Common carp	Longnose gar	Smallmouth bass	

[1]Species list only includes those not documented along Rock Run.
[2]indicates that species is considered diadromous or semi-diadromous.
Source: Starnes et al., 2011

C. Cabin John Creek Watershed

a. Aquatic Habitat

Aquatic habitat assessments were conducted by MCDEP and MBSS throughout the Cabin John Creek watershed from 2008 to 2017. Aquatic habitat conditions in the watershed vary by location (**Table 2-61**); however, most waterways exhibit moderate aquatic habitat degradation. The Cabin John Creek mainstem crosses the Phase 1 South portion of the corridor study boundary along I-270 just south of Montrose Road, and along I-495 at Cabin John Parkway. Along the Cabin John Creek mainstem, MCDEP aquatic habitat assessments indicated Fair to Good aquatic conditions and MBSS aquatic habitat assessments indicated Degraded to Partially Degraded aquatic habitat conditions.

Aquatic habitat was also assessed by MCDEP at Snakeden Branch and Old Farm Creek, two tributaries located near where the Cabin John Creek mainstem crosses I-270. Snakeden Branch lies to the west of I-270, and aquatic habitat ratings ranged from Fair to Good/Fair. Old Farm Creek is primarily east of I-270 but crosses the Phase 1 South portion of the corridor study boundary to join the mainstem within Cabin John Regional Park. Aquatic habitat assessments were conducted downstream of the crossing, and conditions were rated as Fair to Good. Aquatic habitat conditions were also assessed by MCDEP along Unnamed Tributary 1 to Old Farm Creek, located upstream of the Phase 1 South portion of the corridor study boundary, and aquatic habitat along the tributary was generally in Fair condition.

Ken Branch joins the Cabin John Creek mainstem along the midsection of the Cabin John Creek watershed and drains an area to the west of the Phase 1 South portion of the corridor study boundary. Aquatic habitat conditions along Ken Branch were rated as Degraded by MBSS in 2008. Another tributary, Booze Creek, joins the mainstem of Cabin John Creek just downstream of the I-495 crossing, and aquatic habitat conditions were rated as Fair to Good/Fair by MCDEP.

Table 2-61. Range of Aquatic Habitat Scores for the Cabin John Creek Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Booze Creek	MCDEP	2008	96 – 107	Fair – Good/Fair
Cabin John Creek	MCDEP	2008 – 2014	94 – 147	Fair – Good
	MBSS	2008	60.74 – 79.56	Degraded – Partially Degraded
Ken Branch	MBSS	2008	60.19	Degraded
Old Farm Creek	MCDEP	2008 – 2014	93 – 137	Fair – Good
Snakeden Branch	MCDEP	2008 – 2014	95 – 106	Fair – Good/Fair
Unnamed Tributary 1 to Old Farm Creek	MCDEP	2015	79	Fair

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Results of benthic macroinvertebrate sampling in the Cabin John Creek watershed are summarized in **Table 2-62**. Overall, benthic macroinvertebrate community health was variable in the Cabin John watershed, with narrative benthic IBI scores indicating moderate to substantial degradation. MCDEP rated benthic macroinvertebrate communities in the Old Farm Creek and Snakeden Branch tributaries as Poor to Fair, while Ken Branch was rated as Very Poor by MBSS. Benthic macroinvertebrate community health was variable along the Cabin John Creek mainstem, ranging from Poor to Fair overall, as rated by MCDEP. The uppermost portion of the Cabin John Creek mainstem, above I-270, was sampled at various locations by both MCDEP and MBSS and received ratings of Poor and Very Poor, respectively. The benthic macroinvertebrate community in the portion of the Cabin John Creek mainstem that runs parallel to and just west of the I-270 corridor between Montrose Road and River Road was rated as Very Poor by MBSS and Poor by MCDEP. MCDEP sampling in the downstream portion of the Cabin John Creek mainstem resulted in benthic macroinvertebrate community ratings of Poor to Fair.

Table 2-62. Range of Benthic IBI Scores for the Cabin John Creek Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Cabin John Creek	MCDEP	2008 – 2014	12 – 18	Poor – Fair
	MBSS	2008 – 2017	1.00 – 1.33	Very Poor
Ken Branch	MBSS	2008	1.00	Very Poor
Old Farm Creek	MCDEP	2008 – 2014	10 – 20	Poor – Fair
Snakeden Branch	MCDEP	2008 – 2014	8 – 22	Poor – Fair

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

The Cabin John Creek watershed contains 33 recently documented fish species, more than any other watershed in the Phase 1 South portion of the corridor study boundary more recently (**Appendix O**). Black crappie and river chub were recently documented in the Cabin John Creek watershed within the vicinity of the Phase 1 South portion of the corridor study boundary. Black crappie are a sought-after gamefish species and river chub are intolerant of degraded conditions and require coarse riffle habitat for spawning. Six additional intolerant fish species were recently documented in the Cabin John Creek watershed: central stoneroller, common shiner, satinfin shiner, sea lamprey, spotfin shiner, and spottail shiner. These species are generally considered indicative of good stream health and minimally degraded water quality. Fathead minnow and goldfish were documented in the Cabin John Creek and Rock Creek watersheds only. Both species are non-native to Maryland and are thought to have been introduced through the bait and pet trades, respectively (MDNR, 2018b). Sea lamprey are anadromous, inhabiting streams and rivers when young, migrating to the sea or a large lake to mature, and returning to streams and rivers to spawn. According to the CFPP database, there is one fish blockage located within the Cabin John Creek watershed, as well as Little Falls Dam located downstream on the Potomac River mainstem (Martin, 2019). In addition to black crappie, largemouth bass and smallmouth bass were the only other gamefish species documented in Cabin John Creek in the Phase 1 South portion of the corridor study boundary since 2007.

Based on review of the CFPP project tool, alewife, blueback herring, and American eel all potentially occur in the Cabin John Creek watershed, depending on the time of year. American eel potentially occur in all Cabin John Creek perennial streams within the vicinity of the Preferred Alternative. Alewife and blueback herring potentially occur in Cabin John Creek, Thomas Branch, Bulls Run, and Booze Creek within the vicinity of the Preferred Alternative. Although the CFPP project tool indicates that alewife and blueback herring potentially occur in Thomas Branch in the vicinity of the project area, field investigations of this stream reach revealed low head dams and other blockages to aquatic organism passage that make this stream currently inaccessible to both species. American eel has been documented in the Cabin John Creek mainstem and their ability to successfully navigate instream barriers make them likely to occur in at least the downstream portions of Thomas Branch. Although no recent fish data were available for Thomas Branch, MCDEP conducted fish sampling in 1996 and 2003. They documented blacknose dace, common carp, creek chub, and goldfish in 1996 and only observed blacknose dace and creek chub in 2003.

Results of fish sampling in the Cabin John Creek watershed are summarized in **Table 2-63**. Overall, fish communities within the Cabin John Creek watershed are moderately degraded. MCDEP and MBSS sampled several sites along the Cabin John Creek mainstem where fish communities were rated as Fair to Good by MCDEP and Fair by MBSS. MBSS sampling along Ken Branch also resulted in a fish community health rating of Fair. Along Old Farm Creek, the fish community was similar, with MCDEP fish IBIs ranging from Fair to Good. Fish community health was more degraded in Booze Creek and Unnamed Tributary 1 to Old Farm Creek, where communities were rated as Poor by MCDEP.

Table 2-63. Range of Fish IBI Scores for the Cabin John Creek Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Booze Creek	MCDEP	2008	1.4	Poor
Cabin John Creek	MCDEP	2008 – 2014	3.0 – 4.1	Fair – Good

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
	MBSS	2008 – 2017	3.33 – 3.67	Fair
Ken Branch	MBSS	2008	3.00	Fair
Old Farm Creek	MCDEP	2008 – 2014	3.0 – 3.4	Fair – Good
Unnamed Tributary 1 to Old Farm Creek	MCDEP	2015	1.7	Poor

[1]Sampling may not have been conducted during all years within year ranges.

D. Rock Creek Watershed

a. Aquatic Habitat

Aquatic habitat conditions in the Rock Creek watershed vary slightly by subwatershed but are generally considered moderately degraded in the vicinity of the Phase 1 South portion of the corridor study boundary (**Table 2-64**). MCDEP data exist for two sites along the mainstem of Rock Creek just upstream I-495 and to the east of the Preferred Alternative. Aquatic habitat conditions ranged from Fair to Good at both sites.

Recent aquatic habitat condition data also exist for two tributaries within the vicinity of the Preferred Alternative that join the Rock Creek mainstem at or near the I-495 corridor. Luxmanor Branch enters the mainstem near the I-495 & I-270 split and Alta Vista Tributary joins the mainstem directly at I-495, to the east of the Preferred Alternative. MCDEP rated aquatic habitat conditions within Luxmanor Branch as Fair and along Alta Vista Tributary as Fair to Good.

Stoneybrook Tributary joins the mainstem of Rock Creek upstream of I-495 and to the east of the Preferred Alternative. MCDEP rated aquatic habitat conditions along Stonybrook Tributary as Fair to Good.

Table 2-64. Range of Aquatic Habitat Scores for the Rock Creek Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Alta Vista Tributary	MCDEP	2011 – 2013	65 – 123	Fair – Good
Luxmanor Branch	MCDEP	2008 – 2017	95 – 110	Fair
Rock Creek	MCDEP	2008 – 2017	91 – 121	Fair – Good
Stoneybrook Tributary	MCDEP	2014	89 – 117	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Results of benthic macroinvertebrate sampling in the Rock Creek watershed are summarized in **Table 2-65**. In general, benthic macroinvertebrate communities throughout the watershed are moderately to substantially degraded. MCDEP sampled two sites along the Rock Creek mainstem, both of which were located upstream of I-495 and to the east of the Preferred Alternative. The benthic macroinvertebrate community health was rated as Poor to Fair at both sites. One site along the Rock Creek mainstem, located just downstream of Knowles Avenue, had ratings that ranged from Poor to Fair. The other site along the Rock Creek mainstem, located in the portion that runs parallel to I-495, was rated as Poor.

Benthic macroinvertebrate community health was similar across both tributaries that enter the mainstem of Rock Creek at or near I-495 and to the east of the Preferred Alternative. MCDEP benthic IBI ratings were Poor in the Alta Vista Tributary and Luxmanor Tributary. MCDEP also rated benthic macroinvertebrate communities as Poor in Stoneybrook Tributary, which joins Rock Creek upstream of I-495.

Table 2-65. Range of Benthic IBI Scores for the Rock Creek Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Alta Vista Tributary	MCDEP	2012 – 2013	8 – 12	Poor
Luxmanor Branch	MCDEP	2008 – 2017	8 – 12	Poor
Rock Creek	MCDEP	2008 – 2017	14 – 18	Poor – Fair
Stoneybrook Tributary	MCDEP	2014	10 – 12	Poor

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

Twenty-three different fish species were recently documented within the Rock Creek watershed in the vicinity of the Phase 1 South portion of the corridor study boundary (**Appendix O**). All species documented within the Rock Creek watershed are also found within other watersheds along the Preferred Alternative. Goldfish, a non-native species thought to have been introduced through the bait and pet trades, was only documented in the Rock Creek and Cabin John Creek watersheds (MDNR, 2018c). Six species of fish that are considered intolerant of degraded conditions have been documented in nearby areas of Rock Creek in recent years, including fallfish, northern hogsucker, satinfin shiner, sea lamprey, spotfin shiner, and spottail shiner. American eel and sea lamprey were the only diadromous species documented, and no gamefish species have been documented in recent years. According to the CFPP database, there are no fish blockages located in the Rock Creek MD 12-digit watershed; however, there is one blockage located downstream along the Rock Creek mainstem in Washington DC that likely hinders fish movement (Martin, 2019).

Based on review of the CFPP project tool, American eel is the only diadromous fish species potentially occurring in perennial streams throughout the Rock Creek watershed in the vicinity of the Preferred Alternative. However, coordination with NMFS indicated that Pierce Mill Dam, located downstream of the Preferred Alternative on Rock Creek, has been retrofitted with a fish passage structure that is suitable for anadromous fish passage and that potential spawning habitat for alewife and blueback herring is present upstream of the dam.

Results of fish sampling in the Rock Creek watershed are summarized in **Table 2-66**. Fish community health was notably better in the mainstem than in most tributaries near the Phase 1 South portion of the corridor study boundary. Based on MCDEP data collected from sites upstream of I-495, fish communities along the mainstem of Rock Creek were rated as Good.

The fish communities within Alta Vista Tributary and Luxmanor Branch were substantially degraded, as they were consistently rated as Poor by MCDEP. Upstream of the Phase 1 South portion of the corridor study boundary, MCDEP rated Stoneybrook Tributary fish communities as Poor to Fair.

Table 2-66. Range of Fish IBI Scores for the Rock Creek Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Alta Vista Tributary	MCDEP	2012 – 2013	1.0 – 1.4	Poor
Luxmanor Branch	MCDEP	2008 – 2017	1.4 – 1.7	Poor
Rock Creek	MCDEP	2008 – 2017	3.4 – 4.1	Good
Stoneybrook Tributary	MCDEP	2014	1.9 – 2.3	Poor – Fair

[1]Sampling may not have been conducted during all years within year ranges.

E. Watts Branch Watershed

a. Aquatic Habitat

Data collected at two sites along the mainstem of Watts Branch and downstream of I-270 in the Watts Branch watershed indicate moderate aquatic habitat degradation (**Table 2-67**). Existing data collected by MCDEP ranked aquatic habitat conditions as Fair to Good along the Watts Branch mainstem. In general, aquatic habitat conditions were slightly better at the site located farther upstream and closer to I-270.

Table 2-67. Range of Aquatic Habitat Scores for the Watts Branch Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Watts Branch	MCDEP	2007 – 2014	87 – 131	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Results from benthic macroinvertebrate sampling conducted by MCDEP within the Phase 1 South portion of the corridor study boundary are summarized in **Table 2-68**. Benthic macroinvertebrate community health indicated moderate degradation within Watts Branch downstream of I-270 where benthic macroinvertebrate community health was rated as Fair.

Table 2-68. Range of Benthic IBI Scores for the Watts Branch Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Watts Branch	MCDEP	2007 – 2014	14 – 22	Fair

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

Twenty-five different fish species occupy the Watts Branch watershed within the vicinity of the Phase 1 South portion of the corridor study boundary (**Appendix O**). Apart from Blue Ridge sculpin and greenside darter, which have only been recently documented in one other watershed within the Phase 1 South portion of the corridor study boundary, all other fish species documented in Watts Branch are found throughout the Phase 1 South portion of the corridor study boundary and in other Central Maryland streams. The Blue Ridge sculpin is an intolerant species often indicative of good water quality. Two additional intolerant fish species were documented in Watts Branch: central stoneroller and common shiner. American eel was the only diadromous species and largemouth bass was the only gamefish species documented in the vicinity of the Phase 1 South portion of the corridor study boundary in recent years. Historically, smallmouth bass have also been documented throughout the watershed (MCDEP, 2003). According to the CFPP database, there is one fish blockage in the Watts Branch watershed, as well as the Little Falls Dam located downstream on the Potomac River mainstem, that may inhibit fish movement (Martin, 2019).

Based on review of the CFPP project tool, American eel is the only diadromous species potentially occurring in perennial streams throughout the Watts Branch watershed in the vicinity of the Preferred Alternative. No anadromous fish species are expected to occur in the Watts Branch watershed, as it is located upstream of Great Falls.

Results from fish sampling conducted by MCDEP within the Phase 1 South portion of the corridor study boundary are summarized in **Table 2-69**. Fish community health indicated moderate degradation within the Watts Branch; however, fish ratings were slightly better than benthic macroinvertebrate ratings. Based on data collected, fish community health ranged from Fair to Good. On average, fish community health was slightly better at the site located farther upstream and closer to I-270, which is consistent with the better aquatic habitat conditions documented at that location.

Table 2-69. Range of Fish IBI Scores for the Watts Branch Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Watts Branch	MCDEP	2007 – 2014	2.6 – 3.9	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

F. Muddy Branch Watershed

a. Aquatic Habitat

Aquatic habitat assessments conducted by MCDEP in the Muddy Branch watershed show moderately degraded conditions within the vicinity of the I-270 Phase 1 South portion of the corridor study boundary (**Table 2-70**). Data for the Muddy Branch mainstem indicate slightly variable conditions, with ratings ranging from Fair to Good. Along the mainstem, aquatic habitat conditions were slightly less degraded upstream of I-270 (Good) than at the monitoring site well downstream of the Phase 1 South portion of the corridor study boundary (Fair to Good/Fair). An aquatic habitat assessment was also conducted along one tributary to Muddy Branch, Decoverly Tributary, which is located downstream of I-270. MCDEP rated aquatic habitat conditions in Decoverly Tributary as Good.

Table 2-70. Range of Aquatic Habitat Scores for the Muddy Branch Watershed

Waterway	Source Data		Habitat Score Range	Narrative Score Range
	Agency	Year[1]		
Decoverly Tributary	MCDEP	2007	117 – 132	Good
Muddy Branch	MCDEP	2007 – 2014	96 – 120	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

b. Benthic Macroinvertebrates

Results of benthic macroinvertebrate sampling in Muddy Branch are summarized in **Table 2-71**. Overall, benthic macroinvertebrate communities in this watershed indicate moderate degradation. MCDEP sampled two locations along the Muddy Branch mainstem in recent years, one upstream and one downstream of I-495. Benthic macroinvertebrate communities were similar at both sites and were rated as Poor to Fair. Decoverly Tributary located downstream of I-495, had a benthic macroinvertebrate community health rating of Fair.

Table 2-71. Range of Benthic IBI Scores for the Muddy Branch Watershed

Waterway	Source Data		Benthic IBI Range	Narrative Score Range
	Agency	Year[1]		
Decoverly Tributary	MCDEP	2007	18	Fair
Muddy Branch	MCDEP	2007 – 2014	16 – 18	Poor – Fair

[1]Sampling may not have been conducted during all years within year ranges.

c. Fish

Nineteen different fish species were recently documented in the Muddy Branch watershed within the vicinity of the Phase 1 South portion of the corridor study boundary, all of which are also found in neighboring watersheds (**Appendix O**). Central stoneroller was the only intolerant fish species documented in Muddy Branch. No diadromous species were documented and only one gamefish species, largemouth bass, was documented within Muddy Branch in recent years. Aside from central stoneroller, all species observed in the Muddy Branch watershed are generally widely distributed and capable of persisting in degraded stream conditions. According to the CFPP database, there are eight fish blockages in the Muddy Branch watershed, as well as the Little Falls Dam located downstream on the Potomac River mainstem, that likely inhibit fish movement (Martin, 2019).

Based on review of the CFPP project tool, American eel is the only diadromous species potentially occurring in perennial streams throughout the Muddy Branch watershed in the vicinity of the Preferred Alternative. No anadromous fish species are expected to occur in the Muddy Branch watershed, as it is located upstream of Great Falls.

Results of fish sampling in the Muddy Branch watershed are summarized in **Table 2-72**. Recent data collected by MCDEP in the vicinity of the Phase 1 South portion of the corridor study boundary indicate that fish communities in the Muddy Branch watershed appear to be moderately to minimally degraded. Communities in the Muddy Branch mainstem ranged from Fair to Good, based on sampling at one site well downstream of the Phase 1 South portion of the corridor study boundary. Sampling at the MCDEP site located approximately one mile downstream of the Phase 1 South portion of the corridor study boundary along Decoverly Tributary indicated that fish communities were in Good condition.

Table 2-72. Range of Fish IBI Scores for the Muddy Branch Watershed

Waterway	Source Data		Fish IBI Range	Narrative Score Range
	Agency	Year[1]		
Decoverly Tributary	MCDEP	2007	4.1	Good
Muddy Branch	MCDEP	2007 – 2014	3.0 – 3.4	Fair – Good

[1]Sampling may not have been conducted during all years within year ranges.

2.9.3 Environmental Effects

The Preferred Alternative may affect aquatic biota due to direct and indirect impacts to perennial and intermittent stream channels. Stream channel impacts associated with the Preferred Alternative LOD are 42,494 LF. Impacts are provided in more detail in **Section 2.3.3**. Impacts to aquatic biota may include mortality of aquatic organisms during construction of culvert extensions and loss of natural habitat from the placement of culvert pipes and other in-stream structures, or from more gradual changes in stream conditions. Other construction activities that may negatively impact aquatic biota include causeway/trestle construction, demolition of existing structures, channel realignment/stabilization, culvert augmentation/replacement, dredging, pile/cofferdam construction, and permanent shading.

Impacts to aquatic biota, including species of freshwater mussels, are possible from the replacement and extension of bridges and their in-water piers. Noise from driving piles for bridges or temporary structures over the water may result in adverse effects to fish species, potentially including damage to body tissues, behavioral effects, and physiological effects such as changes in stress hormones or sensing and navigation abilities (Fletcher and Busnel, 1978; Kryter, 1984; Popper 2003; Popper et al., 2004). Temporary bridge construction elements such as causeways, riprap pads, or cofferdams in the Potomac River may affect the hydrodynamics of the river, funneling water through reduced cross-sections of the river. These and additional effects from potential rock jetties or other construction related activities may affect anadromous fish species and could result in behavior modification or avoidance. Shading from overwater structures such as bridges can negatively impact migratory fish species by altering behavior, predation, and degrading habitat (Nightingale and Simenstad, 2001; Hanson, et al., 2003). American shad and river herring appear to be particularly affected by shading from overwater structures (Moser and Terra, 1999).

Most culverts within the Preferred Alternative LOD are being extended or augmented rather than replaced since the project would improve an existing roadway. Although this reduces the overall length of potential impacts to waterways, if existing culverts do not meet current aquatic life passage standards and are being extended rather than replaced, then opportunities for improving aquatic life passage are limited. The possibility of retrofitting some culverts with a natural stream bottom will be evaluated in later phases of the study.

No Essential Fish Habitat (EFH) was identified within the study corridors, therefore the MSFCMA does not apply to this project. However, impacts to alosines may adversely affect species that are federally managed and their EFH, because alosines are prey for these species. Alosine population declines are attributed in part to decreases in water quality, channelization, dredging, and in-water construction from construction projects (ASMFC, 2010; ASMFC, 2017).

MDOT SHA requested information from the MDNR ERP regarding the presence of protected aquatic species within the Phase 1 South portion of the corridor study boundary. MDNR ERP provided feedback in a response letter dated January 10, 2019, that included a list of fish species likely to occur within the waterbodies crossed by I-495 and I-270 and time of year restrictions for instream work to minimize impact to these species. A copy of this letter is included in **Appendix N** and the I-495 & I-270 Managed Lanes Study will comply with all time of year restrictions for construction activities within stream channels to protect fish species that are included in this correspondence.

During construction of culvert extensions or stream relocations, the stream channel is excavated and any organisms living within the stream channel would be displaced or crushed by construction equipment. The primary impact from these activities would be to benthic organisms, such as macroinvertebrates, that are relatively stationary. However, fish mortality is also a possibility as they can be trapped in pools during dewatering of the channel. Even if a natural stream bottom is reestablished within the culvert or relocated channel, the habitat is unlikely to immediately support the same fish or macroinvertebrate community present before construction. Relocated channels would require a period of reestablishment before the same fish or macroinvertebrate communities could recolonize the channel. In the majority of the impacted streams, the area of channel disturbance for the culvert extension is relatively small in comparison to the remaining habitat available, making the overall habitat and mortality impact minor. In addition to displacement and habitat alteration, decreased aquatic organism passage could result from the extension of culverts. As detailed in **Section 2.9.2**, fish blockages are prevalent in many of the watersheds within the vicinity of the Preferred Alternative LOD and any additional restrictions to passage at culverts could further hinder aquatic organism movement and migration.

Although the immediate impacts from stream crossings have the potential to cause negative impacts to aquatic biota, some potential long-term negative effects are related to the change in land-cover associated with the Preferred Alternative LOD and the potential for increases in impervious surfaces. The Preferred Alternative LOD will require clearing of forested land, with an impact of approximately 460 acres (**Section 2.7.3, Environmental Effects, Vegetation and Terrestrial Habitat**). Forest impacts would include clearing forested land in stream valleys that currently provides important ecological services including: shading streams; reducing the quantity and increasing the quality of stormwater runoff; providing food and habitat sources from leaf detritus and coarse woody debris; and anchoring stream banks and floodplains with tree and shrub roots. Loss of detrital inputs and other impacts from forest clearing can have far reaching effects, including diminishing critical food sources in downstream waters. Tree removal during the construction process can also reduce the amount of shade provided to a stream and thereby raise the water temperature of that stream. In addition to tree removal, stormwater discharges also have the potential to increase surface water temperatures in nearby waterways. The effect of the temperature change depends on stream size, existing temperature regime, the volume and temperature of stream baseflow, and the degree of shading. Some of this clearing would be a temporary impact related to construction of the road improvements. In these cases, disturbed areas would be revegetated and eventually would again provide shade to the stream. Other temporary impacts to aquatic biota related to construction include the potential for unintentional sediment discharges that degrade aquatic habitat and impair aquatic communities as described in **Section 2.4.3.A, Environmental Effects, Surface Water Quality**.

The conversion of open-space and forested areas to impervious surfaces has the potential to have a wide range of impacts on study area streams and their inhabitants. The scientific literature generally shows that aquatic insect and freshwater fish diversity decline in watersheds at 10 to 15 percent impervious cover, with sensitive elements of the communities being affected at even lower impervious levels (CWP, 2003). Often, impacts from imperviousness are most apparent in the macroinvertebrate community. Macroinvertebrates are relatively immobile and are quickly affected by habitat impacts such as bank erosion, sedimentation, and channel bed instability. While fish are more mobile than macroinvertebrates and can sometimes avoid short-term water quality or flow impacts, long-term changes in flow regime and habitat from imperviousness have been documented across the country. Sensitive fish that require clean and stable stream substrates for feeding and spawning are typically lost at approximately the 10 percent imperviousness threshold, while broader overall declines in the community are documented in the 10 to 15 percent impervious range (CWP, 2003). As discussed in **Section 2.4.2.A**, imperviousness of the greater watersheds within the Preferred Alternative LOD ranges from 11 to 25 percent, with the majority of the watersheds over 15 percent impervious.

The Preferred Alternative LOD will result in a net increase in impervious surfaces of 103.2 additional acres across all watersheds. For most watersheds, the individual increase in imperviousness associated with this study is minimal compared to the size of the watershed, or the amount of existing imperviousness. Additional impervious surface area would equate to less than one percent of the total watershed area for the Preferred Alternative LOD.

The additional impervious acreage added for the Preferred Alternative LOD is summarized in **Table 2-73** below. Through the use of erosion and sediment control measures, SWM, and other BMPs, MDOT SHA will mitigate impacts from any additional impervious area from the proposed project to the greatest extent practicable to avoid further declines in the quality of aquatic habitat and communities.

Table 2-73. Additional Impervious Surfaces by Watershed

MD 12-Digit Watershed Name	MD 12-Digit Watershed	USGS 12-digit HUC Name	USGS 12-digit HUC Number	AC	SF
Potomac River/Rock Run	21402020845	Nichols Run-Potomac River	20700081003	15.0	654,707
Cabin John Creek	21402070841	Cabin John Creek	20700081003	77.0	3,355,862
Rock Creek	21402060836	Lower Rock Creek	20700100102	0.8	32,670
Muddy Branch	21402020848	Muddy Branch	20700081001	7.2	313,196
Watts Branch	21402020846	Watts Branch	20700081002	3.2	137,214

Note: Part of the additional impervious surface area is in the Nichols Run-Potomac River HUC12 Watershed in Virginia and is not associated with an MD 12-digit Watershed.

2.9.4 Avoidance, Minimization, and Mitigation

Aquatic biota will be affected to some degree by the Preferred Alternative LOD. Efforts have been made throughout the planning process to avoid and minimize potential direct impacts to stream channels and these efforts would continue as the project design is refined. Avoidance and minimization efforts to date have included alignment shifts, reductions to roadside ditch widths to minimize the overall width of improvements, bridging waterways when feasible, and addition of retaining walls where practicable. During the development of the engineering layouts and the Preferred Alternative LOD, a process was used to limit or avoid impacts to sensitive environmental features. This included the application of five progressively narrower roadside typical sections, as described in **Section 2.3.4**, to minimize or avoid impacts to these environmental and community resources. MDOT SHA has worked closely with regulatory agencies and resource managers to identify sensitive aquatic resources and to determine further potential avoidance and minimization as design is refined. Agency recommendations have been evaluated based on engineering and cost effectiveness and implemented wherever possible.

Bridges and natural bottom culverts will be used wherever possible to maintain natural stream substrate in areas where new or replaced culverts are necessary. However, opportunities for using natural bottom culverts may be limited because most existing culverts will be extended or augmented rather than replaced. Channel morphology will be evaluated, and culvert extensions designed to maintain aquatic life passage by avoiding downstream scour and channel degradation. Preliminary design includes culvert augmentations resulting from installing new pipes adjacent to existing culverts to provide additional area for flow. Based on culvert analysis, no culverts that are greater than 36 inches in diameter and drain an area of greater than 25 acres will be extended, except for those associated with culvert augmentations or replacements. Ongoing coordination is being conducted with MDNR and MDE to identify culverts within the Preferred Alternative LOD that are of concern for aquatic organism passage. A total of 42 culverts are greater than 150 feet long, of which 40 are existing and 2 are proposed culverts. Although aquatic organism passage may be currently limited within the Preferred Alternative LOD, additional impacts to aquatic organism passage will be avoided and minimized, where practicable.

Unavoidable direct impacts to stream channels will be mitigated in accordance with state and federal regulations through restoration projects aimed at replacing lost aquatic resource functions and services; for example, by improving water quality and providing high quality habitat for aquatic biota. Mitigation for stream channel impacts is discussed in **Section 2.3.4** and is covered in detail in the Final Compensatory Wetlands and Waterways Mitigation Plan (FEIS, Appendix O). Unavoidable impacts to forest from the I-495 & I-270 Managed Lanes Study will be regulated by MDNR under Maryland Reforestation Law and will adhere to all applicable local reforestation requirements. Mitigation for forests is discussed in more detail in **Section 2.7.4** and would be further coordinated in later stages of design.

All in-stream work will comply with the stream closure period for the designated use class of the stream, including that for culvert extensions, and any potential waiver requests would require agency approval(s). In-stream work is prohibited in Use I streams from March 1 through June 15. Riparian forests may be protected during river herring spawning periods by the voluntary time of year restriction for tree clearing that has been agreed upon from May 1 to July 31 of any year within a 3-mile buffer of the positive acoustic detection of the NLEB within the Phase 1 South portion of the corridor study boundary. Riparian forests shade streams and regulate water temperature. Additionally, MDOT SHA commits to maintaining existing or improving aquatic life passage in the primary (not overflow) culverts that are being replaced or extended and continuing to coordinate with MDNR, USFWS, NMFS, and MDE regarding aquatic life passage. In instances where an existing culverted stream crossing of a designated "major stream crossing" requires complete replacement, MDOT SHA agrees to design such replaced culverts to meet the passage criteria described by USFWS (USFWS, 2019b). In areas where culverts are being extended or augmented, retrofitting with a natural or nature-like stream bottom will continue to be considered as an option, pending detailed design.

Replacement of the ALB crossing the Potomac River will require extensive in-stream work, and best management practices will be implemented to avoid and minimize impacts to the river and its aquatic biota. MDOT SHA commits to conducting a mussel survey in the Potomac River surrounding the ALB, 10-meters upstream and 25-meters downstream of the temporary project LOD, for all Maryland State listed mussel species that are short-term and long-term brooders prior to construction and relocation of rare species, if necessary. Construction approaches that minimize the temporal extent of in-water activities in the Potomac River surrounding the ALB will be considered to the extent practicable, such as using coffer dams and temporary construction trestles. Construction of causeways/trestles at the ALB will be considered a permanent impact to mussels and compensatory mitigation in the form of mussel surveys and relocation will be provided for these impacts. Causeways and trestles proposed adjacent to the existing ALB will be designed to minimize in-water fill and avoid impacting fish passage by maintaining river velocities below approximately 3 feet per second at commonly observed discharges (e.g., below 90 percentile) during the period in which anadromous fish are spawning (February 15 - June 15). Trestles or other non-fill accessways will be used in areas of deeper water (e.g., extending from the southern bank) to the extent practicable to minimize fill and associated flow restrictions.

Potential water quality impacts from construction would be minimized through strict adherence to mandated erosion and sediment control and SWM requirements. State-of-the-art erosion and sediment control techniques would be implemented in compliance with MDE regulations. SWM BMPs would be developed in compliance with all applicable MDE regulations and guidance to provide channel protection, protect water quality, and maintain baseflow, which would minimize the negative effects of the roadway improvements on aquatic biota. In particularly sensitive areas, other impact minimization activities may be considered and could include more specialized SWM options; redundant erosion and sediment control measures; monitoring of aquatic biota above and below sensitive stream crossings before and after construction to quantify any inadvertent impacts that occur at the crossing; fish relocation from dewatered work areas during construction to reduce fish mortality and use of a qualified environmental monitor on-site to enhance erosion and sediment control compliance. The Developer will also follow MDE's Best Management Practices for working in waterways, which are required under a Wetlands and Waterways Permit.

The P3 Developer will re-consult with NMFS when construction plans are developed for roadway crossings in anadromous fish use areas identified by MDNR to ensure that impacts due to construction and permanent fill are minimized to the extent practicable.

2.10 Rare, Threatened, and Endangered Species

2.10.1 Regulatory Context and Methods

Section 7 of the ESA of 1973 (16 U.S.C. Sections 1531-1544) requires all federal agencies to use their authorities to conserve endangered and threatened species in consultation with the USFWS and/or National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS). Section 7(a)(2) (16 U.S.C. § 1536) establishes substantive requirements for federal agencies to insure, in consultation with the USFWS, any action authorized, funded, or carried out is not likely to jeopardize the continued existence of any endangered or threatened species or destroy or adversely modify designated critical habitat. The Section 7 implementing regulations (50 CFR Part 402) specify how federal agencies must fulfill their Section 7(a)(2) consultation requirements. Section 9 of the ESA (16 U.S.C. § 1538) prohibits any action that causes a “take” of species listed as endangered or threatened. “Take” is further defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt any of these. The USFWS administers the ESA for all terrestrial and nontidal freshwater species, while the NMFS administers the ESA for marine and anadromous species or critical habitat. While there are no tidal areas within the Phase 1 South portion of the corridor study boundary, NMFS also regulates effects to other trust resources such as anadromous fish species, estuaries, and EFH. The Fish and Wildlife Coordination Act (FWCA) requires consultation with the NMFS to address impacts to fish and aquatic resources under their jurisdiction. The MSFCMA requires consultation to address effects to fish and EFH identified under the MSFCMA. These resources are discussed in **Section 2.9, Aquatic Biota**.

The Maryland Nongame Endangered Species Conservation Act (Md. Code Ann., Nat. Res. § 10-2A-01 through 09) regulates activities that impact plants and wildlife, including their habitats, listed on the Maryland Threatened and Endangered Species list. Protections under the Act are for species listed as Endangered, Threatened, or In Need of Conservation (animals only). Endangered species are those whose continued existence in Maryland is in jeopardy. Threatened species are those that are likely, in the foreseeable future, to become endangered in Maryland. Species with a status of In Need of Conservation are animals whose population is limited or declining in Maryland such that it may become threatened in the foreseeable future if current trends or conditions persist. Any federal, state, local, or private constructing agency is required to cooperate and consult with MDNR regarding: the presence of listed species within a project area, field verification of habitat and/or populations of listed species, and avoidance and minimization efforts, as appropriate.

The Virginia Department of Agriculture and Consumer Services (VDACS), VDGIF, and VDCR cooperate in the protection of Virginia's state and federally listed threatened and endangered species. Threatened and endangered wildlife species are protected under the Virginia ESA of 1972 (Chapter 5 Wildlife and Fish Laws; Va. Code Ann., § 29.1¬563 through 570). Virginia's threatened and endangered plant and insect species are protected under the Endangered Plant and Insect Species Act of 1979 (Chapter 10 Endangered Plant and Insect Species of the Virginia Code; Va. Code Ann., § 3.2¬1000 through 1011). In addition, a cooperative agreement with the USFWS, signed in 1976, recognizes VDGIF as the designated state agency with regulatory and management authority over federally-listed animal species and provides for federal/state cooperation regarding the protection and management of those species. VDACS holds authority to enforce regulations pertaining to plants and insects. However, as per a memorandum of agreement between VDCR and VDACS, VDCR represents VDACS in comments regarding potential impacts to state-listed threatened and endangered plant and insect species.

The Information for Planning and Consultation (IPaC) tool was used to assess the potential presence of federally listed species under the jurisdiction of the USFWS. This online resource allows an assessment of potential listed species within an estimated action area. The IPaC official species list for both the Virginia and Chesapeake Bay Ecological Services field offices of the USFWS were originally accessed on July 11, 2018. Follow-up IPaC coordination occurred on October 24, 2019. The NMFS was contacted by email on July 16, 2018, regarding the potential presence of EFH or federally listed tidal aquatic threatened or endangered species.

The Maryland Trilogy Application was completed to assess the potential for the presence of Maryland state listed terrestrial or aquatic RTE species within the I-495 & I-270 Managed Lanes Study Phase 1 South portion of the corridor study boundary. This online application solicits state listed RTE species review from the MDNR WHS and MDNR ERP. In addition, mapped MDNR Sensitive Species Project Review Areas (SSPRA) were reviewed in Maryland to determine areas supporting or providing habitat buffers for RTE species within the Phase 1 South portion of the corridor study boundary. SSPRAs are mapped to include both sensitive species habitat and a buffer to allow potential activities anywhere within or near the SSPRA to be flagged for more detailed review by MDNR to determine if a sensitive species could potentially be affected. For Virginia state listed RTE species, the VDCR was contacted for information on the potential presence of RTE plant and insect species within the Phase 1 South portion of the corridor study boundary. Response letters, online reviews, and other correspondence from the state and federal agencies responsible for rare, threatened, and endangered (RTE) species are included in **Appendix N**.

2.10.2 Existing Conditions

A. Northern Long-eared Bat and Indiana Bat

The USFWS Virginia field office 2018 official species list indicated the potential presence of the northern long-eared bat (*Myotis septentrionalis*) (NLEB) and the yellow lance (*Elliptio lanceolata*), both federally listed threatened species. The yellow lance appears to be presumed extirpated in the study area, as explained by USFWS in the *Species Status Assessment Report for the Yellow Lance (Elliptio lanceolata)* and the Final Rule (USFWS, 2018a and 2018b). No federally listed species were noted in the Chesapeake Bay field office official species list. However, in early 2019, during coordination meetings with MDOT SHA, USFWS voiced concerns about potential impacts from the I-495 and I-270 Managed Lanes Study in Maryland and Virginia to the NLEB and Indiana bat (*Myotis sodalis*) (IB), a federally-listed endangered species, due to positive detection of these species by Virginia Tech in areas surrounding the Phase 1 South portion of the corridor study boundary in their 2017 and 2018 spring/summer surveys. This concern was raised as a result of research being conducted on NPS lands in the Metropolitan Washington DC area by Virginia Tech (NPS Publication Pending). As a result of this new information, the USFWS met with MDOT SHA and FHWA on March 25, 2019, to further discuss project coordination efforts regarding the NLEB and IB.

Both listed bat species are found throughout the eastern and north-central US, hibernating in mines and caves during winter and spending the summer in wooded areas (USFWS, 2016; USFWS, 2018c). NLEB is typically a short distance migrant, with the distance from winter hibernacula in caves and mines to summer roosts being typically less than 50 miles (USFWS, 2016), while IB are known to migrate hundreds of kilometers from their hibernacula (USFWS, 2007b). No winter hibernacula exist within the Phase 1 South portion of the corridor study boundary for either species, but summer roosting and maternity habitat can include any patch of typically upland forest or loose clusters of trees that have individual live or dead trees with loose bark, crevices, cavities, or hollows. The NLEB will also use barns and sheds in areas where suitable roost trees do not occur (USFWS, 2016). Upland forest habitat that could serve as summer roost habitat for NLEB or IB occurs throughout the Phase 1 South portion of the corridor study boundary in Virginia and Maryland.

On July 18, 2019, the USFWS submitted a letter to the MDOT SHA providing comments on the IPaC Section 7 coordination for the two federally listed bat species. The USFWS letter specifies two potential ESA consultation pathways that can be used when transportation projects may affect the NLEB or IB. These include 1) the Programmatic Biological Opinion (BO) for Transportation Projects in the Range of the Indiana Bat and Northern Long-eared Bat, currently dated February 2018 due to revisions, and 2) the Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-eared Bat and Activities Excepted from Take Prohibitions, dated January 5, 2016. Either of these two Biological Opinions could be used to help facilitate ESA Section 7(a)(2) compliance for the I-495 & I-270 Managed Lanes Study.

According to the July 18, 2019, USFWS letter to MDOT SHA, the project would not qualify under the Programmatic BO for Transportation Projects referenced above because the project proposes to clear more than 20 acres of suitable habitat within any given five-mile section of roadway. The letter states that the project would qualify under the Programmatic BO on Final 4(d) Rule for the NLEB even though forest clearing may affect NLEB. However, the following conservation measures in the Final 4(d) Rule must be followed: Incidental take from tree removal is prohibited if it: (1) occurs within a 0.25-mile (0.4 kilometer) radius of known NLEB hibernacula; or (2) cuts or destroys known occupied maternity roost trees, or any other trees within a 150-foot (45-meter) radius from the known maternity tree during the pup season (June 1 through July 31). Based on the data collected by researchers at Virginia Tech over the previous three summers, the USFWS recommended that MDOT SHA conduct surveys to determine if IB are utilizing summer habitat within the Phase 1 South portion of the corridor study boundary. These studies, which would qualify as Conservation Measures under the Final 4(d) Rule for the NLEB, would include mist-netting, radio-tracking, visual bridge surveys, and emergence bridge surveys. These studies, which include visual bridge surveys and emergence bridge surveys, would qualify as “conservation measures” under Section 7(a)(I) of the ESA for the NLEB and are recommended for the IB to let the USFWS know if conservation measures need to be implemented to avoid adverse effects to the IB.

A follow-up meeting between the MDOT SHA, FHWA, and USFWS was held on July 26, 2019, to further discuss potential bat survey activities and to finalize an acceptable survey approach. It was determined that insufficient time was available to conduct trapping surveys within the acceptable window of May 15 to August 15, 2019. However, it was decided that bat surveys of bridges, both visual and emergence, adjacent to suitable forest habitat could be conducted prior to the August 15, 2019, deadline. Suitable forest habitat includes areas of contiguous forest meeting the definition of FIDS[11] habitat, in proximity to a water resource, or adjacent to areas where NLEB and IB were detected by the Virginia Tech researchers. A preliminary list of bridges to be surveyed was presented to the USFWS for approval at the July 26, 2019, meeting. After the meeting, the USFWS revised the list to include a few additional bridges. The USFWS also accepted the proposed approach to conduct bat emergence surveys at the ALB, an expansive bridge over a broad area of open water that would be difficult to visually survey.

Between August 5 and 12, 2019, 7 bridge structures and associated ramp bridges within the Phase 1 South portion of the corridor study boundary were assessed for the presence of roosting bats or their suitability to support roosting bats. While suitable bat roosting habitat features were present on most bridges, most did not combine all necessary habitat variables. Bat guano was found beneath the ALB on the Maryland side of the Potomac River, the McArthur Boulevard/Clara Barton Parkway Westbound bridge, and the bridge over Seven Locks Road. Based on the results of the visual assessment, there was no evidence of use of the bridges by the NLEB or IB. However, five big brown bats, not state or federally listed, were found day-roosting singly within gaps between pier caps of the bridge over the McArthur Boulevard/Clara Barton Parkway Westbound bridge. All five roosting bats were in locations with a vertical clearance of at least 10 feet with forested habitat adjacent to the bridge. All had small amounts of guano on the ground beneath them suggesting that these were not extensively used roosts. Bat emergence surveys were

[11] FIDS habitat is described as forests at least 50 acres in size with 10 or more acres of forest interior habitat (i.e., forest greater than 300 feet from the nearest forest edge) or riparian forests at least 50 acres in size with an average total width of at least 300 feet.

conducted at the ALB on August 12, 2019. Small and larger bats were observed flying beneath or near the bridge, but no bats were definitively confirmed exiting the bridge structures.

Based on suitable conditions for bridge roosting reported in the literature and evidence of roosting bats from this study, Phase 1 South portion of the corridor study boundary bridges that support or could support roosting bats include the ALB, Clara Barton Parkway Eastbound bridge (not surveyed due to construction, but with conditions similar to the McArthur Boulevard/Clara Barton Parkway Westbound bridge), McArthur Boulevard/Clara Barton Parkway Westbound bridge, and Seven Locks Road bridge. Details of the bridge visual and bridge emergence surveys can be found within the *Bridge Survey Report for the Northern Long-eared Bat (Myotis septentrionalis) and Indiana Bat (Myotis sodalis)* in **Appendix P**.

The IPaC reviews for the USFWS Virginia and Chesapeake Bay field offices were rerun on October 24, 2019. Both field offices listed only the NLEB as potentially occurring within the Phase 1 South portion of the corridor study boundary. The yellow lance, which was reported in the 2018 official species list, appears to be presumed extirpated in the area near the Phase 1 South portion of the corridor study boundary, as explained by USFWS in a 2018 Final Rule regarding the species. To apply “conservation measures” under Section 7(a)(I) of the ESA for the NLEB, MDOT SHA proposed informational mist netting and presence/absence acoustic surveys and radio tracking in areas with positive acoustic identification of rare, threatened, and endangered bat species during the survey window of May 15 through August 15, 2020. The USFWS concurred with the study team’s survey approach on March 11, 2020. USFWS subsequently asked that mist netting and radio telemetry surveys be removed from the study plan due to concerns of transmission of COVID-19 to bats. Coordination with the USFWS and researchers from Virginia Tech regarding these studies is ongoing.

MDOT SHA determined suitable locations for deploying the acoustic survey devices by conducting a broad mapping study within the Phase 1 South portion of the corridor study boundary of suitable maternity roosting and foraging habitat and travel corridors for these bats. Using a GIS approach for linear projects, each forest stand at least 15 acres in size within the Phase 1 South portion of the corridor study boundary was mapped. Follow-up field assessments then identified each stand as being more likely, less likely, or unlikely to be used by NLEB or IB.

A meeting between the MDOT SHA, FHWA, USFWS, and MDNR was held on April 20, 2020, to summarize the results of the bat habitat assessments and to outline a more precise acoustic survey approach based on these results. During the meeting, MDNR also requested that MDOT SHA include acoustic surveys for the state-listed endangered small-footed bat (*Myotis leibii*) (SFB) and that bridge surveys for the presence of roosting bats be conducted on the Clara Barton Parkway East Bound bridges since they were under construction in 2019 and could not be adequately surveyed at that time. On June 29, 2020, a diurnal survey was conducted of abutments, decking, and piers of the Clara Barton Parkway East Bound bridge looking for the presence of roosting bats or bat guano. No bats or bat guano were found beneath the bridge and associated ramps during the survey. The Clara Barton Parkway West Bound bridge and associated ramps were resurveyed during the 2020 bridge surveys to see whether bats were again found roosting within gaps between the pier caps, as observed in 2019. Two individuals of the same species, big brown bat, found in 2019, were again found roosting under the bridge in 2020. The results of the 2020 bridge surveys are included within the *Additional Bridge Survey Report for the Northern Long-eared Bat (Myotis septentrionalis) and Indiana Bat (Myotis sodalis)* in **Appendix P**.

On June 10, 2020, the USFWS approved the *I-495 & I-270 Managed Lanes Study Acoustic Surveys Technical Study Plan for Threatened and Endangered Bat Species* (**Appendix P**), which was used as a framework for conducting the acoustic surveys for threatened and endangered bat species within the Phase 1 South portion of the corridor study boundary during summer 2020. As noted above, MDOT SHA and FHWA agreed to conduct the acoustic surveys to satisfy Section 7(a)(1) of the ESA. Section 7(a)(1) requires federal agencies to use their authorities to further the conservation of listed species. The deployment of acoustic detectors followed the survey protocol for linear projects and included a minimum of 2 detector nights of effort per 1 kilometer of suitable habitat. Based on the habitat data, approximately 66 kilometers of suitable habitat were identified within the corridor study boundary. This resulted in a minimum of 132 acoustic detector nights of survey for the project and 66 detector locations. Twenty of these locations were within the Phase 1 South portion of the corridor study boundary and 16 of these locations were within the Preferred Alternative LOD. Detectors were placed within forest stands mapped as more likely and less likely suitable habitat areas within the Phase 1 South portion of the corridor study boundary during June and July 2020. Each acoustic survey location was surveyed at least twice, and all recorded call data were analyzed using Kaleidoscope® Pro (Wildlife Acoustics Inc.) acoustic identification software.

The survey resulted in the recording of 15,059 bat calls at 16 sites in the Preferred Alternative LOD. One NLEB presence was detected at a site within the Phase 1 South portion of the corridor study boundary along I-495 south of I-270 spur, but this site is not located within the Preferred Alternative LOD. No calls were recorded of either IB or SFB. Details of the acoustic study, including mapping locations of acoustic sampling sites and all acoustic survey protocols and recorded data are included in the *I-495 & I-270 Managed Lanes Study Threatened and Endangered Bat Habitat Assessment and Acoustic Survey Report* in **Appendix P**.

The tri-colored bat (*Perimyotis subflavus*) and little brown bat (*Myotis lucifugus*) are both state Endangered species in Virginia and both species statuses are Under Review federally. The Virginia Department of Wildlife Resources requested via Virginia Department of Environmental Quality's DEIS comment letter dated October 1, 2020, that the I-495 & I-270 Managed Lanes Study either conduct a roost tree survey within the Virginia portion of the Preferred Alternative or adhere to a time of year restriction for tree clearing from April 1 – October 31 in any year to avoid impact to bat roost trees during roosting season.

Biologists conducted acoustic data analysis on behalf of MDOT SHA for the tri-colored bat and little brown bat in the Virginia portion of the Preferred Alternative LOD, using the data collected in 2020 for the NLEB and IB acoustic survey. The MLS acoustic bat survey around the ALB confirmed presence of the tri-colored bat, but no little brown bats were identified. The Virginia LOD area was assessed for bat habitat as part of the MLS acoustic survey, with "Forest Habitat Type (FHT) 1" areas indicating suitable habitat; "FHT 2" areas indicating some suitable habitat; and "FHT 3" areas indicating unsuitable habitat. There are 14.4 acres of suitable habitat, 18.2 acres of somewhat suitable habitat, and 17.5 acres of unsuitable habitat in the Virginia portion of the Preferred Alternative.

B. Fisheries

A response was received on August 9, 2018, from NMFS stating the corridor study boundary lies outside the limits of potential direct or indirect effects to federally listed or proposed threatened or endangered species under the jurisdiction of NMFS. Therefore, further consultation with NMFS under Section 7 of the ESA is not needed unless the study changes substantially or new information becomes available.

The NMFS provided comments on the DEIS and SDEIS regarding upstream passage of diadromous fish in the Potomac River and Cabin John Creek, included in FEIS. Further discussion of diadromous fish is included in **Section 2.9**, since these species are not rare, threatened, or endangered.

C. SSPRAs

MDNR has mapped one SSPRA that intersects with the Phase 1 South portion of the corridor study boundary along the Potomac River. As mentioned previously, these mapped areas include both sensitive species habitat and a buffer to allow potential activities within the SSPRA to be flagged for more detailed review by MDNR to determine if a sensitive species could potentially be affected. Presence of an SSPRA within the Phase 1 South portion of the corridor study boundary does not necessarily mean an impact would occur. **Table 2-74** displays the total acreage of SSPRA located within the Phase 1 South portion of the corridor study boundary.

Table 2-74. SSPRA Acreage within the Phase 1 South Portion of the Corridor Study Boundary

	Permanent	Temporary	Total
Total SSPRA in Acres	24.23	19.28	43.51

D. State-listed Species

<u>**Plants**</u>

MDNR issued a response letter to MDOT SHA's request for review dated July 17, 2018, that documented areas of concern with regards to potential study-related impacts to RTE plant species. No state-listed wildlife species were identified as RTE within the Phase 1 South portion of the corridor study boundary. Follow-up coordination with MDNR resulted in a revised response letter dated September 11, 2018, with additional comments and more detailed descriptions of the potentially affected RTE plant species. A meeting was then held with MDNR on September 14, 2018, to further discuss the potential RTE occurrences within the Phase 1 South portion of the corridor study boundary. MDNR indicated which RTE plant species should be surveyed in the field if suitable habitat exists within the Phase 1 South portion of the corridor study boundary MDOT SHA agreed to conduct state listed RTE plant habitat assessments to determine the presence of suitable habitat and subsequent targeted species surveys to look for RTE plant species within areas determined to have suitable habitat.

Prior to conducting the RTE habitat assessments, available habitat and population occurrence information on each RTE plant species of concern were gathered from published botanical references and records from the MDNR herbarium. Areas identified within the Phase 1 South portion of the corridor study boundary as having potential for RTE species were then investigated in the field to verify and document the presence of suitable habitat for the given species. Areas determined to contain suitable habitat were delineated and mapped, and photographs were taken to document suitable habitat areas. Where suitable

RTE plant species habitat was found during the habitat assessments, targeted species surveys were completed to confirm whether any RTE plant species occur within the Phase 1 South portion of the corridor study boundary. Targeted species surveys are species specific field surveys within suitable habitat and at appropriate seasons of occurrence to determine presence or absence of the species within the Phase 1 South portion of the corridor study boundary. Because the areas the MDNR recommended for RTE plant surveys occur on NPS property near the Potomac River, permission to access NPS lands first had to be obtained. Permission was granted in July 2019, and the RTE plant survey was then carried out within the Phase 1 South portion of the corridor study boundary (**Appendix R**).

Summer 2019 surveys were conducted by walking transects through the area of appropriate habitat during the most likely times of occurrence (e.g., flowering or seeding). Transects were walked to cover all areas of suitable habitat within the study boundary. If a targeted RTE plant species were to be found, all individuals of the population would be counted, or an estimate made of the number of individuals for large populations. Additionally, the population would be surveyed; detailed notes would be taken on the condition of the population as well as other plant species growing with the RTE species; potential threats would be noted; and photographs would be taken of the population and individual plants as appropriate.

The targeted RTE species include the species shown in **Table 2-75**, located within riparian areas on NPS lands along the Potomac River in the southwestern portion of the Phase 1 South portion of the corridor study boundary.

Table 2-75. RTE Plant Species in Riparian Areas of the Potomac River Within the Phase 1 South Portion of the Corridor Study Boundary, as Indicated by MDNR

Scientific Name	Common Name	Status
Rumex altissimus	Pale dock	Endangered
Paspalum repens var. *fluitans*	Horse-tail Crown Grass	Endangered
Matelea obliqua	Climbing milkvine	Endangered
Baptisia australis	Blue wild indigo	Threatened
Coreopsis tripteris	Tall tickseed	Endangered
Phacelia covellei	Buttercup scorpion-weed	Endangered

All of the listed species are known to occur on scour bars of the Potomac River or within the adjacent floodplain, and MDNR recommended habitat surveys of the area where the Potomac River crosses the Phase 1 South portion of the corridor study boundary to determine whether suitable habitat exists for the listed species. Small areas of suitable RTE habitat were found within upland terrace forest and on scour bars/riverside outcrop barrens. Much of the forested upland terrace areas within the proposed limits of disturbance had dense invasive species cover within the understory, vine, and groundcover layers. Dominant species included bush honeysuckle (*Lonicera* spp.), Asian bittersweet (*Celastrus orbiculatus*), Japanese stilt grass (*Microstegium vimineum*), and ground ivy (*Glechoma hederacea*). The scour bar areas occurred beneath the ALB and intermittently downstream to the extent of the Phase 1 South portion of the corridor study boundary. Areas beneath the bridge appeared to be frequently flooded and may not have been able to support herbaceous vegetation growth, as much of the area was bare mud. Riverside outcrop barrens occurred on boulders at the edge of the river, but these areas had very little soil.

Vegetation present in this area included sapling American sycamore (*Platanus occidentalis*) and Rand's goldenrod (*Solidago simplex* ssp. *randii* var. *racemosa*). None of the targeted RTE plant species were found during the surveys. One of the targeted species, buttercup scorpion-weed (*Phacelia covellei*), is an early spring blooming herbaceous plant that would not have been present at the time of the surveys. MDNR reviewed the limits of the Preferred Alternative and did not find any additional RTE species outside of the Potomac River Gorge area.

A response letter was issued by the VDCR Division of Natural Heritage on May 3, 2018, that presented a table of natural heritage resources, including the habitat of RTE plant and animal species, within a two-mile radius of the Phase 1 South portion of the corridor study boundary. Follow up coordination with the VDCR resulted in a revised response letter dated July 31, 2019, that provided a list of natural heritage resources within their database that occur within the narrower Phase 1 South portion of the corridor study boundary. The VDGIF online Fish and Wildlife Information Service was accessed on March 19, 2019, to identify species of conservation concern within a three-mile radius of the Phase 1 South portion of the corridor study boundary. This list includes all federal and state-listed threatened and endangered animal species.

The July 31, 2019, response letter from VDCR indicated that the Phase 1 South portion of the corridor study boundary overlaps the Potomac Gorge Conservation Site. According to VDCR, conservation sites are tools for representing key areas of the landscape that warrant further review for possible conservation action because of the natural heritage resources and habitat they support. Conservation sites are like SSPRAs tracked by the MDNR in Maryland and discussed above. The Potomac Gorge Conservation Site has been given a biodiversity significance rank of B1, which represents a site of outstanding significance. The list of the natural heritage resources known to occur within the Potomac Gorge Conservation site includes several state-listed rare plant and invertebrate fauna. While not protected under state or federal laws, these species are tracked by the state because they are vulnerable to becoming state threatened or endangered. Additionally, the NPS has identified state and globally rare plants and invertebrates from national park property within the Potomac Gorge on both sides of the Potomac River through numerous distributional surveys over the past ten to twenty years.

Further coordination with the NPS in late 2019 resulted in an expanded list of RTE plants from the Chesapeake and Ohio Canal National Historical Park (CHOH) unit that potentially occur or historically occurred within or near the Phase 1 South portion of the corridor study boundary. The NPS requested that MDOT SHA conduct field surveys for these species within the Phase 1 South portion of the corridor study boundary where suitable habitat exists. In early 2020, MDOT SHA submitted a request to the NPS for research permits to authorize targeted plant surveys within the CHOH and George Washington Memorial Parkway (GWMP) unit portions of the Phase 1 South portion of the corridor study boundary. In email correspondence regarding the acquisition of the permits, the NPS indicated that within the CHOH unit there were 52 RTE plant species, in addition to the 15 species that they had previously listed, known to occur or that historically occurred within 500 meters of the current I-495 centerline. They requested that these plants be added to the list of species to be surveyed. For the GWMP unit, the NPS requested that an additional 15 plant species known from nearby Turkey Run and Potomac Heritage Trail be added to the survey list. A conference call with the NPS to discuss the expanded plant list was convened on March 27, 2020. Following the call, MDOT SHA agreed to add the additional species to the overall survey protocol, but limited focused surveys to only cover those species that were state listed threatened or endangered. An exception was made for one species, *Boechera dentata*, that has a state rank in Virginia and Maryland of rare. This species was included on the VDCR list of RTE plants for which MDOT SHA had already agreed to survey. All other species with a state rank of rare would be noted in the field if encountered but would not be specifically targeted. **Table 2-76** provides a list of the 41 species of RTE plants that were targeted for survey within the portion of the Potomac Gorge that is within the Phase 1 South portion of the corridor study boundary, their rank and status within each state, suitable habitat, recommended survey season, and localities where previously found, if known. Within the Maryland portion of the survey, 39 plant species were targeted while within the Virginia portion of the survey, 11 species were targeted.

Plummers Island is a 12-acre island located in the Potomac River within the Potomac Gorge and the Chesapeake and Ohio Canal National Historical Park in Montgomery County, Maryland, adjacent to the American Legion Bridge. The island is separated from the mainland by the oxbow of the Potomac River. Plummers Island is considered the most scientifically studied island in North America, where biologists have documented a great diversity of flora and fauna. The island is the headquarters of the Washington Biologists Field Club, a group incorporated in 1901 to promote the study of biology in the Washington, DC area. The western end of Plummers Island is within the Phase 1 South portion of the corridor study boundary and includes several rock outcroppings, a vernal pool wetland, mature upland forest, terrace and riparian habitat, two Washington Biologists Field Club vegetation research plots, and several species of state listed plants identified during the I-495 & I-270 Managed Lanes Study RTE Plant Survey in 2020, including *Paspalum fluitans, Phacelia covillei, Rumex altissimus, Monarda clinopodia, Solidago simplex* ssp. *randii* var. *racemosa,* and *Hibiscus laevis*. See the RTE Plant Species Survey (**Appendix R**) mapping for more specific locations of where these plant species were identified on the island.

Table 2-76. RTE Targeted Plant Species Survey within the Potomac River Gorge Portion of the Preferred Alternative

MARYLAND

Scientific Name	Common Name	Rank/ Status[1]	State	Flowering/ Fruiting	Habitat	Survey Period	Documented Location
Arabis patens	Spreading Eared Rockcress	S3G3/S1G3	MD/ VA	Apr-May	Crevices/thin soils on outcrops/River floodplain forest	Early May	Turkey Run Park
Astragalus canadensis	Canadian Milk-Vetch	S1G5 Endangered	MD	Flw: Jul; Fr: late Jul-Aug	Scoured bedrock terraces, rocky dry woodlands	Jul	Unknown
Baptisia australis	Blue Wild Indigo	S2G5 Threatened	MD	May-Jun	Flood scoured rocky/gravelly bars/outcrops along rivers	May	Unknown
Bromus latiglumis	Early-leaf Brome	S1G5 Endangered	MD	Flw/Fr: late Aug-mid Sep	Floodplain forests and river bluffs, often over calcareous (limestone, shale, shell-marl?) substrates.	Sep	Unknown
Carex careyana	Carey's Sedge	S1G4G5 Endangered/ S3G4G5	MD/ VA	Flw/Fr: late Apr-May (Jun)	Rich upland or floodplain woods, often over limestone	May	Turkey Run & Great Falls Parks
Carex hitchcockiana	Hitchcock's Sedge	S1G5 Endangered	MD	Flw/Fr: (late Apr)/May-early Jun	Upland forests over calcareous substrates (limestone, shell-marl), less commonly in rich alluvium	May	Unknown
Clematis viorna	Vasevine	S3G5	MD	May-Jun	Rocky forests/Outcrops/Rocky River Shores-Calciphile	Jul	Unknown
Corallorhiza wisteriana	Spring Coralroot	S1G5 Endangered	MD	Flw: late Apr-early May: Fr: Jun.	Descriptions tend to the general, e.g., “rich woods” corresponding on occasion to basic mesic forests over limestone or coastal shell-marl deposits	May	Unknown
Coreopsis tripteris	Tall Tickseed	S1G5 Endangered	MD	Aug-Sep	Riverside prairie/Outcrops-Calciphile	Sep	Unknown
Hybanthus concolor	Eastern Green-Violet	S3G5	MD	May-Jun	Mesic slope forests, dry rocky forests-Calciphile	May	Unknown
Cuscuta polygonorum	Smartweed Dodder	S1G5 Endangered/ S1G5	MD/ VA	Jul-Sep	Riverine marsh, oxbows.	Sep	Unknown

Scientific Name	**Common Name**	**Rank/ Status[1]**	**State**	**Flowering/ Fruiting**	**Habitat**	**Survey Period**	**Documented Location**
Erigenia bulbosa	Harbinger-of-Spring	S3G5/S3G5	MD/ VA	Feb-May	Floodplain and mesic slope forests	Late Mar-Early Apr	Great Falls and Turkey Run Parks
Erythronium albidum	Small White Fawn-Lily	S2G5 Threatened/ S2G5	MD/ VA	Flw: late Mar-late Apr: Fr: May	Mature floodplain terrace forests in rich alluvium.	Apr	Turkey Run, Great Falls, & Theodore Roosevelt Island
Galactia volubilis	Downy Milk-Pea	S5G3	MD	Jul-Aug	Dry woodlands, barrens, and clearings	Early-Mid Jul	Unknown
Gentiana villosa	Striped Gentian	S1G4 Endangered	MD	Flw: Sep; Fr: Oct-Nov	Dry, sandy edges of pine forests, dry forest over serpentine. Plants often along rights-of-way.	Sep	Unknown
Geum aleppicum	Yellow Avens	S1G5 Endangered/ SHG5	MD/ VA	Flw: summer	High elevation seepage swamps. Floodplain forests, and mesic or alluvial shaded clearings. Rare, n. mountains and n. Piedmont; no specimens have been collected in Virginia since 1945.	Jul	Unknown
Scientific Name	Common Name	Rank/ Status1	State	Flowering/ Fruiting	Habitat	Survey Period	Documented Location
Helianthus occidentalis	Few-leaf Sunflower	S1G5 Threatened/ S1G5T5	MD/ VA	Aug-Oct	Riverside prairies/Outcrops	Sep	Unknown
Hibiscus laevis	Halberd-leaf Rose-Mallow	S3G5	MD	July-Sep	Depositional bars, river shores, canals, ditches, ponds	Early-Mid Jul	Unknown
Homalosorus pycnocarpos	Glade Fern	S2G5 Threatened	MD	Aug-Sep	Rich, mesic ravines (shell-marl), steep rocky “seepy” slopes in mesic mixed forests, often over mafic substrates.	Sep	Unknown
Iresine rhizomatosa	Juda's-Bush	S1 G5 Endangered	MD	Aug-Sep/ Sep-Dec	Deep pockets of alluvial silt and sand along flood channels and riverbanks	Sep	Potomac Gorge
Lipocarpha micrantha	Small-flower Halfchaff Sedge	S1G5 Endangered/ S2G5	MD/ VA	Aug-Oct	Seasonally exposed shores and bars on large rivers; riparian shorelines in muddy/sandy soils exposed during low-flow periods	Sep	Montgomery County

Scientific Name	**Common Name**	**Rank/ Status[1]**	**State**	**Flowering/ Fruiting**	**Habitat**	**Survey Period**	**Documented Location**
Maianthemum stellatum	Starry False Solomon's-Seal	S2G5 Endangered/ S2G5	MD/ VA	Apr-Sep	Riverside sand and rock bars, rich floodplain forests, seepage swamps	Late Mar-Early Apr	Turkey Run & Great Falls Parks
Matelea obliqua	Climbing Milkvine	S1S2G4? Endangered	MD	Jun-Jul/Sep	Bedrock scour and terrace woodlands in rich alluvium, upland forests, barrens, glades, clearings, and roadsides over limestone or shale substrates	Jul	Montgomery County
Mecardonia acuminata	Axil-Flower	S2G5 Endangered	MD	Late Aug-Early Sep	Roadsides, sandpits, utility rights-of-way, rocky pools and seeps	Sep	Unknown
Monarda clinopodia	White Bergamot	S3S4G5	MD	Jun-Jul	Rich alluvial soils of streams and rivers	Early-Mid Jul	Potomac River
Paspalum repens var. *fluitans*	Horse-tail Crown Grass	S2G5 Threatened	MD	Late Aug-Sep	Floodplain seeps/pools in muck soils; seasonally exposed rocky stream channels	Sep	Unknown
Phacelia covillei	Buttercup Scorpion-Weed	S2G3 Threatened/ S1	MD/ VA	Apr-May	Rich, well-drained floodplain and adjacent slope forests	Late Mar-Early Apr	Clara Barton and Turkey Run Parks
Phaseolus polystachios	Thicket Bean	S3G5	MD	Jul-Sep	Rocky ravines, scoured bedrock terrace forests, forest edges and hedgerows	Early-Mid Jul	Unknown
Polygala polygama	Racemed Milkwort	S1G5 Threatened	MD	Jun-Jul	Dry, rocky or gravelly barrens, bedrock scour bars and woodlands	Late May	Montgomery County
Potamogeton foliosus	Leafy Pondweed	S2G5	MD	Jul-Oct	Ponds and coastal streams in tidal and nontidal reaches	Sep	Unknown
Pycnanthemum verticillatum	Whorled Mountain-Mint	S2G5 Threatened	MD	Late Jun-Jul	Circumneutral seepage wetlands, dry to mesic calcareous meadows and glades	Jul	Unknown
Sida hermaphrodita	Virginia Fanpetals	S1G3 Endangered/ S1G3	MD/ VA	Jul-Oct	Frequently scoured gravel bars and river island shorelines	Early-Mid Jul	Potomac River shore near Spout Run
Rumex altissimus	Pale Dock	S1G5 Endangered	MD	May-Jun	Frequently flooded zones along rivers in sandy/gravelly alluvium; also forested wetlands in muck soils	May	Unknown

Scientific Name	Common Name	Rank/ Status[1]	State	Flowering/ Fruiting	Habitat	Survey Period	Documented Location
Sagittaria rigida	Sessile-fruit Arrowhead	S1G5 Endangered/ S1G5	MD/ VA	Jul-Sep	Delmarva Bays; spring-fed seepage ponds in the mountains; historical habitats may have included vernal pools in the Piedmont and Ridge and Valley	Sep	Unknown
Salix interior	Sandbar Willow	S1G5 Endangered/ S1G5TNR	MD/ VA	Feb-Jun	Rocky scour bars and scrub-woodlands along the Potomac River	Apr-Oct	Potomac River
Silene nivea	Snowy Catchfly	S1G4? Endangered/ S1G4?	MD/ VA	May-Aug	Mature floodplain and terrace forests over rich alluvial soils	Late May	Unknown
Solidago simplex ssp. *randii* var. *racemosa*	Rand's Goldenrod	S1G3 Threatened/ S1G3?	MD/ VA	Early-Mid Jun	Cliff faces and crevices with shell deposits; riverside woodlands, prairies, outcrops, and rocky bars	Jul	Turkey Run Park and Gulf Branch
Triphora trianthophoros	Threebirds	S1G4? Endangered/ S1G3G4T3T4	MD/ VA	Mid-Late Aug-Early Sep	Rich, humid hardwood forests	Sep	Presumed extirpated from the Gold Mine Tract, Great Falls
Valeriana pauciflora	Large-flower Valerian	S1G4 Endangered/ S1G4	MD/ VA	Late Apr-Mid May	Rich alluvial soils of mature mesic mixed or bottomland hardwood forests	May	Turkey Run & Great Falls Parks

VIRGINIA

Scientific Name	Common Name	Rank/ Status[1]	State	Flowering/ Fruiting	Habitat	Survey Period	Documented Location
Arabis patens	Spreading Eared Rockcress	S3G3/S1G3	MD/ VA	Apr-May	Crevices/thin soils on outcrops/River floodplain forest	Early May	Turkey Run Park
Borodinia dentata	Short's False Rockcress	S3G5/S1G5	MD/ VA	Mar-Jun	Rich, well-drained floodplain and river bluff forests	Late Mar-Early Apr	Unknown
Carex careyana	Carey's Sedge	S1G4G5 Endangered/ S3G4G5	MD/ VA	Flw/Fr: late Apr-May (Jun)	Rich upland or floodplain woods, often over limestone	May	Turkey Run & Great Falls Parks
Erigenia bulbosa	Harbinger-of-Spring	S3G5/S3G5	MD/ VA	Feb-May	Floodplain and mesic slope forests	Late Mar-Early Apr	Great Falls and Turkey Run Parks
Erythronium albidum	Small White Fawn-Lily	S2G5 Threatened/ S2G5	MD/ VA	Flw: late Mar-late Apr: Fr: May	Mature floodplain terrace forests in rich alluvium.	Apr	Turkey Run, Great Falls, & Theodore Roosevelt Island
Maianthemum stellatum	Starry False Solomon's-Seal	S2G5 Endangered/ S2G5	MD/ VA	Apr-Sep	Riverside sand and rock bars, rich floodplain forests, seepage swamps	Late Mar-Early Apr	Turkey Run & Great Falls Parks
Phacelia covillei	Buttercup Scorpion-Weed	S2G3 Threatened/ S1	MD/ VA	Apr-May	Rich, well-drained floodplain and adjacent slope forests	Late Mar-Early Apr	Clara Barton and Turkey Run Parks
Sida hermaphrodita	Virginia Fanpetals	S1G3 Endangered/ S1G3	MD/ VA	Jul-Oct	Frequently scoured gravel bars and river island shorelines	Early-Mid Jul	Potomac River shore near Spout Run
Senecio suaveolens	False Indian-Plantain	S1G4 Endangered/ S2G4	MD/ VA	Flw: Aug; Fr: Sep-Oct	A variety of open to lightly-shaded habitats along river banks, light-gaps on the floodplain, side channels and pond and pool margins.	Sep	Turkey Run & Great Falls Park
Solidago simplex ssp. *randii* var. *racemosa*	Rand's Goldenrod	S1G3 Threatened/ S1G3?	MD/ VA	Early-Mid Jun	Cliff faces and crevices with shell deposits; riverside woodlands, prairies, outcrops, and rocky bars	Jul	Turkey Run Park and Gulf Branch
Valeriana pauciflora	Large-flower Valerian	S1G4 Endangered/ S1G4	MD/ VA	Late Apr-Mid May	Rich alluvial soils of mature mesic mixed or bottomland hardwood forests	May	Turkey Run & Great Falls Parks

Source: Townsend, 2019; MDNR, 2019; Weakley et al., 2012; Brown and Brown, 1984
[1]State Rank: S1=Critically Imperiled/Highly State Rare; S2=Imperiled/State Rare; S3=Vulnerable/Watchlist; T=Subspecies/Variety Ranked Differently than Species
Global Rank: G3=Vulnerable; G4=Apparently Secure; G5=Secure; ?=Inexact Numeric Rank; NR=Not Ranked

The above referenced NPS Potomac Gorge surveys also noted numerous Virginia state first records for various species of beetles (Steury et al., 2018; Steury, 2018a; Steury, 2018b; Steury, 2017; Steury and MacCrae, 2014; Steury and Messer, 2014; Cavey et al., 2013; Evans and Steury, 2012; Steury et al., 2012), moths (Steury et al., 2007), caddisflies (Flint, 2011), and land snails and slugs (Steury and Pearce, 2014). VDCR also indicated the potential presence of other *Stygobromus* amphipod species within the Phase 1 South portion of the corridor study boundary. A discussion of these newly documented invertebrate species is included in **Section 2.8 Terrestrial Wildlife** since they do not yet have designated state or federal rare, threatened, or endangered species ranks or statuses. VDCR and the NPS recommended conducting plant surveys to document whether any of the listed species are presently located within the Phase 1 South portion of the corridor study boundary.

In early 2020, NPS Scientific Research and Collecting Permits were obtained for the CHOH and GWMP units within the Potomac River Gorge area. Plant surveys were then conducted within the CHOH and GWMP units of the Phase 1 South portion of the corridor study boundary during four distinct seasons, including early April, late May, mid-July, and mid-September, to capture the potential flowering or seeding/fruiting times of each of the 41 targeted plant species.

Results of the targeted plant surveys are summarized in the *Rare, Threatened, and Endangered Plant Survey Report I-495 & I-270 Managed Lanes Study* in **Appendix R**. This plant survey report was reviewed and approved by MDNR via e-mail on July 23, 2021. This correspondence with MDNR is included in **Appendix N.** Within the Phase 1 South portion of the corridor study boundary in Virginia, two of the 11 RTE plant species were found, including Carey's sedge (*Carex careyana*) and buttercup scorpion-weed (**Appendix R**, *Rare, Threatened, and Endangered Plant Survey Report I-495 & I-270 Managed Lanes Study, November 2020*, Figure 3). Carey's sedge occurred in one small patch of about 17 plants in mesic forest on the upland terrace just above the active floodplain of the Potomac River, downstream of the ALB. Buttercup scorpion-weed was more widely scattered upstream and downstream of the ALB within this same upland mesic terrace, with plants numbering in the thousands.

On the Maryland side, seven of the 39 RTE plant species were documented within the Phase 1 South portion of the corridor study boundary (**Appendix R**, *Rare, Threatened, and Endangered Plant Survey Report I-495 & I-270 Managed Lanes Study, November 2020*, Figure 3). Documented RTE plants included:

- Buttercup Scorpion-Weed
- Carey's Sedge
- Pale Dock
- Halberd-leaf Rose-Mallow
- White Bergamot
- Rand's Goldenrod
- Horse-tail Crown Grass

Buttercup scorpion-weed plants occurred throughout the upland terraces of the Potomac River, between the river and the Chesapeake and Ohio Canal upstream and downstream of the ALB. Plants likely numbered in the tens of thousands. One small patch also occurred north of the Chesapeake and Ohio Canal. A patch of 10-15 individual Carey's sedge plants occurred on the upland terrace above the active floodplain of the Potomac River upstream of the ALB. The plants were growing at the top of the bank of a tributary stream that drains a large wetland that lies upstream of the ALB. Another lone Carey's sedge plant occurred on an eroding slope of that same tributary on the opposite bank. This plant appeared to be in danger of eroding away. Approximately eight to ten individual pale dock plants were found within the active floodplain of the Potomac River just upstream of the ALB and on Plummers Island along the shoreline of the oxbow of the Potomac River. Dozens of halberd-leaf rose-mallow plants occurred along the active floodplain and scour bars along the Potomac River and along both shorelines of the oxbow of the Potomac River. Two additional plants were found growing within the Chesapeake and Ohio Canal east of I-495. A patch of 10 to 20 badly deer browsed, and insect eaten white bergamot plants were found within mesic forest on the northwest side of Plummers Island. Two patches of up to 50 Rand's goldenrod plants occurred on boulders at the edge of the Potomac River just downstream of the ALB. Thousands of horse-tail crown grass plants were growing along the active floodplain and scour bars of the Potomac River upstream and downstream of the ALB and along the active shoreline of the oxbow of the Potomac River.

<u>Wood Turtle</u>

During MDOT SHA coordination with the VDEQ in October 2020 regarding its review of the I-495 & I-270 Managed Lanes Study Draft EIS, the VDEQ requested that a habitat evaluation of streams in the Virginia portion of the Phase 1 South portion of the corridor study boundary be conducted for the presence of wood turtle (*Glyptemys insculpta*). The wood turtle is a state-threatened species in Virginia, and is known to occur in Turkey Run, a waterbody located east of the Phase 1 South portion of the corridor study boundary. The evaluation was to include an assessment of potential upland and aquatic habitats, the results of which would be reported to the Virginia Department of Wildlife Resources (VDWR). Correspondence related to this study request is provided in **Appendix N**.

Wood turtle is a species that inhabits both aquatic and terrestrial environments. Habitat for wood turtle is characterized by a combination of suitable environmental components, including cold perennially-flowing streams, riparian woodlands, scrubby wetlands, open meadows, and sandy or gravelly areas that can be used for nesting. A key feature is the presence of a flowing stream of adequate width and depth (typically mid-sized streams 10-65 feet wide; Jones et. al, 2018) that does not freeze completely during the winter. Wood turtles hibernate in such streams, as well as using them during the mating season. Within-stream structure is important for providing cover, basking sites, overwintering areas, and stability during high-flow periods. Common structural features within streams include large root masses of adjacent mature trees, logjams, and accumulated woody debris. Additional key terrestrial habitat features include the presence of potential sandy nesting substrate within a reasonable distance (usually up to 300 feet; Jones et. al, 2018) from the stream.

Wood turtle surveys are most effective during their inactive period, generally late October through late March/early April, when they are hibernating in streams. To assess the potential presence of wood turtles within the Virginia portion of the Phase 1 South portion of the corridor study boundary, qualified biologists conducted field surveys of all delineated streams in February 2021. Follow up surveys were also completed of some streams in mid-March. Results of the wood turtle surveys are summarized in the *Wood Turtle Habitat Assessment and Survey Report – Virginia I-495 & I-270 Managed Lanes Study* in **Appendix P**. Portions of eight streams, including the Virginia shoreline of the Potomac River, were assessed within the Phase 1 South portion of the corridor study boundary in Virginia (See Figure 2-1 in Appendix B of the wood turtle report included in **Appendix P**). No wood turtles were found during the field surveys. Four of the streams were either intermittent or ephemeral and, thus, were not suitable overwintering habitat for wood turtles. The perennial streams within the Phase 1 South portion of the corridor study boundary provided only marginal habitat because of their relatively small size and shallow flow. Wood turtles generally do not prefer large rivers but will use smaller tributary streams that flow into larger rivers. Therefore, while some instream habitat features were observed within the Potomac River, no turtles were found, nor would they be expected to overwinter there. No suitable tributary streams flowing into the Potomac River occur within the Phase 1 South portion of the corridor study boundary. Upland habitats within the Phase 1 South portion of the corridor study boundary were also determined to be suboptimal, as the habitat is primarily forested with few suitable openings for basking and egg laying.

Invertebrates

As noted in **Section 2.8**, academic and NPS biologists in Virginia and members of the Biological Society of Washington on Plummers Island in Maryland, have conducted numerous surveys for various invertebrate taxa on NPS lands within the Potomac River Gorge. Recently surveyed taxa included beetles; moths; grasshoppers, crickets, and katydids; snails and slugs; shore flies; sawflies; and caddisflies. Many of these surveys have documented species that are only known from those sites or represent first records of species for the state. These rarer species are listed for each taxon in **Table 2-77**.

Table 2-77. First state records and rare invertebrates documented within the Potomac River Gorge of Maryland and Virginia

Taxa		Documented Location[1]
Order Coleoptera - Beetles		
Staphylinidae (Rove Beetles)	*Trigonodemus striatus* LeConte	TR
	Aleochara ocularis Klimaszewski	GF
	Aleochara rubripes Blatchley	TR
	Aleochara verna Sat	GF
	Phymatura cf. *blanchardi* (Casey)	TR, GF
	Gennadota sp.	TR
	Omalium (sensu lato) *fractum* Fauvel	TR
	Omalium repandum Erichson	TR
	Phyllodrepa humerosa (Fauvel)	GF
	Xylodromus concinnus (Marsham)	GF
	Eleusis pallida (LeConte, J.L.)	TR
	Oxytelus pensylvanicus Erichson	GF
	Oxytelus sculptus Gravenhorst	TR
	Carpelimus bilineatus Stephens	TR, GF
	Carpelimus quadripunctatus (Say)	TR, GF
	Lobrathium collare (Erichson)	TR
	Sunius confluentus (Say)	GF
	Sciocharis carolinensis Casey	TR
	Rugilus angularis (Erichson)	GF

	Homaeotarsus cribratus (LeConte, J.L.)	TR
	Homaeotarsus pimerianus (LeConte, J.L.)	GF
	Batrisodes furcatus (Brendel)	TR
	Batrisodes scabriceps (LeConte, J.L.)	TR
	Batrisodes striatus (LeConte, J.L.)	GF
	Cyparium concolor (Fabricius)	TR, GF
	Scaphidium quadriguttatum Say	TR, GF
	Scaphisoma terminatum Melsheimer, F.E.	GF
	Acylophorus caseyi Leng	GF
	Hemiquedius infinitus Brunke &Smetana	GF
	Bisnius pugetensis (Hatch)	TR
	Hesperus stehri Moore	TR
	Neobisnius paederoides (LeConte, J.L.)	TR
	Philonthus ventralis (Gravenhorst)	TR
	Platydracus exulans (Erichson)	GF
	Platydracus violaceus (Gravenhorst)	TR, GF
	Platydracus viridanus (Horn)	TR
	Tasgius winkleri (Bernhauer)	TR
	Oxybleptes kiteleyi Smetana	TR, GF
	Bolitobius singulatus Mannerheim	GF
	Bryophacis smetanai Campbell	TR
	Lordithon appalachianus Campbell	TR, GF
	Nitidotachinus scrutator (Gemminger & Harold)	TR
	Sepedophilus occultus (Casey)	GF
Erotylidae (Pleasing Fungus Beetles)	*Microsternus ulkei* (Crotch)	TR, GF
	Triplax frontalis Horn	GF
	Tritoma erythrocephala Lacordaire	TR
	Tritoma mimetica (Crotch)	TR, GF
Tetratomidae (polypore Fungus Beetles)	*Hallomenus scapularis* Melsheimer	TR
Buprestidae (Wood Boring Beetles)	*Pachyschelus purpureus purpureus* (Say)	GF
Rhipiceridae (Cicada Parasite Beetles)	*Sandalus petryphya* Knoch	TR
Aderidae (Ant-like Leaf Beetles)	*Emelimus melsheimeri* (LeConte)	GF
	Aderis brunnipennis LeConte	TR, GF
	Vanonus calvescens Casey	GF
Cantharidae (Soldier Beetles)	*Atalantycha neglecta* (Fall)	GF
	Rhagonycha cruralis (LeConte)	GF
	Rhagonycha hirticula (Green)	GF
	Rhagonycha imbecillis (LeConte)	GF
	Rhaxonycha carolina (Fabricius)	GF
	Dichelotarsus cinctipennis (LeConte)	TR
	Podabrus basilaris (Say)	TR, GF

	Podabrus brunnicollis form *brunnicollis* (Fabricius)	GF
	Podabrus flavicollis LeConte	TR, GF
	Podabrus frater LeConte	GF
	Podabrus rugosulus LeConte	TR, GF
	Podabrus tomentosus (Say)	TR
	Ditemnus latilobus (Blatchley)	GF
	Polemius laticornis (Say)	GF
	Silis spathulata LeConte	GF
	Caccodes granicollis (Fender)	GF
	Trypherus pauperculus Fender	TR
Carabidae (Ground Beetles)	*Scarites vicinus* Chaudoir	TR, GF
	Elaphropus quadrisignatus Duftschmid	PH
	Loxandrus nr. *circulus* Allen	GF
	Pterostichus permundus (Say)	TR, GF, PH
	Pterostichus sculptus LeConte	GF
	Harpalus rubripes Duftschmid	GF
	Obrium rubidum LeConte	TR
	Typocerus lugubris (Say)	GF
Chrysomelidae (Leaf Beetles)	*Chaetocnema irregularis* LeConte	GF
	Crepidodera bella Parry	GF
	Longitarsus alternatus Ziegler	TR, GF
	Tricholochmaea decora decora (Say)	PI
	Altica woodsi Melsheimer	PI
	Aphthona insolita Melsheimer	PI
	Capraita quercata (Fabricius)	PI
	Distigmoptera pilosa (Illiger)	PI
	Exema elliptica Karren	PI
	Oulema conuta (Fabricius)	PI
	Pachybrachis cephalicus Fall	PI
	Xenochalepus potomacus Butte	PI
Cerambycidae (Long-horned Beetles)	*Centrodera decolorata* (Harris)	TR
	Neoalosterna capitata (Newman)	GF
	Trachysida mutabilis (Newman)	TR
	Clytus ruricola (Olivier)	TR, GF
	Enaphalodes rufulus (Haldeman)	GF
	Molorchus bimaculatus bimaculatus Say	GF
	Phymatodes amoenus (Say)	GF
	Saperda puncticollis Say	TR
Cleridae (Checkered Beetles)	*Phyllobaenus verticalis* Say	GF
Lycidae (Net-winged Beetles)	*Greenarus thoracicus* (Randall)	TR, GF

	Calopteron terminale (Say)	TR, GF
	Lopheros crenatus (Germar)	TR
Elateridae (Click Beetles)	*Lacon discoideus* (Weber)	TR, GF
	Hemicrepidius ruficornis Kirby	TR, GF
	Glyphonyx quietus (Say)	TR
	Glyphonyx recticollis (Say)	TR, GF
	Ampedus semicinctus (Randall)	TR, GF
Eucnemidae (False Click Beetles)	*Dromaeolus turnbowi* Muona	TR, GF
	Dirrhagofarsus modestus (Fleutiaux)	TR, GF
Throscidae (Throscid Beetles)	*Aulonothroscus distans* Blanchard	TR
	Aulonothroscus nodifrons Blanchard	TR
Mordellidae (Tumbling Flower Beetles)	*Mordellaria fascifera* (LeConte)	TR
	Mordellaria serval (Say)	TR, GF
	Mordellaria undulata (Melsheimer)	TR, GF
	Tomoxia lineella LeConte	TR, GF
	Yakuhananomia bidentata (Say)	TR, GF
	Falsomordellistena discolor (Melsheimer)	GF
	Mordellina floridensis (Smith)	GF
	Mordellina infima (LeConte)	GF
	Mordellina lecontei (Ermisch)	GF
	Mordellina nigricans (Melsheimer)	TR, GF
	Mordellina Testacea (Blatchley)	GF
	Mordellistena aspersa (Melsheimer)	TR, GF
	Mordellistena bicinctella LeConte	TR, GF
	Mordellistena convicta LeConte	TR
	Mordellistena dimidiata Helmuth	TR, GF
	Mordellistena fuscata (Melsheimer)	TR, GF
	Mordellistena masoni Liljeblad	TR, GF
	Mordellistena militaris LeConte	TR
	Mordellistena rubrifascia Liljeblad	TR, GF
	Mordellistena sexnotata Dury	TR
	Mordellistena syntaenia Liljeblad	TR, GF
	Mordellistena vera Liljeblad	TR, GF
	Mordellochroa scapularis (Say)	TR, GF
Order Lepedoptera – Butterflies and Moths		
Noctuidae (Owlet Moths)	*Abrostola urentis* Guenée.	TR
	Acronicta spinigera Guenée[2]	GF
	Acronicta radcliffei Harvey[2]	TR, GF
	Balsa tritrigella Walker[2]	GF
	Bellura brehmei Barnes & McDunnough[2]	GF
	Euxoa violaris Grote & Robinson[2]	GF
	Orthosia revicta Morrison[2]	TR

	Oligia (Neoligia) crytora Franclemont[2]	TR, GF
Geometridae (Geometer Moths)	*Anticlea multiferata* Walker[2]	GF
	Anticlea vasiliata Guenée[2]	TR, GF
	Metarranthis indeclinata Walker[2]	TR, GF
Euteliiadae (Eutelia Moths)	*Eutelia pulcherrima* Grote[2]	GF
Order Trichoptera – Caddisflies		
Leptoceridae (Long-horned Caddisflies)	*Ceraclea resurgens* Walker	TR, GF
Order Diptera - Flies		
Ephydridae (Shore Flies)	*Hydrellia toma* Mathis & Zatwarnicki	GF
Order Orthoptera – Grasshoppers, Crickets & Katydids		
Trigonidiidae	*Anaxipha tinnulacita* Walker & Funk	GF
	Anaxipha vernalis Walker & Funk	GF

[1]TR=Turkey Run Park, GF=Great Falls Park, PH=Potomac Heritage Trail – Virginia; PI=Plummers Island – Maryland
[2]Virginia State Watch List Species

2.10.3 Environmental Effects

The USFWS IPaC indicated that the NLEB may occur within the Preferred Alternative. USFWS also identified the Indiana bat as a species of concern because it was detected near the Preferred Alternative by Virginia Tech. MDOT SHA coordinated closely with USFWS and DNR regarding NLEB and Indiana bat, and Endangered Species Act Section 7 consultation has concluded. Additionally, the NPS, MDNR, and VDCR have identified rare, threatened, and endangered state-listed plant and invertebrate species that occur on NPS lands within the Potomac River Gorge.

Neither NLEB or IB species were confirmed within the corridor study boundary during visual bridge and emergence surveys in 2019. However, temporary day roosting by big brown bats on the bridge over McArthur Boulevard/Clara Barton Parkway Westbound and evidence of guano beneath the ALB and bridge over Seven Locks Road, suggest that bats do occasionally roost on suitable I-495 bridges. As noted above, based on the small amount of guano observed beneath the day roosting big brown bats and guano found on other bridges, none of the I-495 bridges appeared to serve as maternity roosting habitat, but were likely used as temporary day or night roosting sites. Therefore, potential impacts to bridge roosting bats would be minimal and would likely cause a shift to other suitable roosting sites near the bridges rather than resulting in an impact to the bats.

To determine potential impacts to suitable forested habitat for The NLEB and IB acoustic surveys undertaken within the corridor study boundary during the 2020 active season (May 15 through August 15) were conducted to better determine the potential presence of these federally listed bat species within the corridor study boundary.

Informal consultation between the FHWA/MDOT SHA and the USFWS continued with submittal of the habitat assessment and acoustic study report to the USFWS and MDNR. In a letter to the FHWA dated January 13, 2021, the USFWS issued a "no effect" determination for the IB based on the absence of documented IB during bridge, emergence, and acoustic surveys. The USFWS also indicated that the project is covered by the January 5, 2016, Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-eared Bat and Activities Excepted from Take Prohibitions since the area where forest clearing will occur does not have known maternity roost trees or hibernacula. In their letter, the USFWS stated that the project was "not likely to adversely affect" the NLEB. Therefore, while 20 kilometers of potentially suitable bat habitat was mapped within the Phase 1 South portion of the corridor study boundary, the USFWS determined that forest clearing associated with the project's Preferred Alternative will have no effect on the IB and will not likely adversely affect the NLEB.

Virginia DWR recommended that the FEIS consider potential impacts to Virginia state-endangered tricolored bat (*Perimyotis subflavus*) and little brown bat (*Myotis lucifugus*) in the Virginia portion of the Preferred Alternative. The acoustic survey on the Virginia side of the Potomac River identified four instances of the tricolored bat and no presence of the little brown bat. The Preferred Alternative would potentially affect the tri-colored bat in Virginia. The majority of the Preferred Alternative LOD area in Virginia is composed of suitable/somewhat suitable bat habitat, with 32.6 acres of potential tri-colored bat habitat in the Virginia portion of the Preferred Alternative. There is a high likelihood of roost trees occurring in this area and tree removal during roosting season could negatively impact the tri-colored bat population in Virginia.

The MDNR identified several state-listed threatened or endangered plant species that may occur within scour bars or the adjacent floodplain of the Potomac River. A habitat assessment and targeted species survey was completed on federal lands within the Chesapeake and Ohio Canal National Historical Park in late June and early July 2019 to determine whether suitable habitat for the state listed plant species exists. Marginally suitable habitat was found for climbing milkvine (*Matelea obliqua*) and buttercup scorpion-weed within less disturbed understory of upland terrace forest habitat and on scour bar/riverside outcrop barren habitat along the Potomac River for the remaining species. The targeted species survey did not identify any of the listed species, though surveys for the buttercup scorpion-weed were conducted outside the suitable flowering period for this species. Follow-up surveys were conducted for buttercup scorpion-weed and 40 additional rare species during four seasons in 2020. As noted above, results of the targeted RTE species surveys documented seven rare species within the Preferred Alternative LOD on the Maryland side of the Potomac River and two species on the Virginia side.

Based on the results of the targeted RTE species survey conducted in 2020, the Preferred Alternative would likely impact six of the seven RTE plant species of concern within the Potomac River corridor near the ALB. While complete avoidance of these resources is not possible, impacts were minimized to the greatest extent practicable. Most RTE plant impacts will occur during the construction phase of the ALB for temporary access, equipment storage, and the building of the new bridge. Likely tens of thousands of buttercup scorpion-weed plants occur within the Preferred Alternative LOD where temporary construction activities are anticipated. While this represents a significant temporary impact, it should be noted that this species was also widespread and abundant outside the limits of the project survey upstream and downstream of the ALB on both the Maryland and Virginia sides of the Potomac River. Impacts to other RTE plant species within the Preferred Alternative LOD where temporary construction activities are anticipated include 10-50 Carey's sedges, thousands of horse-tail crown grass, 10-15 pale dock, 10-50 Rand's goldenrod, and about 50 halberd-leaf rose-mallow. Horse-tail crown grass was also observed in abundance upstream of the ALB on the Maryland shoreline and both upstream and downstream of the ALB on the Virginia shoreline. While temporarily disturbed areas will be restored following construction of the replacement ALB, the duration of construction will be several years, likely resulting in permanent impacts to RTE plants within the temporary limits of disturbance. However, most restored areas will be replanted with RTE plant species that were documented growing within those areas prior to construction (FEIS, Section 5.19.4 Mitigation). Some restored areas that might not be replanted with RTE plants are areas beneath the widened ALB, as shading may limit their success in these areas for certain species. Further investigations would occur post construction to determine the extent that sufficient light would reach beneath the new bridge to support RTE plant reestablishment.

Buttercup scorpion-weed and horse-tail crown grass are the only two RTE plant species with individuals located within the permanent limits of disturbance. The greatest permanent impacts to buttercup scorpion-weed would occur at the northern end of the replacement ALB, affecting thousands of individual plants within an area of about an acre. Permanent impacts would also occur to perhaps a few hundred horse-tail crown grass plants along the Potomac River shoreline and edges of the oxbow of the Potomac River for the placement of bridge piers. As noted above, other permanent impacts to RTE plants may occur from shading by the wider ALB footprint, but the extent of those potential permanent impacts will need to be investigated post construction.

Some impacts to RTE plants will occur on Plummers Island, though most will occur in areas that will be temporarily disturbed during construction of the new ALB. RTE plants potentially affected within the areas of temporary disturbance on Plummers Island include thousands of horse-tail crown grass plants, about a dozen pale dock plants, 30-50 halberd-leaf rose-mallow plants, and 10-50 Rand's goldenrod plants. All of these plants occur either along the Plummers Island shoreline of the oxbow of the Potomac River or along the Plummers Island shoreline of the Potomac River. As noted above, because of the duration of construction of the new ALB and potential shading effects from the expanded ALB, the plant impacts are likely more permanent than temporary, even though they occur outside of the permanent footprint of the bridge. The only RTE plant impacts resulting from the bridge pier footprint on Plummers Island would be to a few dozen horse-tail crown grass plants along the edge of the oxbow of the Potomac River.

MDNR indicated in an email on February 28, 2020, included in **Appendix N**, that MDNR no longer tracks bald eagle nests and that although this species is no longer listed by the state, it is protected under the federal Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c). As noted in their email, MDNR generally defers to the National Bald Eagle Management Guidelines. MDOT SHA has coordinated and will continue to coordinate with USFWS concerning bald eagles, in addition to peregrine falcons, as discussed in **Section 2.8**.

2.10.4 Avoidance, Minimization, and Mitigation

MDOT SHA and FHWA have worked closely with USFWS and MD DNR to ensure protection of listed bat species. While the I-495 & I-270 Managed Lanes Study was determined to have "no effect" on the IB and "not likely to adversely affect" the NLEB, MDOT SHA voluntarily committed to a time of year restriction for tree clearing from May 1 through July 31 of any year within a 3-mile buffer around each of the three positive NLEB detection locations within the I-495 & I-270 Managed Lanes Study corridors to go above and beyond what is required to protect this bat species. IB was not detected in the acoustic or bridge surveys.

MDOT SHA commits to a time of year restriction for tree clearing within the Virginia portion of the Preferred Alternative from April 1 – October 31 of any year to avoid impact to tri-colored bat roost trees during roosting season.

As stated above, effects to RTE plant species are anticipated from the Preferred Alternative in the vicinity of the ALB. Potential impacts, including wetlands, waterways, forests, archaeological sites, and RTE plant species, were considered in the development of the LOD in the vicinity of the ALB. While complete avoidance of these resources is not possible, impacts have been minimized to the greatest extent practicable. MDOT SHA has committed to coordinating with NPS and MDNR to determine a comprehensive ecological restoration plan for NPS lands within the Preferred Alternative LOD prior to construction. This plan will include RTE plant species restoration components, such as: conducting a final pre-construction RTE plant inspection; topsoil salvage and restoration; collecting seeds and/or individual RTE plants from the impact area prior to construction; cultivating plants and storing seeds/propagating plants from seed in an off-site nursery; re-establishing RTE species from stored seed and cultivated and propagated plants following construction and topsoil restoration and monitoring replanted RTE plant populations to ensure successful reestablishment. MDOT SHA is currently working with the NPS and MDNR to develop an acceptable mitigation plan to offset RTE plant impacts during and post construction of the Preferred Alternative. MDOT SHA believes that this mitigation strategy to replant temporarily disturbed areas outside the bridge footprint can be successful, as recolonization by buttercup scorpion-weed on fill slopes of the existing ALB was observed during RTE plant surveys and most of the other potentially impacted RTE plant species rely on temporary disturbance from periodic flooding events to facilitate germination and growth.

Virginia DWR determined this project is not likely to result in significant adverse impacts to wood turtles. However, because they may be encountered on site during work, DWR recommends the following as avoidance and minimization measures:

- Prior to the commencement of work all contractors associated with work at this site be made aware of the possibility of encountering wood turtles on site and become familiar with their appearance, status, and life history. An appropriate information sheet / field observation form to distribute to contractors and employees was provided.

- If any wood turtles are encountered and are in jeopardy during the development or construction of this project, remove them from immediate harm and call DWR. If staff on site hold an appropriate Threatened and Endangered Species Scientific Collection Permit, this staff member may relocate wood turtles out of harm's way and into suitable habitat, preferably within the nearest perennial stream. Any relocations should be reported to DWR, and the wood turtle observation form should be completed and faxed to DWR.

To minimize potential wildlife entanglements, resulting from use of synthetic/plastic erosion and sediment control matting, use matting made from natural/organic materials such as coir fiber, jute, and/or burlap.

2.11 Unique and Sensitive Areas

2.11.1 Regulatory Context and Methods

Unique and Sensitive Areas are ecological resources designated by state and local municipalities that do not fall within the regulations of other environmental resources such as waterways or forests. Maryland's 2001 GreenPrint Program was established to protect Maryland's most-ecologically-valuable natural lands and watersheds, which were designated as "Targeted Ecological Areas" (TEAs). TEAs have been identified by MDNR as conservation priorities for natural resource protection and receive the majority of Maryland's Program Open Space funds. These areas provide natural resource-based services to Maryland citizens including clean water and air, flood protection, recreational and commercial fishing, wood products, forestry, and ecotourism. TEAs were identified by maps of Maryland's most ecologically important forests, wetlands, meadows, streams, and other natural systems using over 30 years of collected data. TEAs were created based on rankings of Green Infrastructure (GI); RTE species; aquatic habitat and biota; water quality; coastal ecosystem; and climate change adaptation. Developed lands were excluded from the TEA layer since developed lands are not preferred for stateside Program Open Space funding (MDNR, 2013b).

GI areas were identified by the Maryland Greenways Commission and MDNR's Green Infrastructure Assessment (GIA), which considered land cover, wetlands, sensitive species, roads, streams, terrestrial and aquatic conditions, floodplains, soils, and developmental pressure to identify a network of "hubs" and "corridors" containing the most ecologically critical undeveloped lands remaining in Maryland. "Hubs" are contiguous forest blocks and wetland complexes of at least 250 acres, rare or sensitive species habitats, biologically important rivers and streams, and existing conservation lands managed for their natural values. "Corridors" are linear stretches of land, at least 1,100 feet wide that follow the best ecological or most natural routes for animals, seeds, water, and other important resources to move between hubs. Areas of disconnect between the hubs and corridors are called "gaps" (Weber et al., 2006).

Montgomery County has designated certain watersheds as Special Protection Areas (SPAs) due to the presence of high-quality water resources and related natural features that could be jeopardized by development activities without additional water quality protection measures. SPAs provide protection beyond standard environmental laws and regulations for land use and development, calling for stringent water resource protection measures in new and expanded development projects. Regulations in SPAs require developers to: support stream monitoring; adhere to stormwater BMPs; conduct water quality inventory and monitoring; establish performance goals to protect critical natural resources and minimize impacts; and maintain a close working relationship with Montgomery County Department of Permitting Services (MCDPS), MCDEP, and the M-NCPPC throughout the regulatory process (MCDEP, 2018). Environmental Overlay Zones were established within the limits of SPAs to impose additional land use regulations and impervious surface limits on the underlying areas (Montgomery Planning, 2012; Blackwell, 1989).

Locations of TEAs, GI hubs and corridors, SPAs, and Environmental Overlay Zones within the corridor study boundary were determined using desktop review. Background information and geospatial data for TEAs and GI areas were obtained from MDNR and Maryland iMap (State of Maryland, 2018). Background information and geospatial data for SPAs and Environmental Overlay Zones in the corridor study boundary were obtained from Montgomery County Atlas (MCAtlas) (See **Appendix Q**) (Montgomery Planning, 2018).

The Virginia Department of Conservation and Recreation (VDCR) Natural Heritage (DNH) Program conserves Virginia's natural resources through programs such as biological inventories, natural community inventory and classification, and the creation of Natural Area Preserves throughout the state (VDCR, 2018b). In addition, VDCR-DNH identifies Conservation Sites, which represent key areas of the landscape worthy of protection and stewardship action, because of the natural heritage resources and habitat they support (VDCR, 2018c). Conservation Sites are given a biodiversity significance ranking based on the rarity, quality, and number of element occurrences they contain on a scale of B1-B5, with B1 being the most significant.

2.11.2 Existing Conditions

A. Targeted Ecological Areas and Green Infrastructure

As shown in **Appendix Q**, four GI corridors and three GI hubs overlap with the Phase 1 South portion of the corridor study boundary. The GI corridors are associated with Muddy Branch, Watts Branch, Cabin John Creek, and Rock Creek. The GI hubs are associated with Cabin John Creek, Potomac River, and Rock Creek.

In addition to the GI areas mentioned above, TEAs overlap with the Phase 1 South portion of the corridor study boundary between Cabin John Creek and the Potomac River in Montgomery County.

B. Special Protection Area (SPA) and Environmental Overlay Zones

There are no SPAs or Environmental Overlay Zones within the Phase 1 South portion of the corridor study boundary, but the Piney Branch SPA is located approximately 4,000 feet southwest of the I-270/Shady Grove Road interchange.

C. Natural Area Preserves and Conservation Sites

There are no VDCR-DNH Natural Area Preserves within the Phase 1 South portion of the corridor study boundary or within Fairfax County, Virginia. There are two VDCR Conservation Sites within a five-mile radius of the Phase 1 South portion of the corridor study boundary according to the VDCR initial project review: the Potomac River Yellow Falls SCU and the Potomac Gorge. The Potomac River Yellow Falls SCU is the stretch of Bullneck Run between Old Dominion Drive and the Potomac River. VDCR ranks this area as a B3 High Significance stream. This stream is approximately 0.8 miles from the Phase 1 South portion of the corridor study boundary in Virginia. The Potomac Gorge is located in the entrenched valley of the Potomac River that generally extends between Great Falls and DC, along the Fall Line between the Piedmont Plateau and the Atlantic Coastal Plain. The landscape of the Potomac Gorge fosters great species diversity and includes Great Falls on the Potomac River, high rocky bluffs, forested river terraces, and grassy meadows.

2.11.3 Environmental Effects

Impacts associated with the Preferred Alternative LOD are summarized in **Table 2-78**[5] below. SPAs and VDCR Natural Area Preserves would not be impacted by the Preferred Alternative LOD.

Table 2-78. Impacts to Unique and Sensitive Areas in Acres

	Permanent	Temporary	Total
Targeted Ecological Areas	40.12	15.74	55.86
Green Infrastructure Hubs	12.88	10.89	23.77
Green Infrastructure Corridors	82.66	0.73	83.39
Special Protection Areas	0.00	0.00	0.00
Total Impacts to Unique and Sensitive Areas	**135.66**	**27.36**	**163.02**

[5] For reference, impact tables presented in the report are also included in Appendix A.

The Preferred Alternative LOD would increase the man-made footprint within the TEAs and GI areas, but the GI hubs and corridors will remain intact. However, road widening would create larger gaps in GI corridors, further fragmenting the GI network. New manmade structures and roadways impact contiguous forest blocks and wetland complexes in TEAs and GI areas, which are often habitats for rare and sensitive species, and contain biologically important rivers, streams, and other natural resources. While most impacts associated with construction of the Preferred Alternative LOD are linear and along existing roadways, the Preferred Alternative LOD will impact TEAs and GI hubs and corridors, which could potentially threaten important habitat and ecosystems (MDNR, 2018d).

2.11.4 Avoidance, Minimization, and Mitigation

Avoidance and minimization efforts to reduce impacts to GI and TEAs involves a two-tiered approach. The first level will occur during the planning stage where every reasonable effort will be made to avoid wetlands and waterways as well as parklands to the greatest extent practicable. Many GI, TEA, and wildlife corridors overlap with wetlands, waterways, and park land. The second level of avoidance and minimization will occur at the P3 design/build stage, with advancement of the design and further refinements to the LOD. Reducing construction cost by limiting vegetation removal, the need for endangered species assessment, and forest and wetland mitigation provide incentive to refine the LOD and reduce impacts to resources. However, opportunities for avoidance and minimization of impacts to roadside resources are limited due to the fixed nature of the highway corridor. The Developer will continue to look for opportunities to avoid and minimize impacts throughout the remainder of the design process to the greatest extent practicable. Monetary incentives have been added to the Section Developer’s Technical Provisions to encourage further avoidance and minimization of impacts to wetlands, waterways, forest, and parkland.

References

Section 2.1 Topography, Geology, and Soils

Code of Maryland Regulations (COMAR). Title 26 Department of Environment. Part 3 Subtitle 17 Water Management. Chapter 26.17.01 Erosion and Sediment Control. Section 26.17.01.01 Definitions. Available at: http://mdrules.elaws.us/comar/26.17.01 [Accessed 20 December 2018].

Fairfax County, 2018a. Understanding Erosion and Sediment Controls. https://www.fairfaxcounty.gov/soil-water-conservation/erosion-sediment-controls-construction-site [Accessed 20 April 2019].

Federal Register (FR). 1978. Volume 43. Issue 21. Chapter 657.5. 1978. *Identification of Important Farmlands.*

FR. 1994. Volume 59. Issue 133. July 13, 1994. *Changes in hydric soils of the United States.* Available at: https://www.govinfo.gov/app/details/FR-1994-07-13/94-16835 [Accessed 20 December 2018].

Maryland Department of the Environment (MDE). 2011. *Maryland Standards and Specifications for Soil Erosion and Sediment Control*. Available at: https://mde.maryland.gov/programs/Water/StormwaterManagementProgram/Pages/2011_ESC_details.aspx [Accessed 19 December 2018].

MCAtlas. 2019. Available at: www.mcatlas.org

Montgomery County Rustic Roads Advisory Committee. 2015. Status Report – Rustic Roads Program. Available at: https://www.montgomerycountymd.gov/council/Resources/Files/agenda/cm/2015/151019/20151019_TE3.pdf

Reger, J. P. and Cleaves, E. T. 2008. *Physiographic Map of Maryland*. Towson University Center for Geographic Information Sciences.

United States Department of Agriculture (USDA). 1981. *Farmland Protection Policy Act*.

USDA Natural Resources Conservation Service (NRCS). 2000. *Erosion and Sedimentation on Construction Sites.* Soil Quality Institute, Soil Quality- Urban Technical Note No. 1, Auburn, Alabama. Available at: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053285.pdf [Accessed 19 December 2018].

USDA NRCS. 2010. *From the Surface Down, An Introduction to Soil Surveys for Agronomic Use, Second Edition.* Available at: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053238.pdf [Accessed 19 December 2018].

USDA NRCS. 2018. Web Soil Survey. Available at: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx [Accessed 03 August 2018].

Virginia Department of Environmental Quality (VDEQ). 1992. Virginia Erosion and Sediment Control Handbook. Available at:

https://www.deq.virginia.gov/Programs/Water/StormwaterManagement/Publications/ESCHandbook.aspx [Accessed 20 April 2019].

VDEQ. 2014. Virginia Erosion and Sediment Control Law: Virginia Erosion and Sediment Control Regulations and Certification Regulations. Available at: https://www.deq.virginia.gov/Portals/0/DEQ/Water/StormwaterManagement/Erosion_Sediment_Control_Handbook/ESC_Handbook_Law_Regulations.pdf [Accessed 20 April 2019].

Virginia Department of Transportation (VDOT). 2017. *Drainage Manual*. Available at: http://www.virginiadot.org/business/locdes/hydra-drainage-manual.asp [Accessed 20 April 2019].

Section 2.2 Air Quality

See footnotes within Section 2.2.

Section 2.3 Waters of the US, Including Wetlands

Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C. 339 pp.

COMAR Title 26 Department of Environment. Part 4 Subtitle 23 Nontidal Wetlands. Chapter 26.23.01 General (COMAR26.23.01). Available at: http://mdrules.elaws.us/comar/26.23.01 [Accessed 20 December 2018].

Code of Federal Regulations (CFR). Title 33 Navigation and Navigable Waters. Chapter II Corps of Engineers, Department of the Army, Department of Defense. Section 328.3 Definitions. Available at: https://www.govregs.com/regulations/title33_chapterII [Accessed 19 December 2018].

CFR. Title 40 Protection of Environment. Chapter I Environmental Protection Agency. Section 230.3 Definitions. Available at: https://www.govregs.com/regulations/expand/title40_chapterI_part230_subpartA_section230.3 [Accessed 19 December 2018].

Cowardin, L.M., V. Carter, F.C. Golet, E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington D.C. Available at: https://www.fws.gov/wetlands/Documents/Classification-of-Wetlands-and-Deepwater-Habitats-of-the-United-States.pdf [Accessed 1 December 2019].

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

FR. 1977. Volume 42, Number 3. May 1977. *Protections of Wetlands*. Executive Order 11990. Available at: https://www.archives.gov/federal-register/codification/executive-order/11990.html [Accessed 19 December 2018].

FR. 2020. Volume 85, Issue 77. April 2020. *The Navigable Waters Protection Rule: Definition of "Waters of the United States."* Available at: https://www.federalregister.gov/documents/2020/04/21/2020-02500/the-navigable-waters-protection-rule-definition-of-waters-of-the-united-states [Accessed August 2020].

Starr, R., W. Harman, S. Davis. 2015. FINAL DRAFT Function-Based Rapid Stream Assessment Methodology. U. S. Fish and Wildlife Service, Chesapeake Bay Field Office, Annapolis, MD. CAFE S15-06.

National Park Service (NPS). 2010. National Park Service Director's Order #77-1: Wetland Protection.

NPS. 2002. National Park Service Procedural Manual #77-2: Floodplain Management.

NPS. 2016. National Park Service Procedural Manual #77-1: Wetland Protection.

United States Army Corps of Engineers (USACE). 1999. *The Highway Methodology Workbook Supplement – Wetland Functions and Values; A Descriptive Approach.* Available at: https://www.nae.usace.army.mil/Portals/74/docs/regulatory/Forms/HighwaySupplement6Apr2015.pdf [Accessed 19 December 2018].

USACE. 2010. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region Version 2.0,* ed. J.S. Wakeley, R.W. Lichvar, C.V. Noble. ERDC/EL TR-10-20. Vicksburg, MS: U.S. Army Engineer Research and Development Center. Available at: https://usace.contentdm.oclc.org/utils/getfile/collection/p266001coll1/id/7594 [Accessed 19 December 2018].

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, C.V. Noble, ERDC/EL TR-12-9. Vicksburg, MS: U.S. Army Engineer Research and Development Center. Available at: https://usace.contentdm.oclc.org/utils/getfile/collection/p266001coll1/id/7607 [Accessed 20 December 2018].

USACE. 2020. Instructions for Maryland Stream Mitigation Framework Calculator Beta Version May 11, 2020. (Draft version).

U.S. Code. Title 33 Navigation and Navigable Waters. Chapter 9 Protection of Navigable Waters and of Harbor and River Improvements. Subchapter I 403. Available at: https://www.govinfo.gov/content/pkg/USCODE-2011-title33/html/USCODE-2011-title33.htm [Accessed 20 December 2018].

U.S. Code. Title 33 Navigation and Navigable Waters. Chapter 26 Water Pollution Prevention and Control, Subchapter IV Permits and Licenses, 1344. Available at: https://www.govinfo.gov/content/pkg/USCODE-2011-title33/html/USCODE-2011-title33.htm [Accessed 20 December 2018].

Annotated Code of Virginia. Fisheries and Habitat of the Tidal Waters Article §28.2-1204. Ownership and Uses of Submerged Lands.

Annotated Code of Virginia. Waters of the State, Ports and Harbors Article §62.1-44.15. State Water Control Law.

Virginia Administrative Code (VAC). Title 9. Agency 25 State Water Control Board. Chapter 210 *Virginia Water Protection Permit Program Regulation*.

VAC. Title 9. Agency 25 State Water Control Board. Chapter 680 *Virginia Water Protection General Permit for Linear Transportation Projects*.

VDEQ. 2018. Virginia Water Protection Compliance Program. https://www.deq.virginia.gov/Programs/Water/WetlandsStreams/Compliance.aspx [Accessed 15 December 2018].

<u>Section 2.4 Watersheds and Surface Water Quality</u>

Annotated Code of Maryland. Natural Resources Article § 8-402. Scenic and Wild Rivers Review Board and Related Program: Establishment and Administration of Program; Study of Deer Creek.

Barrett, M. E., R. D. Zuber, E. R. Collins III, J. F. Malina, Jr., R. J. Charbeneau, and G. H. Ward. 1993. A Review and Evaluation of Literature Pertaining to the Quantity and Control of Pollution from Highway Runoff and Construction. Center for Transportation Research. Austin, TX.

Berry, W., N. Rubinstein, B. Melzian, and B. Hill. 2003. The Biological Effects of Suspended and Bedded Sediment (SABS) in Aquatic Systems: A Review. US Environmental Protection Agency, Narragansett, Rhode Island. Internal Report.

Buckler, D. A. and G. E. Granato. 1999. Assessing Biological Effects from Highway-Runoff Constituents. US Geological Survey, Northborough, Massachusetts. Open-File Report 99-240.

City of Rockville. 2015. *Final Watts Branch Watershed Assessment.* Maryland Department of Public Works.

CFR Title 40 Protection of Environment, Chapter I Environmental Protection Agency, Part 121 Clean Water Act Section 401 Certification Rule. Available at: https://www.epa.gov/sites/default/files/2020-07/documents/clean_water_act_section_401_certification_rule.pdf.

CFR Title 40 Protection of Environment, Chapter I Environmental Protection Agency, Section 131.12 Antidegradation Policy and Implementation Methods.

Center for Watershed Protection (CWP). 2003. Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1.

COMAR, 26.08.02.01-03. 1997. Water Quality. Maryland Department of the Environment.

COMAR, 26.08.02.04-1. Antidegradation Policy Implementation Procedures. Maryland Department of the Environment.

District Department of the Environment Watershed Protection Division (DDOE). 2010. *Rock Creek Watershed Implementation Plan (WIP).*

Environmental Protection Agency (EPA). 1986. *Quality Criteria for Water*. Office of Water Regulations and Standards, Washington, DC.

EPA. 2000. Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria for Rivers and Streams in Nutrient Ecoregion IX. EPA 822-B-00-019.

Fairfax County Department of Public Works and Environmental Services (FCDPWES). 2008. The Middle Potomac Watershed Management Plan. Accessed at: https://www.fairfaxcounty.gov/publicworks/sites/publicworks/files/assets/documents/watersheds/middle-potomac-watersheds-full-plan.pdf.

Interagency Wild and Scenic River Coordinating Council (IWSRCC). 2018. *A Compendium of Questions & Answers Relating to Wild & Scenic Rivers, A Technical Report of the Interagency Wild and Scenic Rivers Coordinating Council*. Available at: https://www.rivers.gov/documents/q-a.pdft [Accessed 27 September 2018].

Lopes, T. J. and S. G. Dionne. 1998. A Review of Semivolatile and Volatile Organic Compounds in Highway Runoff and Urban Stormwater. US Geological Survey, Northborough, Massachusetts. Open-File Report 98-409.

MDE. 2009. Stormwater Design Manual (effective October 2000, revisions effective May 2009).

MDE. 2012a. *Watershed Report for Biological Impairment of the Cabin John Creek Basin in Montgomery County, Maryland: Biological Stressor Identification Analysis Results and Interpretation.*

MDE. 2012b. *Watershed Report for Biological Impairment of the Non-Tidal Rock Creek Basin in Montgomery County, Maryland: Biological Stressor Identification Analysis Results and Interpretation.*

MDE. 2014a. Stormwater Management Program. http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/SoilErosionandSedimentControl/Pages/programs/waterprograms/sedimentandstormwater/erosionsedimentcontrol/index.aspx

MDE. 2018a. *Maryland's Searchable Integrated Report Database [Combined 303(d)/305(b) List].* Available at: http://www.mde.state.md.us/programs/Water/TMDL/Integrated303dReports/Pages/303d.aspx [Accessed 20 July 2018].

MDE. 2018b. TMDL Maps. Available at: https://mde.maryland.gov/programs/Water/TMDL/DataCenter/Pages/TMDLMaps.aspx. [Accessed 20 August 2018].

Maryland Department of Natural Resources (MDNR). 2016a. *2015 Maryland FMP Report Section 2. Alosines: a) Shad, and b) Herring*.

MDNR. 2018a. *Land Acquisition and Planning, Stewardship, Scenic and Wild Rivers. Maryland's Scenic and Wild Rivers Map.* Available at: http://dnr.maryland.gov/land/Pages/Stewardship/Scenic-and-Wild-Rivers.aspx [Accessed 12 September 2018].

MDNR. 2018b. *Spring 2018 Trout Stocking Schedule.* Available at: http://dnr.maryland.gov/fisheries/Documents/2018_trout_stock_sched.pdf

Maryland-National Capital Park and Planning Commission (M-NCPPC). 2002. *Potomac Subregion Master Plan.*

MCDEP. 2011. *Lower Potomac Direct Pre-Assessment Report*.

MCDEP. 2012a. *Cabin John Creek Implementation Plan.*

MCDEP. 2012b. *Muddy Branch and Watts Branch Subwatersheds Implementation Plan.*

MCDEP. 2012c. *Rock Creek Implementation Plan.*

Morgan R.P., K.M. Kline, and S.F. Cushman. 2007. Relationships among nutrients, chloride, and biological indices in urban Maryland streams. Urban Ecosystems 10:153-177

Schueler, T.R., and A. Youngk. 2015. Potential benefits of nutrient and sediment practices to reduce toxic contaminants in the Chesapeake Bay Watershed. Part 1: Removal of urban toxic contaminants. Annapolis, MD: Chesapeake Bay Partnership Toxics Workgroup. http://chesapeakestormwater.net/wp-content/uploads/dlm_uploads/2016/02/Toxics-Report-1.pdf. [Accessed 2 March 2020].

Trombulak, S.C. and C.A. Frissell. 2001. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. Conservation Biology. 14(1):18-30.

United Research Services (URS). 2014. *Muddy Branch Watershed Study Prepared for the City of Gaithersburg.* Accessed at: http://www.gaithersburgmd.gov/services/environmental-services. [Accessed 2 August 2018].

United States Geological Survey (USGS). 2018. *StreamStats*. Available at: https://streamstats.usgs.gov/ss/. [Accessed 2 August 2018].

USGS. 2019. StreamStats. Available at: https://streamstats.usgs.gov/ss/. [Accessed 10 April 2019].

U.S. Code. Title 33 Navigation and Navigable Waters. Chapter 26 Water Pollution Prevention and Control, Subchapter IV Permits and Licenses, 1341 and 1342. Available at: https://www.govinfo.gov/content/pkg/USCODE-2011-title33/html/USCODE-2011-title33.htm [Accessed December 2018].

VAC. Title 9. Agency 25 State Water Control Board. Chapter 260 *Water Quality Standards.*

Virginia Department of Conservation and Recreation (VDCR). 2018. *Designated Rivers*. Virginia Scenic Rivers Program. Available at: http://www.dcr.virginia.gov/recreational-planning/srmain [Accessed 19 July 2018].

VDEQ. 2006. Using Probabilistic Monitoring Data to Validate the Non-Coastal Virginia Stream Condition Index

VDEQ. 2016. The Final 2016 305(b)/303(d) Water Quality Assessment Integrated Report.

The Water Research Foundation. 2020. *International Stormwater BMP Database: 2020 Summary Statistics*. Published November 6, 2020.

Section 2.5 Groundwater Hydrology

42 U.S.C. § 300h-6. *Sole source aquifer demonstration program.* Safe Drinking Water Act, as amended.

42 U.S.C. § 300h-7. S*tate programs to establish wellhead protection areas*. Safe Drinking Water Act of 1974, as amended.

42 U.S.C. § 300j-13. *Source water quality assessment.* Safe Drinking Water Act of 1974, as amended.

Barrett M.E., R.D. Zuber, E.R. Collins, J.F. Malina, R.J. Charbeneau, and G.H. Ward. 1995. *A Review and Evaluation of Literature Pertaining to the Quantity and Control of Pollution From Highway Runoff and Construction*. Center for Research in Water Resources (CRWR) Online Report 95-5. University of Texas at Austin. Available at: https://repositories.lib.utexas.edu/bitstream/handle/2152/6737/crwr_onlinereport95-5.pdf?sequence=2 [Accessed 24 September 2018].

EPA. 2004. *Understanding the Safe Drinking Water Act*. Office of Water. 816-F-04-030. Available at: https://www.epa.gov/sdwa/overview-safe-drinking-water-act [Accessed 5 September 2018].

EPA. 2009. *National Primary Drinking Water Regulation Table.* EPA 816-F-09-004. Available at: https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulation-table [Accessed 24 September 2018].

EPA. 2021. *Drinking Water Mapping Application to Protect Source Waters (DWMAPS)*. Available at: https://geopub.epa.gov/DWWidgetApp/ [Accessed 20 October 2021].

Fairfax Water. 2018. *Annual Water Quality Report*. Available at https://www.fairfaxwater.org/sites/default/files/newsletters/ccr_2018.pdf [Accessed 16 April 2019].

Kobringer N.P. and A. Geinopolos. 1984. *Volume III. Sources and Mitigation of Highway Runoff Pollutants – Research Report*. Federal Highway Administration. Office of Research and Development. Available at: https://rosap.ntl.bts.gov/view/dot/850 [Accessed 24 September 2018].

MDE. 2015. *Maryland Groundwater Well Database*. Maryland Department of the Environment. Received via request 1 November 2016.

MDE. 2018c. *Wellhead Protection*. Water Supply Program – Source Protection and Appropriation Division. Available at:

http://www.mde.state.md.us/programs/water/water_supply/Source_Water_Assessment_Program/Pages/wellhead.aspx [Accessed 5 September 2018].

MDE. 2019. *Maryland Wellhead Protection Areas*. Maryland Department of the Environment. Received via request 15 October 2021. Last updated December 2019.

Maryland Geological Survey (MGS). 2013. *Ground Water and Wells in the Maryland Piedmont*. Maryland Geological Survey Fact Sheet 19. Maryland Department of Natural Resources. Available at: http://www.mgs.md.gov/publications/report_pages/FS_19.html [Accessed 7 August 2018].

MGS. 2014. *Ground Water and Wells in the Maryland Coastal Plain*. Maryland Geological Survey Fact Sheet 20. Maryland Department of Natural Resources. Available at: http://www.mgs.md.gov/publications/report_pages/FS_20.html [Accessed 7 August 2018].

MGS. 2018. *Aquifers in Maryland*. Available at: http://www.mgs.md.gov/groundwater/md_groundwater.html. [Accessed 25 July 2018].

USGS. 1997. *Ground Water Atlas of the United States. Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, West Virginia HA 730-L.* Available at: http://capp.water.usgs.gov/gwa/ch_l/index.html [Accessed 24 July 2018].

USGS. 2017. *USGS Groundwater Daily Data for the Nation*. National Water Information System: Mapper. Available at: https://maps.waterdata.usgs.gov/mapper [Accessed 24 September 2018].

VDEQ. 2005. *Wellhead Protection Plan.* Commonwealth of Virginia. Available at: http://www.a-npdc.org/wp-content/uploads/2018/06/VDEQ-Wellhead-Protect-Plan-2005.pdf [Accessed 4 February 2019].

Virginia Department of Health (VDH). 1999. *Virginia Source Water Assessment Program.* Available at: http://www.vdh.virginia.gov/content/uploads/sites/14/2016/04/1999VDH_SWAP.pdf [Accessed 4 February 2019].

VDH. 2019. Private Well Program. Available at: http://www.vdh.virginia.gov/environmental-health/onsite-sewage-water-services-updated/private-well-program/ [Accessed 16 April 2019].

Section 2.6 Floodplains

COMAR. Title 26 Department of Environment. Part 3 Subtitle 17 Water Management. Chapter 26.17.04 Construction on Nontidal Waters and Floodplains. Available at: http://mdrules.elaws.us/comar/26.17.04.11 [Accessed 20 December 2018].

Fairfax County. 2018b. Flood Information. Available at: https://www.fairfaxcounty.gov/publicworks/stormwater/flood-information [Accessed 15 December 2018].

Federal Emergency Management Agency (FEMA). 2015. *Executive Order 11988: Floodplain Management.* Available at: https://www.fema.gov/executive-order-11988-floodplain-management [Accessed 03 August 2018].

FEMA. 2018. Floodplain Management Requirements, Unit 1: Floods and Floodplain Management. Available at: https://www.fema.gov/pdf/floodplain/nfip_sg_unit_1.pdf [Accessed August 23, 2018].

MDE. 2014b. *Maryland Model Floodplain Management Ordinance*. Available at: https://mde.maryland.gov/programs/Water/FloodHazardMitigation/Documents/www.mde.state.md.us/assets/document/flood_hazards/MD_Model_FPMO_Ordinance_May2014.pdf [Accessed 19 December 2018].

Maryland Department of Transportation (MDOT). 2015. *Joint Federal/State Permit Wetlands, Waterways, and Floodplains*. Available at: http://www.mdot.maryland.gov/Office_of_Planning_and_Capital_Programming/Environmental_Permits_Construction/Wetlands.html [Accessed 7 September 2018].

NPS. 2002. National Park Service Procedural Manual #77-2: Floodplain Management.

U.S. Department of Transportation (USDOT). 1979. *Floodplain Management and Protection*. USDOT Order 5650.2, Office of the Secretary, Washington DC. Available at: http://isddc.dot.gov/OLPFiles/DOT/007652.pdf [Accessed 03 August 2018].

VDOT. 2018. Road and Bridge Specifications and Revisions. Available at: http://www.virginiadot.org/business/const/spec-default.asp [Accessed 15 December 2018].

<u>Section 2.7 Vegetation and Terrestrial Habitat</u>

Anderson, J. R., E. E. Hardy, J. T. Roach, and R. E. Witmer. 1976. *A Land Use and Land Cover Classification System for Use with Remote Sensor Data*. Geological Survey Professional Paper 964. 41pp. Available at*:* http://www.pbcgis.com/data_basics/anderson.pdf [Accessed 19 December 2018]

Brush, G.S., C. Lenk, and J. Smith. 1976. *Vegetation Map of Maryland, The Existing Natural Forests*. Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, Maryland.

COMAR. Title 08 Department of Natural Resources. Subtitle 19 Forest Conservation. Chapter 08.19.03 Model Forest Conservation Ordinance. Article 2.17. Available at: http://mdrules.elaws.us/comar/08.19.03.01 [Accessed 20 December 2018].

Eyre, F. H. 1980. *Forest* cover *types of the Unites States and Canada*. Society of American Foresters, Washington D.C.

Annotated Code of Maryland. Natural Resources Article § 5-103. Maryland Reforestation Law.

Annotated Code of Maryland. Natural Resources Article § 5-1601. Forest Conservation Act.

MDNR. 2013a. *Maryland Reforestation Law*. Available at: https://dnr.maryland.gov/forests/Documents/textupdate13.pdf [Accessed 18 July 2018].

MDNR. 2010. *Maryland's Environmental Resource & Land Information Network (MERLIN).* Available at: https://gisapps.dnr.state.md.us/MERLIN/index.html [Accessed 21 August 2018].

MDNR. 2017. *Pollinator Habitat Plan*. Available at: https://dnr.maryland.gov/wildlife/Documents/PollinatorHabitatPlan_June2017.pdf [Accessed 19 December 2018].

Maryland Department of Transportation State Highway Administration (MDOT SHA). 2006. *Draft Capital Beltway Study Natural Environmental Technical Report.*

Maryland Environmental Trust (MET). 2016. *Conservation Easement Policies of the Maryland Environmental Trust.* Available at: https://dnr.maryland.gov/met/Documents/Easement_Criteria.pdf [Accessed 19 December 2018].

M-NCPPC. 1992. *Trees: Approved Technical Manual.* Available at: http://www.montgomeryplanning.org/environment/forest/trees/toc_trees.shtm#details [Accessed 19 December 2018].

M-NCPPC. 2016. *Types of Conservation Easements*. Available at: http://montgomeryplanning.org/planning/environment/forest-conservation-and-trees/conservation-easements/types-of-easements/ [Accessed 19 July 2018].

Swearingen, J., K. Reshetiloff, B. Slattery, and S. Zwicker. 2002. *Plant Invaders of Mid-Atlantic Natural Areas*. National Park Service and US Fish and Wildlife Service, Washington, DC. 82 pp. Available at: https://www.invasive.org/alien/pubs/midatlantic/midatlantic.pdf [Accessed 19 December 2018].

University of Maryland. 2018. *Emerald Ash Borer (EAB)*. Available at https://extension.umd.edu/hgic/invasives/emerald-ash-borer [Accessed 17 Sept 2018].

Virginia Department of Forestry (VDOF). 2014. GIS Data Layers. Available at: http://www.dof.virginia.gov/gis/dwnload/index.htm [Accessed 15 December 2018].

Section 2.8 Terrestrial Wildlife

Barrows, E.M. and D.R. Smith. 2014. Sawflies (Hymenoptera: Symphyta) of Three Mid-Atlantic Parks in the George Washington Memorial Parkway, USA. J. Hymenoptera Res. 39:17-31.

Brattain, R.M., B.W. Steury, A.F. Newton, M.K. Thayer, and J.D. Holland. 2019. The Rove Beetles (Coleoptera: Staphylinidae) of the George Washington Memorial Parkway, with a Checklist of Regional Species. Banisteria 53:27-71.

John W. Brown, Marc E. Epstein, Kimberly Vann, Reed A. Watkins, Stephen M. Bahr II, and Erin Kolski. 2008. "An Overview of the Lepidoptera (Insecta) of Plummers Island, Maryland," Bulletin of the Biological Society of Washington 15(1), 65-74, (1 May 2008). https://doi.org/10.2988/0097-0298(2008)15[65:AOOTLI]2.0.CO;2

Cavey, J.F., B.W. Steury and E.T. Oberg. 2013. Leaf Beetles (Coleoptera: Bruchidae, Chrysomelidae, Orsodacnidae) from the George Washington Memorial Parkway, Fairfax County, Virginia. Banisteria 41:71-79.

Chesapeake Conservancy Conservation Innovation Center. 2016. *High-Resolution Land Cover Dataset, 2013/2014*. Published 2016. Retrieved from https://www.chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/land-cover-data-project/.

CFR Title 50 Wildlife and Fisheries, Chapter I United States Fish and Wildlife Service, Department of the Interior, Section 10.13 List of Migratory Birds.

CFR Title 50 Wildlife and Fisheries, Chapter I United States Fish and Wildlife Service, Department of the Interior, Section 22.3 Definitions.

COMAR 27.01.09.04. Critical Area Commission for the Chesapeake and Atlantic Coastal Bays, Habitat Protection Areas.

Cunningham, Heather R. and N. H. Nazdrowicz. 2018. *The Maryland Amphibian and Reptile Atlas*. Baltimore, MD: The Johns Hopkins University Press. 283 pages.

Evans, A.V. and B.W. Steury. 2012. The Cicada Parasite Beetles (Coleoptera: Rhipiceridae) of Virginia. Banisteria 39:65-70.

FHWA. 2008. Wildlife-Vehicle Collision Reduction Study: Report to Congress. August 2008. FHWA-HRT-08-034.

Flint, Jr., O.S. 2011. Trichoptera from the Great Falls and Turkey Run units of the George Washington Memorial Parkway, Fairfax Co., Virginia, USA. Zoosymposia 5:101-107.

Flint Jr, O.S. and K.M. Kjer, 2011. A new species of Neophylax from northern Virginia, USA (Trichoptera: Uenoidae). Proceedings of the Entomological Society of Washington 113(1): 7-13.

Jones, Claudia, J. McCann, and S. McConville. 2000. *A Guide to the Conservation of Forest Interior Dwelling Birds in the Critical Area*. Chesapeake Bay Critical Area Commission, 58 pp.

Flint, Jr., O.S. 2011. Trichoptera from the Great Falls and Turkey Run units of the George Washington Memorial Parkway, Fairfax Co., Virginia, USA. Zoosymposia 5:101-107.

Flint Jr, O.S. and K.M. Kjer, 2011. A new species of Neophylax from northern Virginia, USA (Trichoptera: Uenoidae). Proceedings of the Entomological Society of Washington 113(1): 7-13.

MDNR. 2016b. *Maryland State Wildlife Action Plan*. Annapolis, Maryland.

The Nature Conservancy. 2005. *Discover the Potomac Gorge: A National Treasure*. Available at: https://www.nps.gov/grfa/planyourvisit/upload/Potomac%20Gorge%20brochure%20B.pdf [Accessed 3 March 2020].

C. L. Staines. 2008. "Chrysomelidae or Leaf Beetles (Insecta: Coleoptera) of Plummers Island, Maryland," Bulletin of the Biological Society of Washington 15(1), 141-144, (1 May 2008). https://doi.org/10.2988/0097-0298(2008)15[141:COLBIC]2.0.CO;2

Steury, B.W. 2019. The Ant-like Leaf Beetles (Coleoptera: Aderidae) of the George Washington Memorial Parkway, Fairfax County, Virginia. Banisteria 52:46-49.

Steury, B.W. 2018a. Annotated Checklist of Some Fungivorous Beetles (Coleoptera: Anamorphidae, Biphyllidae, Derodontidae, Endomychidae, Erotylidae, and Tetratomidae) of the George Washington Memorial Parkway. Banisteria 50:21-28.

Steury, B.W. 2018b. Four Long-horned Beetles (Coleoptera: Cerambycidae) New to Virginia and Additional New Park Records (Coleoptera: Anthicidae, Buprestidae, Cantharidae, Carabidae, Cerambycidae, Chrysomelidae) for the George Washington Memorial Parkway. Banisteria 50:29-31.

Steury, B.W. 2017. First Record of the Rove Beetle Trigonodemus striatus LeConte (Coleoptera: Staphylinidae) from Virginia and Additional New Park Records (Coleoptera: Anthicidae, Buprestidae, Carabidae, Cerambycidae, Chrysomelidae) for the George Washington Memorial Parkway. Banisteria 48:14-16.

Steury, B.W. and D.S. Chandler. 2021. The Reticulated Beetles and Net-winged Beetles (Coleoptera: Cupedidae and Lycidae) of the George Washington Memorial Parkway, Virginia, USA. The Maryland Entomologist 8(1):23-30.

Steury, B.W. and W.E. Steiner, Jr. 2021. The Tumbling Flower Beetles (Coleoptera: Mordellidae) of the George Washington Memorial Parkway, Virginia, USA. The Maryland Entomologist 8(1):52-92.

Steury, B.W. and J.M. Leavengood, Jr. 2018a. Annotated Checklist of Checkered Beetles from the George Washington Memorial Parkway, Virginia (Coleoptera: Cleridae). Banisteria 51:52-58.

Steury, B.W. and J.M. Leavengood, Jr. 2018b. Three Checkered Beetles (Coleoptera: Cleridae) New to Virginia and Additional Records for *Phyllobaenus verticalis* (Say) and *Wolcottia pedalis* (LeConte). Banisteria 51:59-60.

Steury, B.W., W.E. Steiner, Jr., and F.W. Shockley. 2018. The Soldier Beetles and False Soldier Beetles (Coleoptera: Cantharidae and Omethidae) of the George Washington Memorial Parkway. The Maryland Entomologist 7(2):11-27.

Steury, B.W. and P.W. Messer. 2014. Twelve Ground Beetles New to Virginia or the District of Columbia and an Annotated Checklist of the Geadephaga (Coleoptera, Adephaga) from the George Washington Memorial Parkway. Banisteria 43:40-55.

Steury, B.W. and T.C. MacRae. 2014. The Longhorned Beetles (Insecta: Coleoptera: Cerambycidae) of the George Washington Memorial Parkway. Banisteria 44:7-12.

Steury, B.W., T.C. MacRae, and E.T. Oberg. 2012. Annotated List of the Metallic Wood-boring Beetles (Insecta: Coleoptera: Buprestidae) of the George Washington Memorial Parkway, Fairfax County, Virginia. Banisteria 39:71-75.

Steury, B.W., J. Glaser, and C.S. Hobson. 2007. A Survey of Macrolepidopteran Moths of Turkey Run and Great Falls National Parks, Fairfax County, Virginia. Banisteria 29:17-31.

U.S. Code. Title 16 Conservation, Chapter 7 Protection of Migratory Game and Insectivorous Birds, Subchapter II Migratory Bird Treaty.

U.S. Code. Title 16 Conservation, Chapter 5a Protection and Conservation of Wildlife, Subchapter II Protection of Bald and Golden Eagles.

U.S. Fish and Wildlife Service (USFWS). 2007a. C. Koppie, MD Peregrine Falcon Annual Nest Survey

USFWS. 2019a. Koppie, C.A, MD Peregrine Falcon Nest Survey

VDOF. 2014. GIS Data Layers. Available at: http://www.dof.virginia.gov/gis/dwnload/index.htm [Accessed 15 December 2018].

Virginia Department of Game and Inland Fisheries (VDGIF). 2015. Virginia State Wildlife Action Plan. Henrico, Virginia.

Section 2.9 Aquatic Biota

Atlantic States Marine Fisheries Commission (ASMFC). 2010. Atlantic Croaker 2010 Benchmark Stock Assessment. Washington, D.C. 366 p

ASMFC. 2012. American Eel Benchmark Stock Assessment. Stock Assessment Report No. 12- 01. Washington, DC. 29 p.

ASMFC. 2017. River Herring Stock Assessment Update Volume I: Coastwide Summary. Washington, D.C. 193 p.

Burton, J. and Gerritsen, J. 2003. A Stream Condition Index for Virginia Non Coastal Streams.

CWP. 2003. *Impacts of Impervious Cover on Aquatic Systems.* Available at: https://www.fws.gov/southwest/es/Documents/R2ES/LitCited/4TX_Sal/Center_for_Watershed_Protection_2003_Impervious_Cover_Impacts.pdf. [Accessed 8 August 2018].

FCDPWES, Watershed Planning and Assessment Branch. 2006. Standard Operating Procedure Manual: Fairfax County Biological Stream Monitoring Program.

Fletcher, JL, and Busnel, RG. 1978. Effects of Noise on Wildlife. Academic Press.

Hanson, J., Helvey, M., Strach, R., editors. 2003. Non-fishing impacts to essential fish habitat and recommended conservation measures. Long Beach (CA): National Marine Fisheries Service (NOAA Fisheries) Southwest Region. Version 1. 75p.

Kryter, K.D. 1984. Physiological, Psychological, and Social Effects of Noise, NASA Reference Publication 1115

Martin, E. H. 2019. Chesapeake Fish Passage Prioritization: An Assessment of Dams in the Chesapeake Bay Watershed. The Nature Conservancy. https://maps.freshwaternetwork.org/chesapeake/ [Accessed 2 October 2019].

MDE. 2014c. *Biological Assessment Methodology for Non-Tidal Wadeable Streams*.

MDNR. 2018b. *Spring 2018 Trout Stocking Schedule.* Available at: http://dnr.maryland.gov/fisheries/Documents/2018_trout_stock_sched.pdf

MDNR. 2018c. *MBSS Fish Distributions*. Available at: http://eyesonthebay.dnr.maryland.gov/mbss/fishes.cfm [Accessed 15 November 2018].

MCDEP. 2003. *Watts Branch Restoration Study.*

Moser, M. L. and M.E. Terra. 1999. Low light as a possible impediment to river herring migration. Final Report to N.C. Department of Transportation, Raleigh, N.C., 112 p.

Nightingale, B and C Simenstad. 2001. Overwater structures: Marine issues. Aquatic Habitat Guidelines: An integrated approach to marine, freshwater, and riparian habitat protection and restoration. Prepared for Washington Department of Fish and Wildlife, Washington Department of Ecology and Washington State Department of Transportation by University of Washington, Seattle, Washington.

Paul, M. J., R. J. Klauda, P. F. Kazyak, M. T. Southerland, and N. E. Roth. 2002. *A Physical Habitat Index for Freshwater Wadeable Streams in Maryland.* Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment, Annapolis, MD.

Popper, A. N. 2003. Effects of anthropogenic sounds on fishes. Fisheries 28: 24–31.

Popper, A. N., D. T. T. Plachta, D. A. Mann, and D. Higgs. 2004. Response of clupeid fish to ultrasound: a review. Ices Journal of Marine Science 61: 1057–1061.

Roth, N. E., M. T. Southerland, J. C. Chaillou, P. F. Kazyak, and S. A. Stranko. 2000. *Refinement and validation of a fish Index of Biotic Integrity for Maryland streams*. Versar, Inc., Columbia, MD, with Maryland Department of Natural Resources, Monitoring and Non- Tidal Assessment Division. CBWP-MANTA-EA-00-2.

Roth, N. E., M. T. Southerland, J. C. Chaillou, R. Klauda, P. F. Kazyak, S. A. Stranko, S. B. Weisberg, L. Hall Jr., R. Morgan II. 1998. *Maryland Biological Stream Survey: Development of a Fish Index of Biotic Integrity.* Environmental Monitoring and Assessment. 51 (1): 89-106.

Southerland, M. T., G. M. Rogers, M. J. Kline, R. P. Morgan, D. M. Boward, P. F. Kazyak, R. J. Klauda, S. A. Stranko. 2005. *New Biological Indicators to Better Assess the Condition of Maryland Streams.* DNR-12-0305-0100. Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division. Annapolis, MD.

Starnes, W. C. J. Odenkirk, and M. Ashton. 2011. *Update and analysis of fish occurrences in the lower Potomac River drainage in the vicinity of Plummers Island, Maryland – Contribution XXXI to the natural history of Plummers Island, Maryland*. Proceedings of the Biological Society of Washington: 124 (4): 280-309.

Stranko, S. A., D. M. Boward, J. V. Kilian, C. J. Millard, A. J. Becker, R. Gauza, A. Schenk, A. Roseberry-Lincoln, and M. O'Connor. 2007. *Maryland Biological Stream Survey Sampling Manual.* Maryland Department of Natural Resources, Annapolis, Maryland.

Stribling, J. B., B. K. Jessup, J. S. White, D. Boward, and M. Hurd. 1998. *Development of a Benthic Index of Biotic Integrity for Maryland Streams.* Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment, Annapolis, MD.

USFWS. 2019b. Fish Passage Engineering Design Criteria. USFWS, Northeast Region R5, Hadley, Massachusetts.

Van Ness, K., K. Brown, M. Haddaway, D. Marshall, and D. Jordahl. 1997. *Montgomery County Water Quality Program, Stream Monitoring Protocols.* Montgomery County Department of Environmental Protection.

VDEQ. 2018. 2018 Water Quality Assessment Guidance Manual. Guidance Memo No. GM18-2001.

Section 2.10 Rare, Threatened, and Endangered Species

Annotated Code of Maryland. Natural Resources Article §10-2A-01. Nongame and Endangered Species Conservation Act.

Annotated Code of Virginia. Endangered Species Article §29.1.563-570. Game, Inland Fisheries and Boating Act.

Annotated Code of Virginia. Endangered Plant and Insect Species §3.2.1000-1011. Agriculture, Animal Care, and Food Act.

Brown, M. L. and R. G. Brown. 1984. Herbaceous Plants of Maryland. Port City Press, Baltimore, Maryland.

Cavey, J.F., B.W. Steury and E.T. Oberg. 2013. Leaf Beetles (Coleoptera: Bruchidae, Chrysomelidae, Orsodacnidae) from the George Washington Memorial Parkway, Fairfax County, Virginia. Banisteria 41:71-79.

Evans, A.V. and B.W. Steury. 2012. The Cicada Parasite Beetles (Coleoptera: Rhipiceridae) of Virginia. Banisteria 39:65-70.

Flint, Jr., O.S. 2011. Trichoptera from the Great Falls and Turkey Run units of the George Washington Memorial Parkway, Fairfax Co., Virginia, USA. Zoosymposia 5:101-107.

Jones, Mike & Liz Willey (eds). Ecology & Conservation of the Wood Turtle. Appendix VII to: Jones, M.T., H.P. Roberts, and L.L. Willey. 2018. Conservation Plan for the Wood Turtle in the Northeastern

United States. Report to the Massachusetts Division of Fisheries & Wildlife and the U.S. Fish & Wildlife Service. 259 pp

MDNR. 2019. Rare, Threatened, and Endangered Plants of Maryland, C. Frye Ed., Maryland Department of Natural Resources, 580 Taylor Avenue, Annapolis, MD 21401. DNR 03-031319-136

Mathis, W.N. and Zatwarnicki. 2010. New Species and Other Taxonomic Clarifications for Shore Flies from the Delmarva States (Diptera: Ephydridae). Proceedings Entomological Society of Washington 112:97-128.

Steury, B. W. & T. A. Pearce. 2014. Land snails and slugs (Gastropoda: Caenogastropoda and Pulmonata) of two national parks along the Potomac River near Washington, District of Columbia. Banisteria 43:3-20.

Steury, B.W. 2018a. Annotated Checklist of Some Fungivorous Beetles (Coleoptera: Anamorphidae, Biphyllidae, Derodontidae, Endomychidae, Erotylidae, and Tetratomidae) of the George Washington Memorial Parkway. Banisteria 50:21-28.

Steury, B.W. 2018b. Four Long-horned Beetles (Coleoptera: Cerambycidae) New to Virginia and Additional New Park Records (Coleoptera: Anthicidae, Buprestidae, Cantharidae, Carabidae, Cerambycidae, Chrysomelidae) for the George Washington Memorial Parkway. Banisteria 50:29-31.

Steury, B.W. 2017. First Record of the Rove Beetle Trigonodemus striatus LeConte (Coleoptera: Staphylinidae) from Virginia and Additional New Park Records (Coleoptera: Anthicidae, Buprestidae, Carabidae, Cerambycidae, Chrysomelidae) for the George Washington Memorial Parkway. Banisteria 48:14-16.

Steury, B.W., W.E. Steiner, Jr., and F.W. Shockley. 2018. The Soldier Beetles and False Soldier Beetles (Coleoptera: Cantharidae and Omethidae) of the George Washington Memorial Parkway. The Maryland Entomologist 7(2):11-27.

Steury, B.W. and P.W. Messer. 2014. Twelve Ground Beetles New to Virginia or the District of Columbia and an Annotated Checklist of the Geadephaga (Coleoptera, Adephaga) from the George Washington Memorial Parkway. Banisteria 43:40-55.

Steury, B.W. and T.C. MacRae. 2014. The Longhorned Beetles (Insecta: Coleoptera: Cerambycidae) of the George Washington Memorial Parkway. Banisteria 44:7-12.

Steury, B.W., T.C. MacRae, and E.T. Oberg. 2012. Annotated List of the Metallic Wood-boring Beetles (Insecta: Coleoptera: Buprestidae) of the George Washington Memorial Parkway, Fairfax County, Virginia. Banisteria 39:71-75.

Steury, B.W., J. Glaser, and C.S. Hobson. 2007. A Survey of Macrolepidopteran Moths of Turkey Run and Great Falls National Parks, Fairfax County, Virginia. Banisteria 29:17-31.

Townsend, John F. 2019. Natural Heritage Resources of Virginia: Rare Plants. Natural Heritage Technical Report 19-15. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia. Unpublished report. March 2019. 57 pages plus appendices

U.S. Code. Title 16 Conservation, Chapter 35 Endangered Species.

U.S. Fish and Wildlife Service (USFWS). 2007b. Indiana Bat (Myotis sodalis) Draft Recovery Plan: First Revision. U.S. Fish and Wildlife Service, Fort Snelling, MN. 258 pp.

USFWS. 2016. *Revised Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat.* USFWS, Bloomington, Minnesota.

USFWS. 2018a. Environmental Conservation Online System. *Species profile for Yellow Lance (Elliptio lanceolata).* Available at https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=F03I [Accessed 16 October 2018].

USFWS. 2018b. Threatened Species Status for the Yellow Lance; Final Rule. 83. Fed. Reg. 14189. (May 3, 2018).

USFWS. 2018c. Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-eared Bat. U.S. Fish and Wildlife Service Midwest Regional Office, Bloomington, MN. 157pp.

Weakley, A. S., J. C. Ludwig, and J. F. Townsend. 2012. Flora of Virginia. Bland Crowder, ed. Foundation of the Flora of Virginia Project Inc., Richmond. Fort Worth: Botanical Research Institute of Texas Press.

Section 2.11 Unique and Sensitive Areas

Blackwell, Robert J. 1989. *Overlay Zoning, Performance Standards, and Environmental Protection After Nollan*. 16 B.C. Envtl. Aff. L. Rev. 615. Available at: http://lawdigitalcommons.bc.edu/ealr/vol16/iss3/6 [Accessed 7 September 2018].

MDNR. 2013b. *Maryland Land Preservation and Recreation Plan 2014-2018*. Maryland Department of Natural Resources, Chapter 5. Available at: http://dnr2.maryland.gov/land/Documents/LPRP/LPRP_%202014-2018.pdf [Accessed 28 August 2018].

MDNR. 2018d. *Maryland's Green Infrastructure Assessment: Why Large Forest Areas are Important.* Available at: http://dnr.maryland.gov/land/Pages/Green-Infrastructure-Forests.aspx [Accessed 30 August 2018].

MCDEP. 2018. *Special Protection Areas*. Available at: https://www.montgomerycountymd.gov/water/streams/spa.html [Accessed 19 October 2018].

Montgomery Planning. 2012. Special Protection Areas (SPA). Available at: http://www.montgomeryplanning.org/environment/spa/index.shtm [Accessed 7 September 2018].

Montgomery Planning. 2018. *MCATLAS*. Available at: http://montgomeryplanning.org/resources/mc-atlas/ [Accessed 19 December 2018].

State of Maryland. 2018. *MD iMAP*. Maryland's Open Data Portal. Available at: https://imap.maryland.gov/Pages/default.aspx [Accessed 19 December 2018].

Weber, T., Sloan, A., and Wolf, J. 2006. *Maryland's Green Infrastructure Assessment: Development of a comprehensive approach to land conservation*. Landscape and Urban Planning. 77. 94-110. 10.1016/j.landurbplan.2005.02.002. Available at: https://www.researchgate.net/publication/222519545_Maryland's_Green_Infrastructure_Assessment_Development_of_a_comprehensive_approach_to_land_conservation [Accessed 19 December 2018].

VDCR. 2018b. Natural Heritage Conservation Sites. Available at: http://www.dcr.virginia.gov/land-conservation/tools02c [Accessed 15 December 2018].

VDCR. 2018c. The Virginia Natural Heritage Program. Available at: http://www.dcr.virginia.gov/natural-heritage/about [Accessed 15 December 2018].

List of Acronyms

AADT – Average Annual Daily Traffic

AASHTO – American Association of State Highway and Transportation Officials

ALT* – Alternative
*Only abbreviated in tables.

ARDS – Alternatives Retained for Detailed Study

BARC – Beltsville Agricultural Research Center

BLM – Bureau of Land Management

BMP(s) – Best Management Practice(s)

CEA – Cumulative Effects Analysis

CEQ – Council on Environmental Quality

CFR – Code of Federal Regulations

CLRP – Constrained Long-Range Plan

CMP – Compensatory Wetlands and Waterways Mitigation Plan

COMAR – Code of Maryland Regulations

Critical Area – Chesapeake Bay Critical Area

CRWR – Center for Research in Water Resources

CRZ – Critical Root Zone

CWA – Clean Water Act

CWP – Center for Watershed Protection

CWR – Clean Water Rule

DBH – Diameter at Breast Height

DC – District of Columbia

DDOE – District Department of the Environment Watershed Protection Division

DEIS – Draft Environmental Impact Statement

DO – Dissolved Oxygen

EAB – Emerald ash borer

EFH – Essential Fish Habitat

EIS – Environmental Impact Statement

EoPB – Eyes of Paint Branch

EPA – Environmental Protection Agency

EPD – Environmental Program Division

ERP – Environmental Review Program

ESA – Endangered Species Act

ESD – Environmental Site Design

ETL – Express Toll Lanes

FAST – Fixing America's Surface Transportation

FCDPWES – Fairfax County Department of Public Works and Environmental Services

FCP – Forest Conservation Plan

FEMA – Federal Emergency Management Agency

FHWA – Federal Highway Administration

FIDS – Forest Interior Dwelling Bird Species

FPPA – Farmland Protection Policy Act

FR – Federal Register

FWCA – Fish and Wildlife Coordination Act

GI – Green Infrastructure

GIA – Green Infrastructure Assessment

GIO – Geographic Information Office

GIS – Geographic Information System

GP – General Purpose

GPS – Global Positioning System

HOT – High-Occupancy Toll

HOV – High-Occupancy Vehicle

IBI – Index of Biotic Integrity

ICC – Intercounty Connector

ICM – Innovative Congestion Management

IPaC – Information for Planning and Consultation

IRVM – Integrated Roadside Vegetation Management

ISW – Interstate Waters

IWSRCC – Interagency Wild and Scenic River Coordinating Council

JD – Jurisdictional Determination

LESA – Land Evaluation and Site Assessment

LF – Linear Feet

LOD – Limits of Disturbance

MAL – Minimum Allowable Limit

MBSS – Maryland Biological Stream Survey

MCAtlas – Montgomery County Atlas

MCDEP – Montgomery County Department of Environmental Protection

MCDPS – Montgomery County Department of Permitting Services

MCL – Maximum Contaminant Limit

MD – Maryland

MDE – Maryland Department of the Environment

MDNR – Maryland Department of Natural Resources

MDOT SHA – Maryland Department of Transportation State Highway Administration

MERLIN – Maryland's Environmental Resources and Land Information Network

MET – Maryland Environmental Trust

MGS – Maryland Geological Survey

M-NCPPC – Maryland National Capital Park and Planning Commission

MS4 – Municipal Separate Storm Sewer System

MSFCMA – Magnuson-Stevens Fishery Conservation and Management Act

MWCOG – Metropolitan Washington Council of Governments

NCEI – National Centers for Environmental Information

NEPA – National Environmental Policy Act

NFIP – National Flood Insurance Program

NLEB – Northern Long-Eared Bat

NMFS – National Marine Fisheries Service

NOAA – National Oceanic and Atmospheric Administration

NPDES – National Pollutant Discharge Elimination System

NPS – National Park Service

NRCS – Natural Resources Conservation Service

NRTR – Natural Resources Technical Report

NTCHS – National Technical Committee for Hydric Soils

NTU – Nephelometric Turbidity Units

NWI – National Wetlands Inventory

NWQMC – National Water Quality Monitoring Council

OHW – Ordinary High Water

P3 – Public-Private Partnership

PEM – Palustrine Emergent

PFO – Palustrine Forested

PHI – Physical Habitat Index

POW – Palustrine Open Water

PSS – Palustrine Scrub-Shrub

RBP – Rapid Bioassessment Protocol

RFP – Request for Proposals

ROW – Right-of-Way

RTE – Rare, Threatened, and Endangered

SDWA – Safe Drinking Water Act

SF – Square Feet

SGCN – Species of Greatest Conservation Need

SPA(s) – Special Protection Area(s)

SSPRA – Sensitive Species Project Review Area

SWANCC – Solid Waste Agency of Northern Cook County

SWAP – State Wildlife Action Plans

SWM – Stormwater Management

TCP – Tree Conservation Plan

TEAs – Targeted Ecological Areas

TMDL – Total Maximum Daily Load

TNW – Traditionally Navigable Waters

TPB – Transportation Planning Board

TS – Territorial Seas

UA – Urbanized Area

URS – United Research Services

US – United States

USACE – United States Army Corps of Engineers

USC – United States Code

USDA – United States Department of Agriculture

USDOT – United States Department of Transportation

USFS – United States Forest Service

USFWS – United States Fish and Wildlife Service

USGS – United States Geological Survey

VA – Virginia

VAC – Virginia Administrative Code

VCPMI - Virginia Coastal Plain Macroinvertebrate Index

VDACS – Virginia Department of Agriculture and Consumer Services

VDCR – Virginia Department of Conservation and Recreation

VDEQ – Virginia Department of Environmental Quality

VDGIF – Virginia Department of Game and Inland Fisheries

VDH – Virginia Department of Health

VDOF – Virginia Department of Forestry

VDOT – Virginia Department of Transportation

VMRC – Virginia Marine Resources Commission

VOF – Virginia Outdoors Foundation

VSCI - Virginia Stream Condition Index

VWPP – Virginia Water Protection Permit

WHS – Wildlife and Heritage Service

WIP – Watershed Implementation Plan

WMA – Water Management Administration

WRR – Water Resources Registry

WSSC – Washington Suburban Sanitary Commission

Glossary

Anadromous – Fish that spend most of their adult lives at sea but return to fresh water to spawn. (National Conservation Training Center - https://nctc.fws.gov/pubs5/web_link/text/int_fish.htm)

Aquifer – An underground layer of water-bearing rock. Water-bearing rocks are permeable, meaning that they have openings that liquids and gases can pass through. (National Geographic - https://www.nationalgeographic.org/encyclopedia/aquifer/)

- Artesian aquifer – Water is pushed to the surface as a result of pressure between rock formations (USGS - https://water.usgs.gov/edu/qa-home-artesian.html)
- Unconfined (water-table) aquifer – Water is near the land surface and movement is controlled by the water table, therefore subject to rise and fall of the water table (USGS - https://www.usgs.gov/faqs/what-difference-between-a-confined-and-unconfined-water-table-aquifer?qt-news_science_products=0#qt-news_science_products)

Benthic - Occurring at the bottom of a body of water. (EPA - https://www.epa.gov/national-aquatic-resource-surveys/indicators-benthic-macroinvertebrates)

Catadromous – Fish that spend most of their adult lives in fresh water but return to salt water to spawn (NOAA Fisheries - https://www.nefsc.noaa.gov/faq/faq-archive/fishfaq1a.html)

Corridor Study Boundary – The project area that includes a 48-mile long and approximately 600-foot wide roadway corridor around I-495 and I-270 spanning two states, three counties, and 15 MD 12-digit watersheds. (NRTR)

Diadromous - A general category describing fish that spend portions of their life cycles partially in fresh water and partially in salt water. (National Conservation Training Center - https://nctc.fws.gov/pubs5/web_link/text/int_fish.htm)

Palustrine emergent wetland (PEM) – A nontidal wetland characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants. (USFWS - https://www.fws.gov/wetlands/documents/classwet/emergent.htm)

Ephemeral Streams that flow only after precipitation. Runoff from rainfall is the primary source of water for these streams. Like seasonal streams, they can be found anywhere but are most prevalent in arid areas. (Streams under CWA Section 404 - https://archive.epa.gov/water/archive/web/html/streams.html)

Exotic species – A species not native to the continent on which it is now found (USDA NRCS- https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ct/technical/ecoscience/invasive/?cid=nrcs142p2_011124)

Forest – A biological community dominated by trees and other woody plants covering a land area of 10,000 square feet or greater. Forest includes (1) areas that have at least 100 trees per acre with at least 50% of those having a two-inch or greater diameter at 4.5 ft above the ground and larger, and (2) forest areas that have been cut but not cleared. Forest does not include orchards (Maryland State Forest Conservation Technical Manual - https://mdstatedocs.slrc.info/digital/collection/mdgov/id/11130/)

Forest Stand – A contiguous group of trees sufficiently uniform in species composition, arrangement of age classes, and condition to be a distinguishable, homogeneous unit. (Maryland State Forest Conservation Technical Manual - https://mdstatedocs.slrc.info/digital/collection/mdgov/id/11130/)

Palustrine forested wetland (PFO) – A nontidal wetland characterized by woody vegetation that is 6 m tall or taller. (USFWS - https://www.fws.gov/wetlands/documents/classwet/forested.htm)

Geology – Referring to physical features of the earth's surface including rock and soil formations. (Geology.com - https://geology.com/articles/what-is-geology.shtml)

Hydrologic Unit Code (HUC) – A number ranging from 2 to 8 digits nationally that classifies an area into regions, sub-regions, accounting units, and cataloging units that identify the movement of water into successively smaller geographic areas. The term can be used interchangeably with "watershed." (USGS - https://water.usgs.gov/GIS/huc.html)

Intermittent – Streams that flow seasonally and often have connectivity to groundwater. Runoff from rainfall or other precipitation supplements the flow of seasonal stream. During dry periods, seasonal streams may not have flowing surface water. Larger seasonal streams are more common in dry areas. (Streams under CWA Section 404 - https://archive.epa.gov/water/archive/web/html/streams.html)

Interstate waters (ISW) - A water body that flow across, or form a part of, a State's boundaries. (Congressional Research Service - https://fas.org/sgp/crs/misc/R44585.pdf)

Invasive species – Any living organism that is not native to an ecosystem and causes harm to the ecosystem, community, or health of the area where they are introduced. These species usually reproduce quickly and outcompete native species. They are not necessarily from different countries or continents. (National Wildlife Federation - https://www.nwf.org/Educational-Resources/Wildlife-Guide/Threats-to-Wildlife/Invasive-Species)

Karst – An area of land comprised of limestone (soft rock) that is prone to erosion when exposed to water and can result in steep, rocky cliffs or sinkholes. (National Geographic - https://www.nationalgeographic.org/encyclopedia/karst/)

Macroinvertebrate – Small aquatic animals and the larval stage of insects that are visible without the aid of a microscope and lack a backbone. Commonly described as "benthics." (EPA - https://www.epa.gov/national-aquatic-resource-surveys/indicators-benthic-macroinvertebrates)

Non-native/Introduced species – A species introduced intentionally or accidentally by human intervention to an area/region where it was previously not found. Not all non-native species are invasive or exotic. (USDA NRCS - https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ct/technical/ecoscience/invasive/?cid=nrcs142p2_011124)

Nontidal – Not influenced by tide, most commonly used to describe wetlands along rivers, streams, isolated depressions, or other low-lying areas where groundwater intercepts the soil surface. These areas can be inundated seasonally and can consist of a variety of vegetation types from grasses to forest, and in some cases may lack vegetation. (EPA - https://www.epa.gov/wetlands/what-wetland)

Palustrine open water (POW) – Nontidal system that is permanently flooded and largely lacks rooted vegetation above the water's surface. (USFWS - https://www.fws.gov/wetlands/documents/classwet/)

Palustrine - All nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 %. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2 m at low water; and (4) salinity due to ocean-derived salts less than 0.5 %. (USFWS - https://www.fws.gov/wetlands/documents/classwet/palustri.htm)

Perennial – Streams that typically have water flowing in them year-round. Most of the water comes from smaller upstream waters or groundwater while runoff from rainfall or other precipitation is supplemental. (Streams under CWA Section 404 - https://archive.epa.gov/water/archive/web/html/streams.html)

Scrub-shrub wetland – (Palustrine) A wetland dominated by woody vegetation less than 6 m (20 feet) tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. (USFWS - https://www.fws.gov/wetlands/documents/classwet/scrbshrb.htm)

Territorial seas (TS) - The area of the sea immediately adjacent to the shores of a state and subject to the territorial jurisdiction of that state. (Britannica - https://www.britannica.com/topic/territorial-waters)

Tidal – Influenced by tide, most commonly used to describe wetlands along coast lines and usually a mix of salt and freshwater. Vegetation may be absent, as in sand or mud flats, but many areas consist of grasses, shrubs, and some tree species that have adapted to the influence of salt water. (EPA - https://www.epa.gov/wetlands/what-wetland)

Topography - The configuration of a surface including its relief and the position of its natural and man-made features (Merriam-Webster Dictionary - https://www.merriam-webster.com/dictionary/topography)

Traditionally navigable waters (TNW) - A water body that is subject to the ebb and flow of the tide, and/or the water body is presently used, or has been used in the past, or may be susceptible for use to transport interstate or foreign commerce. (United States Army Corps of Engineers Jurisdictional Determination Form Instructional Guidebook - https://www.epa.gov/sites/production/files/2017-05/documents/app_d_traditional_navigable_waters.pdf)

Watershed - An area of land that drains water, sediment and dissolved materials to a common receiving body or outlet. The term is not restricted to surface water runoff and includes interactions with subsurface water. Watersheds vary from the largest river basins to just acres or less in size. (EPA Watershed Academy Web - https://www.epa.gov/hwp/basic-information-and-answers-frequent-questions)