National Park Service
U.S. Department of the Interior

Chesapeake & Ohio Canal National Historical Park
Maryland, West Virginia, District of Columbia

Chesapeake & Ohio Canal National Historical Park
Potomac Submerged Channel Intake

Environmental Assessment

July 2016

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PROJECT SUMMARY

INTRODUCTION

Washington Suburban Sanitary Commission (WSSC) proposes to construct a new offshore submerged channel intake for water supply at its Potomac Water Filtration Plant (WFP). The Potomac WFP is located along River Road near Potomac, Montgomery County, Maryland. The Chesapeake and Ohio Canal National Historical Park (C&O Canal NHP or the park) is located parallel to the Potomac River and passes between the existing water intake structure and the remaining facilities of the WFP. The project would involve construction activities and the location of permanent WFP structures within the C&O Canal NHP. Since some of the existing and proposed intake facilities reside on National Park Service (NPS) property within the C&O Canal NHP, WSSC is planning to purchase and provide land to the NPS in exchange for a perpetual easement for the existing and proposed intake facilities.

PURPOSE OF ACTION

The purpose of the federal action is to respond to WSSC's proposal considering the purpose and resources of C&O Canal NHP, as expressed in statute, regulation, policy, and the NPS objectives in taking action.

NEED FOR ACTION

The federal action by the NPS is needed because the applicant has submitted an application and preliminary plans to construct a submerged intake and supporting features in and adjacent to C&O Canal NHP. The applicant requests NPS permission to construct a new submerged channel intake in the Potomac River, as well as an onshore intake shaft, a boat ramp, a parking area, and a permanent access road. Construction would include temporary cofferdams in the Potomac River for the submerged intake and boat ramp and a temporary construction access road including embankments across the Potomac River and C&O Canal.

PROJECT BACKGROUND

WSSC's need for the proposed submerged channel intake is to provide a consistently higher quality raw water source than can be achieved using the existing onshore intake. Tributary inflows on the north bank of the Potomac River immediately upstream of the WFP intake have been identified as having a major impact on raw water quality and treatment plant operation. More specifically, Watts Branch enters the Potomac River approximately 0.25 miles upstream of the Potomac WFP intake and Seneca Creek enters the Potomac River approximately 5 miles upstream.

OVERVIEW OF THE ALTERNATIVES

There are four alternatives evaluated in this EA: the no-action alternative and three action alternatives. Under all action alternatives, the new intake and intake shaft would be constructed southwest of the existing intake facility using the drill and blast method. A boat ramp, parking area, and permanent access road would be constructed to provide access to the intake for maintenance. Cofferdams would be needed in the river for construction of the intake shaft and the boat ramp. Alternative 2 would include tunneling for installation of all new piping (conduits) except at the connection to the existing raw water conduits, where it would be open cut. Alternative 3 is similar to alternative 2; however, the installation of new conduits would use both open-trench construction (between the intake and junction vault) and tunneling construction (between the junction vault and the existing intake conduits). The tunneling construction methods under alternative 4 are similar to those described under alternative 2. However, the onshore

shaft/junction vault would be placed east of the existing intake facility and the tunneled conduits would run from the new intake northeast to the junction vault.

SUMMARY OF THE IMPACTS

Under alternative 1, no-action, long-term adverse impacts on soils/geology, water resources, wetlands, floodplains, scenic resources, and visitor use and experience have resulted from the existing Potomac WFP. Alternative 2, the preferred alternative, would have long-term adverse impacts on geology and soils/sediment, water resources, wetlands, floodplains, vegetation, wildlife, special-status plant species, cultural resources, scenic resources, and visitor use and experience as a result of construction and operation activities. Even though terrestrial habitat areas would be revegetated following construction, these areas would not succeed to the deciduous woodlands currently present at the project site within the scope of this analysis; therefore construction impacts for vegetation, terrestrial wildlife, scenic resources, and visitor use and experience are considered long term.

Impacts from alternative 3 would be similar to those of alternative 2, except the impact area of riverine systems (Potomac River), floodplains, and aquatic wildlife would be larger compared to alternative 2; however this increase in area impacted would not increase the impact intensity to these resources. In addition, impacts on visitor experience would be greater under this alternative due to surface blasting associated with trenching construction, which creates louder and more intense noise. Impacts from alternative 4 would be the same as those under alternative 2. Although some of the project components have slightly different configurations, the construction methods under alternative 4 are similar to alternative 2. Since this alternative requires the temporary relocation of the towpath this would cause a greater impact on visitors, but is not expected to increase the impact intensity.

HOW TO COMMENT

Agencies and the public are encouraged to review and comment on the contents of this EA during the public review period. We invite you to comment on this EA by any one of several methods. The preferred method of comment is on the park's Planning, Environment, and Public Comment (PEPC) web site at http://parkplanning.nps.gov/choh.You may also submit written comments to:

Christopher J. Stubbs
Chief, Division of Resources Management
Chesapeake & Ohio Canal National Historical Park
1850 Dual Highway, Suite 100
Hagerstown, MD 21740
Attention: Submerged Channel Intake EA

The date and location for the public meeting are listed below:

Public meeting date: Thursday, July 14, 2016
Public meeting time: 7:00 to 9:00 pm
Public meeting location: Potomac Community Library (Medium Room), 10101 Glenolden Drive, Potomac, Maryland, 20854

Only written comments will be accepted. Please submit your comments by August 14, 2016. Please be aware that your entire comment will become part of the public record. If you wish to remain anonymous, please clearly state that within your correspondence, although we cannot guarantee that personal information, such as email address, phone number, etc. will be withheld.

TABLE OF CONTENTS

Project Summary **1**
Introduction 1
Purpose of Action 1
Need for Action 1
Project Background 1
Overview of the Alternatives 1
Summary of the Impacts 2
How to Comment 2
Purpose and Need **1**
Introduction 1
Purpose of Action 1
Need for Action 1
Background of the Park 2
Purpose and Significance of the Park 2
Project Background 4
Potomac Water Filtration Plant 4
WSSC's Need for the Proposed Intake 5
Previous Planning, Studies, Reports, and Surveys 6
Current Studies, Reports, and Surveys 7
Scoping Process and Public Participation 8
Issues and Impact Topics 8
Impact Topics Included in This Document 9
Impact Topics Dismissed from Further Analysis 10
Alternatives **15**
Introduction 15
Description of the Alternatives 15
Alternative 1: No-action Alternative 16
Common to All Action Alternatives 19
Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake 26
Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake 27
Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake 28
Construction Staging 44
Mitigation Measures for the Action Alternatives 44
Mitigation Impact Fund 47
Overview of Visitor Impact Analysis 47
Overview of Ecological Impact Analysis 48
Next Steps 48
Alternatives Considered but Dismissed 49
Environmentally Preferable Alternative 49

Summary of Environmental Consequences/Impact Comparison Matrix 50
Affected Environment 59
Overview 59
Geology and Soils 59
Geology 59
Soils 63
Water Resources 64
Water Quality 64
Stormwater Management 69
Wetlands 70
Floodplains 76
Flood Stages and Frequencies 77
Aquatic and Terrestrial Vegetation 77
Aquatic Vegetation 77
Terrestrial Vegetation 78
Aquatic and Terrestrial Wildlife 82
Aquatic Species 82
Terrestrial Species 93
Special-status Species 96
Scenic Resources (Aesthetics and Viewsheds) 103
Cultural Resources 104
Historic Structures and Districts 104
Archeological Study and Resources 105
Cultural Landscapes 106
Visitor Use and Experience 106
Human Health and Safety 107
Land Use 108
Environmental Consequences 109
Overview 109
General Methodology for Establishing Impact Thresholds and Measuring Effects by Resource 109
General Analysis Methods 109
Assumptions 109
Impact Thresholds 110
Cumulative Impacts Analysis Method 110
Geology and Soils 116
Methodology and Assumptions 116
Project Area 116
Impact Thresholds 116
Alternative 1: No-action Alternative 116
Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative) 117
Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake 121

Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake 124
Water Resources 127
Methodology and Assumptions 127
Project Area 127
Impact Thresholds 127
Alternative 1: No-action Alternative 128
Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative) 129
Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake 131
Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake 133
Wetlands 135
Methodology and Assumptions 135
Project Area 135
Impact Thresholds 136
Alternative 1: No-action Alternative 136
Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative) 137
Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake 140
Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake 144
Floodplains 147
Methodology and Assumptions 147
Project Area 147
Impact Thresholds 147
Alternative 1: No-action Alternative 147
Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative) 148
Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake 150
Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake 152
Aquatic and Terrestrial Vegetation 154
Methodology and Assumptions 154
Project Area 154
Impact Thresholds 155
Alternative 1: No-action Alternative 155
Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative) 155
Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake 158
Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake 160
Aquatic and Terrestrial Wildlife 161
Methodology and Assumptions 161
Project Area 161
Impact Thresholds 162
Alternative 1: No-action Alternative 162
Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative) 162
Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake 165
Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake 167

Special-status Species 168
Methodology and Assumptions 168
Project Area 169
Impact Thresholds 169
Alternative 1: No-action Alternative 170
Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative) 170
Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake 173
Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake 174
Scenic Resources – Aesthetics and Viewsheds 175
Methodology and Assumptions 175
Project Area 175
Impact Thresholds 175
Alternative 1: No-action Alternative 175
Impacts of the Action Alternatives 176
Cultural Resources 178
Methodology and Assumptions 178
Project Area 179
Historic Structures, Buildings, Objects, and Districts 179
Archeological Sites 182
Cultural Landscapes 184
Visitor Use and Experience 186
Methodology and Assumptions 186
Project Area 186
Impact Thresholds 186
Alternative 1: No-action Alternative 187
Impacts of the Action Alternatives 188
Human Health and Safety 190
Methodology and Assumptions 190
Project Area 190
Impact Thresholds 190
Alternative 1: No-action Alternative 191
Impacts of the Action Alternatives 191
Land Use 192
Methodology and Assumptions 192
Project Area 192
Impact Thresholds 192
Alternative 1: No-action Alternative 193
Impacts of the Action Alternatives 193
Consultation and Coordination 195
Public Involvement 195
Agency Consultation 195

Section 7 Consultation 196
Section 106 Consultation 196
List of Preparers 199
Glossary and Acronyms 201
Glossary of Terms 201
Bibliography 209

LIST OF APPENDICES

Appendix A: Public Involvement

Appendix B: Agency Correspondence

Appendix C: Air Quality General Conformity Applicability Analysis

Appendix D: Habitat Restoration Plan

Appendix E: Statement of Findings

Appendix F: Bird Species Identified in the Vicinity of the WSSC Potomac Water Filtration Plant

Appendix G: Special-Status Species Identified in the Vicinity of the WSSC Potomac Water Filtration Plant

LIST OF FIGURES

Figure 1. Vicinity Map 3
Figure 2. Alternative 1 No-Action 17
Figure 3. Alternative 2 Tunneling to Onshore Shaft – West of Existing Intake 35
Figure 4. Alternative 3 Trenching/Tunneling to Onshore Shaft – West of Existing Intake 37
Figure 5. Alternative 4 Tunneling to Onshore Shaft – East of Existing Intake 39
Figure 6. Comparison of Alternatives 2, 3, and 4 41
Figure 7. Surveyed Land Exchange Boundary of the Project Area 43
Figure 8. Boring Sample Locations, 2005 Geotechnical Investigation 61
Figure 9. Schematic of Watts Branch Runoff Influence on Water Quality in the Potomac River 66
Figure 10. Wetlands Including Riverine Wetlands Delineated in Project Area 73
Figure 11. Submerged Aquatic Vegetation in the Potomac River, Summer 2013 79
Figure 12. Mussel Survey Stations, Summer 2013 91
Figure 13. Rare Plants Survey Results, 2013 99
Figure 14. Floating Paspalum Survey Results, 2014 101

LIST OF TABLES

Table 1. General Summary of Required Permits and Approvals 23
Table 2. Detailed Comparison of Alternatives 30
Table 3. Estimated Impacts on Visitor Types from Project Construction 48
Table 4. Summary of Environmental Consequences/Impact Comparison Matrix 51
Table 5. Characteristics of Soil Series in the Vicinity of the Potomac WFP 64
Table 6. Potomac River Water Quality Data 67
Table 7. Effects of Flow Conditions on Raw Water Quality Average Daily Values of Key Water Quality Parameters 67
Table 8. Potomac WFP Plant Performance Data 68
Table 9. Water Quality Parameters in Relation to Distance Offshore 68
Table 10. Wetlands and Waters of the U.S. Delineated in the Project Area 72
Table 11. Ten Greatest Floods of the Potomac River 77
Table 12. Benthic Macroinvertebrates Observed by Montgomery County DEP during the 2007 Sampling Event 84
Table 13. Fish Species Sampled by Electrofishing in the Potomac River, Near River Bend Park, Virginia, June 2005 – MDNR 85
Table 14. Fish Species Sampled by Seine in the Potomac River (Near Seneca Creek), ... 86
Table 15. Fish Species Observed by Montgomery County DEP during 2007 Sampling Event 87
Table 16. Fish Species Identified in the C&O Canal NHP Survey 2000 to 2003 88
Table 17. Freshwater Mussel Species Collected During Surveys Conducted in July 2005 90
Table 18. Abundance of Freshwater Mussel Collected in the Potomac River during a Qualitative Survey, August 2013 93
Table 19. Reptile and Amphibian Species Recorded by NPS within the C&O Canal NHP 94
Table 20. List of Classified Structures in or Adjacent to the Project Area 105
Table 21. Cumulative Impact Scenario Table 115
Table 22. Construction Area Limits (Limits of Disturbance) 119
Table 23. Construction Impacts - Permanent Structures 119
Table 24. Construction Impacts - Temporary Structures 119
Table 25. Alternative 2 Riverine Systems and Wetland Impacts 137
Table 26. Alternative 3 Riverine Systems and Wetland Impacts 141
Table 27. Alternative 4 Riverine Systems and Wetland Impacts 144
Table 28. Alternative 2 Floodplain Impacts 149
Table 29. Alternative 3 Floodplain Impacts 151
Table 30. Alternative 4 Floodplain Impacts 153

PURPOSE AND NEED

INTRODUCTION

Washington Suburban Sanitary Commission (WSSC) proposes to construct a new offshore submerged channel intake for water supply at its Potomac Water Filtration Plant (WFP). The Potomac WFP is located along River Road near Potomac, Montgomery County, Maryland, on the north side of the Potomac River (figure 1). The Chesapeake and Ohio Canal National Historical Park (C&O Canal NHP or the park) is located parallel to the Potomac River and passes between the existing water intake structure and the remaining facilities of the WFP. The C&O Canal NHP extends for 184.5 miles from Washington, D.C. to Cumberland, Maryland. The project area is located near mile marker (MM) 17.5 of the C&O Canal NHP. The project would involve construction activities in and adjacent to the C&O Canal NHP. Construction of a new submerged channel intake would require a temporary cofferdam in the Potomac River to provide a "dry" working area. A temporary construction access road including embankments across the Potomac River and C&O Canal would be needed to allow access from Potomac WFP property to construction areas. Finally, an onshore intake shaft, a boat ramp, a parking area, and a permanent access road would be constructed to support maintenance activities for the new facilities.

Since some of the existing and proposed facilities reside on National Park Service (NPS) property within the C&O Canal NHP, a land exchange between the NPS and WSSC may occur. WSSC is planning to purchase and provide land to the NPS in exchange for a perpetual easement for the existing intake facilities and the proposed facilities.

The federal action by the NPS analyzed in this environmental assessment (EA) is deciding whether or not, and under what conditions, to issue WSSC the permits it has requested and whether or not to execute a land exchange. This EA was prepared in accordance with the National Environmental Policy Act of 1969, as amended (NEPA) guidelines, and it examines the consequences of the alternatives on the environment. The document analyzes the short-term, long-term, and cumulative effects of the proposed action and alternatives, including "no-action." By comparing the proposed action with the alternatives and no-action alternative, and identifying mitigation measures that would minimize adverse effects, this EA aims to inform stakeholders about the decision making process and provide a format for submitting public comment.

PURPOSE OF ACTION

The purpose of the federal action is to respond to WSSC's proposal considering the purpose and resources of C&O Canal NHP, as expressed in statute, regulation, policy, and the NPS objectives in taking action, detailed later in this chapter.

NEED FOR ACTION

The federal action by the NPS is needed because the applicant has submitted an application and preliminary plans to construct a submerged intake and supporting features in and adjacent to C&O Canal NHP. The park's enabling legislation recognizes the potential need for utility projects to cross the park and provides the Secretary authority to permit crossings "if such crossings are not in conflict with the purposes of the park and are in accord with any requirements found necessary to preserve park values" Public Law 91-644, Section 5 (b), 1971. The applicant requests NPS permission to construct a new submerged channel intake in the Potomac River, as well as an onshore intake shaft, a boat ramp, a parking area, and a permanent access road. Construction would include temporary cofferdams in the Potomac

River for the submerged intake and boat ramp and a temporary construction access road including embankments across the Potomac River and C&O Canal.

BACKGROUND OF THE PARK

Purpose and Significance of the Park

The C&O Canal NHP is the last towpath that remains fully intact from the mule-drawn barge transportation era in the United States. The C&O Canal NHP was established in 1971 and is located along 184.5 miles of the Potomac River's Maryland shoreline from the mouth of Rock Creek in Georgetown, Maryland to Cumberland, Maryland. The C&O Canal NHP is historically significant primarily because it embodies nineteenth-century engineering and architectural technology. The canal operated from the 1820s to the 1920s as a route for transporting coal, lumber, and agricultural products, such as grain, from western Maryland to the port of Georgetown and to the navigable lower reaches of the Potomac River. During this time, the C&O Canal provided jobs and opportunities for people throughout the Potomac River Valley. The canal included 74 lift locks, 11 stone aqueducts built to carry the canal prism over the Potomac River tributaries, and 241 historic culverts built to carry small streams and roads under the canal.

Today, the canal's remaining historical structures tell the story of the canal's important role in many aspects of American history, including transportation, engineering achievement, and commerce.

The park's mission is to preserve and protect the natural, cultural, and historic resources of the park. The park provides recreational activities including hiking, biking, camping, canoeing, fishing, and boating to visitors in addition to allowing them to experience the rich history, wildlife, and geologic resources of the canal.

The purpose of the park is to provide visitors the opportunity:

- to understand the canal's reason for being, its construction, its role in transportation, economic development and westward expansion, the way of life which evolved upon it, the history of the region through which it passes, and to gain an insight into the era of canal building in the country;
- to appreciate the setting in which it lies and the natural and human history that can be studied along its way; and
- to enjoy the recreational use of the canal, the parklands and the adjacent Potomac River (NPS 1976).

Chesapeake and Ohio Canal

During the late 1790s and early 1800s, more than 3,000 miles of canals were built throughout the United States to transport goods and supplies from coastal to inland areas and to aid in the migration of people heading west to settle beyond the original thirteen colonies. Construction of the C&O Canal began in 1828 when President John Quincy Adams broke ground for a canal that would stretch from Georgetown, Maryland to Pittsburgh, Pennsylvania to connect the Chesapeake Bay and the Ohio River. Irish, Dutch, and English immigrants worked long hours for little pay using primitive tools to dig the canal. Masons, stonecutters, carpenters, and blacksmiths were employed to create the engineering marvels along the canal. After 22 years of construction and $13 million to build, the canal was completed in 1850, but only extended to Cumberland, Maryland.

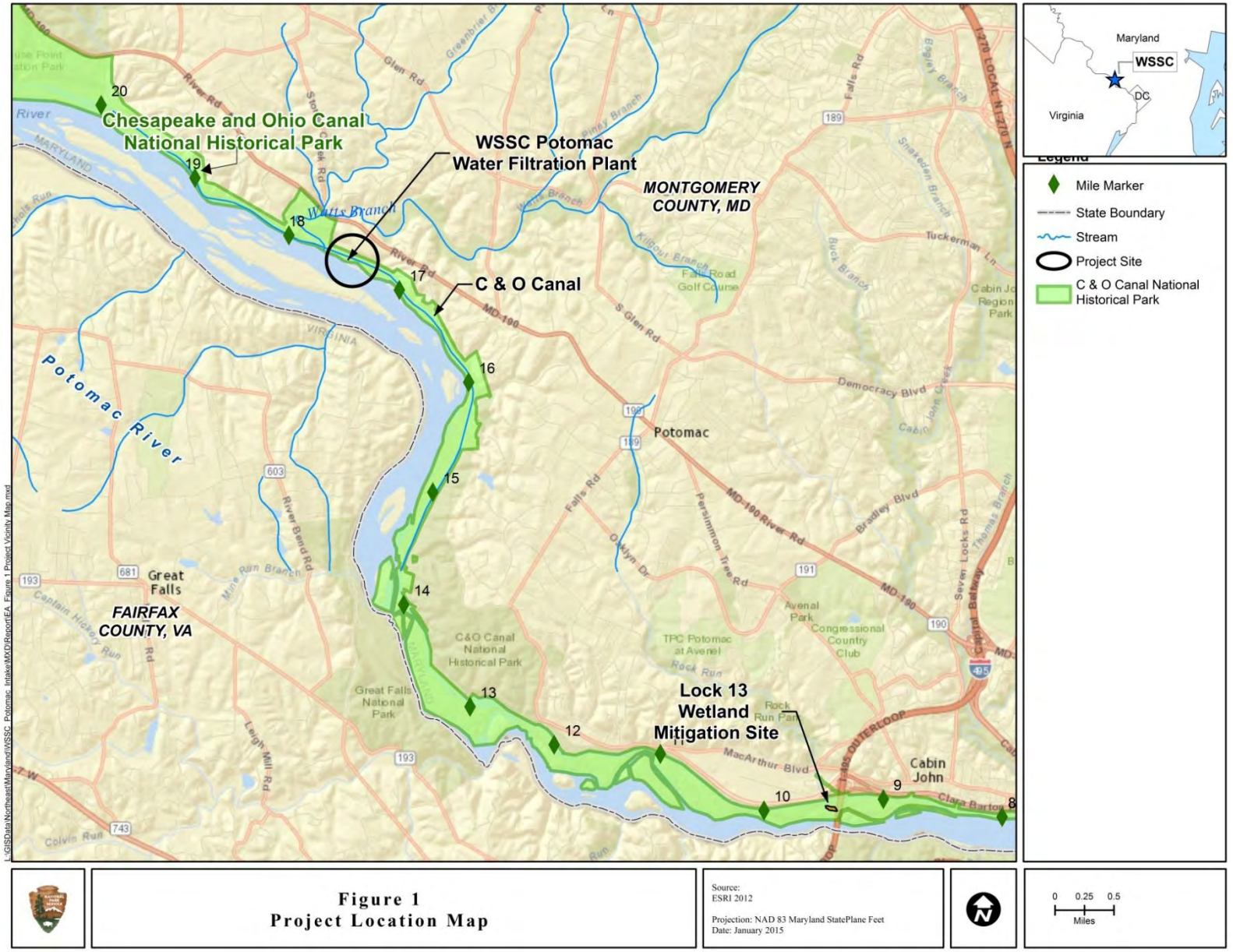


Figure 1
Project Location Map

The C&O Canal remained in operation for 96 years, from 1828 to 1924. Mules pulled boats along a 12-foot-wide towpath. The boats floated on average between 90 and 120 tons of cargo including hay, coal, hydraulic cement, fertilizer, and virtually any product that could be placed on a boat. Seven feeder dams were built on the Potomac River to supply water for the canal. To control the water, 74 lift locks were placed in the canal, which were typically 100 feet long and 15 feet wide. There were a variety of boats used on the canal over the years, but the typical freight boat that is commonly associated with the canal measured approximately 90 to 95 feet long and 14.5 feet wide and traveled at a speed of 2 to 3 miles per hour. The locks raised and lowered boats 8 feet, allowing them to travel both downstream and upstream. Flooding in 1924 finally led to the permanent closure of the canal.

PROJECT BACKGROUND

Potomac Water Filtration Plant

The Potomac WFP draws water directly from the Potomac River and can treat up to 285 million gallons of water each day. The Potomac WFP produces approximately three-quarters of the water used by approximately 1.8 million customers in Montgomery and Prince George's Counties, Maryland. The plant was originally built to treat 30 million gallons per day in 1961 but was enlarged in 1966 to 90 million gallons per day, and again in 1971 to 160 million gallons per day. Later improvements increased the plant treatment capacity to the current 285 million gallons per day. The existing intake structure, located on the canal above Swain's Lock, was built in 1982. The maximum capacity of this intake structure is 400 million gallons per day.

The main facilities that support the Potomac WFP include the existing intake, diversion weir, two raw water pumping stations, and six raw water intake conduits. The existing intake is located along the shoreline of the Potomac River opposite the Unnamed Island. Water flows through the existing intake by gravity through six conduits under the C&O Canal to the raw water pumping stations.

Water is withdrawn from the Potomac River by the existing intake structure and processed as follows:

1. Coagulation – This process adds chemicals (coagulants) to the water to condition the particles to combine and form floc. Floc formation makes the particles heavier for sedimentation. Acid may also be added to reduce the pH to improve the removal of natural organic matter by coagulation.
2. Sedimentation – After coagulation, the heavier floc particles that are formed are allowed to settle to the bottom of the basin. The clear water moves to the filtration process.
3. Filtration – During filtration, the water passes through granular media filters to remove remaining smaller particles.
4. Disinfection – The filtered water is exposed to ultraviolet lights and chlorinated to kill bacteria and microorganisms.
5. Storage – The treated water is transferred to large reservoirs to provide contact time for chlorine disinfection and also to provide storage for high water demand periods. Fluoride is added to the finished water to prevent tooth decay, and lime and orthophosphate are added to minimize corrosion and pinhole leaks in household plumbing. From there, the water is pumped to the distribution system for use by customers.

An access road to the existing intake extends from the south gate of the Potomac WFP and across the C&O Canal at the west side of the intake. The road divides into the upper access road that follows a

retaining wall and the intake access road that parallels the Potomac River and terminates at the WSSC monument. The intake access road is connected to the towpath via a foot path.

WSSC's Need for the Proposed Intake

WSSC's need for the proposed submerged channel intake is to provide a consistently higher quality raw water source than can be achieved using the existing onshore intake. Tributary inflows on the north bank of the Potomac River immediately upstream of the WFP intake have been identified as having a major impact on raw water quality and treatment plant operation. More specifically, Watts Branch enters the Potomac River approximately 0.25 miles upstream of the Potomac WFP intake. Seneca Creek enters the Potomac River approximately 5 miles upstream. Watts Branch, although smaller than Seneca Creek, has a greater impact on intake water quality because of its proximity. The impacts of Watts Branch are primarily during storms and were noted by plant operators as early as the 1970s. The Montgomery County Department of Environmental Protection (DEP), the City of Rockville, the Maryland Department of the Environment (MDE), and others have addressed, and continue to address, the water quality in Watts Branch and other tributaries upstream.

MDE and WSSC undertook a formal Source Water Assessment (SWA) in response to the 1996 Safe Drinking Water Act Amendments. The SWA, completed in 2002, was a comprehensive evaluation of the Potomac River watershed and included a number of findings and recommendations relative to providing high quality drinking water. The SWA specifically addressed the impact of Watts Branch and concluded:

> "*Watts Branch causes sudden negative changes in raw water quality and treatability at the Potomac WFP intake. Negative changes are characterized by sudden and extreme increases in suspended solids, fecal coliforms, as well as decreases in pH and alkalinity. The rapid changes in water quality make it challenging for the plant operational staff to accurately adjust coagulant dosage and pH to achieve optimum particle removal. These impacts are out of proportion with the upper watershed impacts relative to watershed size. A submerged channel intake (at a mid-channel location) would allow the Potomac WFP to effectively avoid these impacts."*

Based upon these conclusions and other supporting information, the SWA recommended that *"Serious consideration should be given to an upgraded intake structure with flexibility to withdraw water from a submerged mid-channel location.*"

In addition, the SWA concluded that "Flow control practices [at the treatment plant] are therefore expected to yield more immediate results than sediment runoff control practices (which are expected to take on the order of 60 years or more to yield full improvements)" (Becker and O'Melia 2002). Since the SWA was completed, efforts to reduce erosion and runoff in the watershed by the State of Maryland, Montgomery County, and the City of Rockville have not reduced the challenge of raw water treatability during storm events. These challenges remain essentially the same, confirming the SWA conclusion.

Operation of a submerged channel intake would reduce the frequency that Watts Branch adversely impacts raw water quality and, as a result, would reduce the number of occurrences of poor raw water quality, thereby reducing the amount of materials needed to treat the raw water. This would result in the following improvements in the WSSC's drinking water treatment process:

- Fewer contaminants in the raw water such as solids, chemicals and pathogens improving the effectiveness of the water treatment process
- Fewer solids, chemicals and pathogens removed from the raw water, subsequently requiring treatment and disposal
- Fewer purchased chemicals required to treat the raw water
- More consistent raw water quality improving the efficiency and reliability of the treatment process
- Reduced exposure to near-shore intake obstructions such as leaves, grass and ice improving the reliability of the raw water supply

The proposed project would not increase the volume of water withdrawals from the river, but would provide higher quality source water from an alternate location. The current shoreline intake has a greater withdrawal capacity than that for which WSSC is permitted. The proposed submerged channel intake would have the same design capacity as the existing intake. Water consumption has been static over the last 30 years and WSSC expects this trend to continue. The construction of the submerged intake would be a major undertaking, and the intake has been designed for long-term use. The proposed intake accommodates future requirements, and reduces the likelihood of future construction in the river. If WSSC were to require additional water withdrawals in the future, a new permit would be required.

Previous Planning, Studies, Reports, and Surveys

C&O Canal NHP General Plan - In 1976, NPS published the General Plan for the park. Within the plan, the C&O Canal area within the vicinity of the Potomac WFP was identified as Zone A, a National Interpretive Center Zone. This zone identifies sections of the park containing major historic restoration opportunities where visitors would be able to observe a functioning canal in a historic setting. This zone is accessible to visitors and provides available parklands for development of visitor facilities with the compatibility of the surrounding environment outside the park. The interpretive centers have the ability to support the largest density of visitor use.

Feasibility Study (2005) and Draft EA for the WSSC Offshore Submerged Channel Intake - Planning for this project began in early 2000. A feasibility study entitled *Alternative Development and Evaluation Criteria, Washington Suburban Sanitary Commission Potomac WFP Submerged Channel Intake Feasibility Study* was prepared in 2005 (MWH Americas and EAEST 2005). The study evaluated the benefits and impacts of a new submerged offshore channel intake at the Potomac WFP. A draft EA for this project was initiated in 2004, but completion was delayed and resulted in the need to perform additional analyses in the form of a sand study and an evaluation of a new intake location. The net result was the passage of a substantial amount of time since the development of the feasibility study and draft EA.

Phase I Archeological Resources Survey, WSSC Potomac River Submerged Intake Tunneling/Trenching Alternatives and Parking Area, Montgomery County, Maryland – This report summarized the findings of the Phase I archeological 2005 survey in the undisturbed portion of the project site. The investigation identified site 18MO633 on the T-1 terrace south of the canal prism. (Cheek et al. 2007).

In addition, many studies were conducted to support the early planning and include:

- Water quality studies performed offshore of the Potomac WFP between the existing intake and Watkins Island. The results of these studies are presented in Existing Conditions and Data Report (MWH 2004).
- Poto*mac River SWA for Maryland Plants: WSSC Potomac WFP* report (Becker and O'Melia 2002).
- Bathymetry survey performed in August and September 2004 (EAEST, unpublished data 2004).
- Geotechnical Investigation conducted in 2005 (MWH 2007).
- Submerged aquatic vegetation (SAV) surveys conducted in the Potomac River in August and September 2005 (EAEST 2005a).
- Freshwater mussel survey conducted in the Potomac River in July 2005 (EAEST 2005b).
- Wetland delineation survey performed in February 2005 in three areas adjacent to the WSSC Potomac WFP proposed for geotechnical drilling (EAEST 2005c).
- Phase I archeological survey conducted in 2005 in the undisturbed portion of the project site, west of the existing intake where prior construction had not occurred (Cheek et al. 2007).

Current Studies, Reports, and Surveys

Feasibility Study (2013) and Draft EA for the WSSC Offshore Submerged Channel Intake - A second feasibility study that included identification of a new intake location, alternatives development, and evaluation process for the proposed offshore submerged channel intake at the Potomac WFP was conducted by Black and Veatch in late 2013. These alternatives are described and the environmental consequences of the alternatives have been evaluated in this EA.

Phase II Archeological Evaluation of Sites 18MO633 and 18MO719, C&O Canal National Historical Park, Montgomery County, Maryland - Since Site 18MO633 was identified by Cheek et al. (2007) during the Phase I survey of the project area and site 18MO719 through limited archeological testing in 2013, a Phase II evaluation of these sites was recommended based on identification of the potentially intact buried surfaces with a high probability of containing undisturbed archeological deposits. This report (Klein et al. 2015) summarizes the results of the phase II evaluation at the project site.

Resource Surveys

- Three seasonal rare plant species surveys were conducted in the project area in the spring (June 10, 2013), summer (August 27, 2013), and fall (September 26, 2013) (EAEST 2013a).
- Additional surveys for floating paspalum (*Paspalum fluitans*) were conducted in September 2014 to determine the extent of the species along the Potomac River in the vicinity of the project area (EAEST 2014a).
- A qualitative mussel survey was conducted in the Potomac River in the project area on August 27-28, 2013 (EAEST 2013b).
- Two SAV surveys were conducted in the project area - one survey occurred in early summer (July 2, 2013) and the second survey occurred in late summer (September 3, 2013) (EAEST 2013c).

- A wetland delineation was conducted in the project area in November 2013 (PEER Consultants 2013).
- A Forest Stand Delineation (FSD) was conducted in October 2014 to identify, delineate, and characterize forest stands in the project area (EAEST 2014b).
- A limited archeological survey was conducted in 2013, and a Phase II Archeological Evaluation of sites 18MO633 and 18MO719 was completed during the spring and summer of 2014 (Klein et al. 2015).

SCOPING PROCESS AND PUBLIC PARTICIPATION

Internal scoping defines issues, alternatives, and data needs for the potential action. On May 6, 2013, a formal project kick off meeting was initiated with the interdisciplinary team (staff members of NPS, WSSC, and design and NEPA contractors. At this meeting, the team discussed the proposed project and project milestones.

In accordance with NPS guidelines for implementing NEPA and NHPA, external scoping, the process used to gather public input, was conducted. NPS released a project scoping newsletter on July 19, 2013 describing the proposed project (appendix A). Additionally, a public scoping meeting was held on August 1, 2013 to give the public the opportunity to join project staff to learn about the proposed project. The public scoping period lasted a total of 30 days. During this time, the public was invited to identify any issues or concerns they may have with the proposed project so that the NPS could appropriately consider them in this EA. One correspondence was received during the public comment period that focused on potential sources of funding and cooperation activities to clean up the Potomac River.

Scoping includes consultation with any interested agency, or any agency with jurisdiction by law or expertise. Consultation letters were mailed to local and federal agencies on December 10, 2013 requesting consultation and comments regarding the proposed project at WSSC. One response was received from the U.S. Fish and Wildlife Service (USFWS) on January 15, 2014. The USFWS stated in the letter that no federally proposed or listed endangered or threatened species are known to exist within the project impact area and thus no Biological Assessment or further Section 7 Consultation with the USFWS is required. Consultation was again conducted with the USFWS on the recently federally listed northern long-eared bat. The USFWS has determined in a response letter on August 5, 2015 that the proposed submerged channel intake project will "*not likely to adversely affect*" the northern long-eared bat given that vegetation clearing will not occur between April 15 and August 30. Copies of the consultation letters and responses to the letters are located in appendix B. In addition, two Policy Review Group meetings (June 1, 2013 and October 22, 2013) were held with federal, state, and local agencies.

ISSUES AND IMPACT TOPICS

Issues can be defined as the relationship between the proposed action and the human, physical, and natural environment (NPS 2001). Issues are used to define which environmental resources may experience either negative or beneficial consequences from an action. They do not predict the degree or intensity of potential consequences that might result from an action. Issues are usually problems caused by the no-action alternative or other alternatives, but may be other questions, concerns, or problems.

As a result of internal scoping efforts with NPS and WSSC, issues were identified that would require further analysis. Issues are problems, opportunities, and concerns regarding the construction, operation, and maintenance of the proposed submerged channel intake within the C&O Canal NHP. Issues identified from internal scoping were either resolved or have been incorporated into the impact analysis

"Environmental Consequences" section of this EA. Only one comment was received during the public comment scoping period. It included concerns with potential sources of funding and cooperation activities to clean up the Potomac River. The following issues were identified during internal scoping:

- Visitor safety during construction
- Adverse impacts (e.g., aesthetics, noise) to visitor experience during construction
- Long-term visual impacts to visitor experience
- Minimize impacts to vegetation and wildlife habitat
- Concern for impacts to canal prism and towpath from construction
- Impacts to archeology sites
- Water needs to continue to flow through the canal during construction
- Impacts to rare, threatened, and endangered species
- Surveys (e.g., wetlands, rare plants, mussels, SAV) are old and need to be redone
- Ownership of Unnamed Island
- Land exchange for a perpetual easement for proposed and current WSSC facilities located on NPS lands; existing WSSC facilities have no easement or current right-of-way (ROW)
- Impact mitigation fund for impacts to visitor experience and natural resources

Impact topics were used to define and focus the discussion of resources that could be affected by the alternatives, and are the focus in the evaluation of the potential environmental consequences of the alternatives. Potential impact topics were identified based on legislative requirements, Executive Orders, topics in Director's Order 12 and Handbook (NPS 2001), NPS Management Policies 2006 (NPS 2006), guidance from NPS, input from other agencies, public concerns, and resource information specific to the park. The interdisciplinary team discussed each resource topic and how the proposed project would either benefit or adversely impact the resource. In general, if negligible impacts would result from the proposed project, the impact topic was dismissed from further analysis. A summary of impact topics analyzed is provided below, along with the rationale for their inclusion or dismissal.

Impact Topics Included in This Document

The following impact topics have the potential to be affected by the proposed action and are evaluated in detail in this EA.

Geology and Soils - The excavation of soils/bedrock and soil disturbance during construction of the potential action would have implications for soils and geologic resources

Water Resources (Water Quality) - The construction adjacent to and within the Potomac River may potentially impact the water quality of the Potomac River.

Wetlands - Wetlands are expected to be impacted since wetland areas have been identified at the project site through delineation surveys and National Wetland Inventory maps. NPS has adopted a policy of "no net loss of wetlands" and Director's Order 77-1: *Wetland Protection* states that for new actions where impacts on wetlands cannot be avoided, proposals must include plans for compensatory mitigation that restores wetlands on NPS lands, where possible, at a minimum acreage ratio of 1:1.

Floodplains - Floodplains are expected to be impacted since the project site is located within the Potomac River floodplain. Director's Order 77-2: *Floodplain Management* states that floodplain management will provide for the protection and preservation of floodplain functions and natural resources, and will avoid environmental effects (both long-term and short-term) of use and alteration of floodplains, including development that could adversely affect the functions and/or resources of floodplains and increase the risk of flooding. In addition, NPS policy recommends restoration of affected natural floodplain functions where possible.

Aquatic and Terrestrial Vegetation - Vegetation removal is expected and wildlife habitat at the site would be disturbed during construction activities.

Aquatic and Terrestrial Wildlife - Aquatic (Potomac River and C&O Canal) and terrestrial species are expected to be impacted during construction of the project.

Special-Status Species - Protected species may occur in the area of the Potomac WFP and may be affected by the project.

Scenic Resources (Aesthetics and Viewsheds) - The proposed project is expected to impact the scenic resources of the C&O Canal NHP.

Cultural Resources - Portions of the proposed action occur within the C&O Canal NHP, which is a nationally significant historic site listed in the National Register of Historic Places (NRHP); therefore, adverse effects may occur to cultural resources. In addition, archeological sites 18MO633 and 18MO719 are located in the proposed project area.

Visitor Use and Experience - The proposed action may cause temporary and permanent impacts on users of the towpath, C&O Canal, and Potomac River for recreational activities.

Human Health and Safety - Construction activities in the park may pose safety concerns to visitors.

Land Use - A land exchange between the NPS and WSSC may occur. WSSC is planning to purchase and provide land to the NPS in exchange for a perpetual easement for the existing and proposed intake facilities.

Impact Topics Dismissed from Further Analysis

A summary of impact topics dismissed from analysis is provided below, along with the rationale for the dismissal.

Air Quality – The Federal Clean Air Act (CAA) requires federal agencies to comply with existing federal, state, and local air pollution control laws and regulations. The U.S. Environmental Protection Agency (USEPA) is required to set primary National Ambient Air Quality Standards (NAAQS) under the CAA for air pollutants that create public health risks. NAAQS currently exist for the following six criteria pollutants: carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter with size less than 2.5 and 10 μm ($PM_{2.5}$ and PM_{10}), nitrogen oxides (NO_X), ozone, and lead.

The CAA and Amendments of 1990 define a nonattainment area as a locality where pollution levels persistently exceed NAAQS or a locality that contributes to ambient air quality in a nearby area that fails to meet standards. The Potomac WFP is located in Montgomery County, which is part of the Washington, DC – Maryland – Virginia Air Quality Control Region (AQCR). This region is classified as marginal nonattainment area for the 2008 8-hour ozone standard and is within the ozone transport region, and is

classified as nonattainment for the 1997 $PM_{2.5}$ standard. Since the designations for $PM_{2.5}$ were published in 2005, this AQCR's $PM_{2.5}$ air quality has improved, and USEPA has been petitioned to redesignate the Washington DC-Maryland-Virginia 1997 $PM_{2.5}$ nonattainment area to attainment for this standard. The region is in attainment for other criteria pollutants.

Construction of the proposed alternatives would generate air emissions from the operation of construction equipment. It is considered a "Federal Action" subject to the provisions of General Conformity [40 Code of Federal Regulations (CFR) Part 93 Subpart B], and the applicability determination was performed and can be found in appendix C. The impacts on air quality from construction of the proposed submerged intake structure would be similar under the three different action alternatives. While the methods of construction would be different, the differences between alternatives would be imperceptible. During construction activities, the action alternatives would have negligible adverse impacts for all criteria pollutants and no significant impacts from greenhouse gas (GHG) emissions during construction activities. Operation of the submerged intake would have no impacts on air quality, as there would be no change in operating air emissions after construction is complete.

Climate Change - There is strong evidence linking global climate change to human activities, especially GHG emissions associated with the burning of fossil fuels (IPCC 2007). The project would have air quality impacts associated with the construction of the new intake; however, there would be negligible adverse impacts for all criteria pollutants and no-significant impacts from GHG emissions for the construction phase of the project. Since GHG emissions associated with the project would be negligible, the issue of the contribution of project activities to climate change through GHG emissions was dismissed from further analysis. After construction, the withdrawal capacity would not increase; therefore, no fossil fuel consumption is associated with the project in the long term and the operational impact on climate change would not change from current conditions.

Topography - The natural topography of the project site has been altered as a result of construction projects at the Potomac WFP. The existing raw water intake and the intake access road are located south of the C&O Canal at the Potomac River which has an approximate normal water level of 160 feet above mean sea level (MSL). The invert of the intake is at approximately 152 feet above MSL. The area between the intake and the C&O Canal was re-graded during construction. The area immediately surrounding the existing intake was raised to 176 feet above MSL. The area to the north, between the access road and the C&O Canal, was graded to approximately 190 feet above MSL. A wall was constructed immediately to the north of the intake access road to retain the fill. The upper access road is located on the fill at 190 feet above MSL to the north of the retaining wall. The maximum recorded water surface level at the Potomac WFP is 188 feet above MSL, approximately 28 feet above the normal water level. Any changes to topography during construction would be mitigated by restoring elevations to pre-construction conditions.

Hydrology - The proposed project is located within the Potomac River Montgomery County Watershed (Hydrologic Unit Code 02140202). This watershed is included as a portion of the Middle Potomac River Basin that drains approximately 610 square miles in Montgomery and Prince George's Counties, Maryland. Portions of Maryland, Pennsylvania, West Virginia, and Virginia drain into the Potomac River. Major tributaries of the river include the North Branch Potomac River, the South Branch Potomac River, the Shenandoah River, and the Monocacy River. The Potomac River Montgomery County Watershed, which is located predominately in Montgomery County, Maryland, covers 89,617 acres. Small portions also extend into Frederick County, Maryland (448 acres) and Washington, D.C. (1,369 acres) (MDE 2011). The watershed encompasses numerous sub-watersheds including Little Monocacy River, Broad Run, Horsepen Branch, Muddy Branch, Watts Branch, and Piney Branch (MDE 2011). The eastern portion of the watershed contains highly urbanized areas of old and newly developed suburban

neighborhoods. The western portion of the watershed contains areas of agriculture and rural pastures, with scattered forested parklands throughout the watershed.

During construction, the flow velocity of the Potomac River at the project site would be slightly altered as a result of using a cofferdam for the construction of the new intake, intake shaft, boat ramp, and intake tunnel. However, utilization of cofferdams would be temporary and localized and no long term changes to the hydrology of the Potomac River are expected from the proposed project. Additionally, there would be no change in the quantity of water withdrawn.

Groundwater **-** In the project area, the general groundwater flow is toward the Potomac River. In 2005, boreholes were drilled in the project area and groundwater was found at approximately 166 feet above MSL near the raw water pumping stations and approximately 160 feet above MSL near the river. The normal Potomac River level is approximately 160 feet above MSL. Groundwater levels are also likely to be influenced by the water level in the C&O Canal, approximately 100 feet north of the Potomac River. The C&O Canal is approximately 173 feet above MSL.

Approximately 80,000 residents in Montgomery County rely on groundwater as their only source of water, with approximately 50,000 individual wells in use. According to the Maryland Geological Survey and the Department of Permitting Services, the County's groundwater is generally of good quality with fairly reliable flow rates (Montgomery County Planning Department 2009). Groundwater is also used in the county for industrial uses, irrigation, and agricultural uses.

Both trenching and tunneling alternatives would result in excavation of rock and soil below the groundwater level, resulting in the seepage of some groundwater into the trench and/or tunnels. This seepage could locally reduce groundwater levels in the area of the trench or tunnel. However, geotechnical investigations of the rock strata indicate that these quantities of seepage would be small and the impact on groundwater levels would also be confined to the area immediately adjacent to the trench or tunnel. Seepage through the soil between the river and the trench or tunnel would maintain the groundwater levels outside of the construction area at current levels. Following completion of construction, the trenched tunnel conduit would be filled with permeable bedding material and the pipe, and the tunneled conduit would be filled with river water. There would be no further potential for seepage of groundwater into an excavated area. Therefore, there would be no impacts on groundwater levels or groundwater flow during project operation in the long-term. Groundwater recharge areas are essentially the soils above the bedrock, and these would be restored with soil material taken from the excavation. There would be no net change in groundwater flow or recharge; therefore, this topic was dismissed from further consideration.

Scenic and Wild River - The project site is within the portion of the Potomac River that is designated as a Scenic and Wild River in Maryland. The State of Maryland created the Scenic and Wild Rivers System by an Act of the General Assembly in 1968. In passing the Act, the State recognized that many rivers of Maryland or portions of them and their related land areas possess outstanding scenic, geologic, ecologic, historic, recreational, agricultural, fish, wildlife, cultural and other similar resources values (MDNR 2014). 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 (MDNR 2014). None of the alternatives would affect the designation of the Potomac River as Scenic and Wild.

Environmental Justice **-** Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" requires each federal agency to make achieving environmental justice part of its mission. Specifically, each agency must identify and address

"disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." The intent is to prevent minority and low-income populations from being disproportionately affected by adverse human health and environmental impacts of federal actions. The minority population is defined as the non-white and multi-racial population of a given area and includes African-American, Asian, American Indian, Native Alaskan, Native Hawaiian, Pacific Islander, persons reporting some other race, and persons reporting two or more races.

According to the 2010 demographic profile for Travilah, Maryland, Montgomery County, Maryland, and the State of Maryland, minorities comprise 23.2%, 35.5%, and 38.3%, respectively (U.S. Census Bureau 2013). The percentage of individuals living below poverty level within Travilah, Maryland is 3.7%, which is lower than the county (6.3%) and state (9%) poverty levels. Based on the 2009-2013 estimates, the median household income was $205,268; also greater than the county ($98,221) and state ($73,538) median house hold incomes (U.S. Census Bureau 2015a, b). Therefore, minority and low-income characteristics apply to a small percentage of the individuals residing in the immediate vicinity of the project. None of the alternatives (including the no-action alternative) are expected to result in disproportionate impacts on minority populations; therefore this topic was dismissed.

Transportation and Traffic **–** Maryland State Highway Administration's (SHA) Traffic Monitoring Program is responsible for the collection, processing, analysis, summarization, and dissemination of Maryland highway traffic data and is supported by a comprehensive, user friendly, management information computer database system. The program provides documentation of the sources, methodologies and procedures used to collect, validate; calculate and apply adjustment, axle-correction, and growth factors; and calculate Annual Average Daily Traffic (AADT) counts. AADT counts and Annual Average Weekday Traffic (AAWDT) by road segments in Maryland (SHA 2014) was used to determine vehicle traffic in the project area. According to Maryland SHA data, the AADT vehicle count on River Road (Travilah Road to MD 189/Falls Road) is 15,240 and the AAWDT is 16,460 (3.7% are trucks), which is approximately 609 trucks on a weekday.

Excavation required for shafts and trenches and blasting for tunnels would generate soil and rock that needs to be removed from the project site. Additionally, the project would require delivery of construction materials to the project site, such as concrete, steel, lagging, stone, pipes, valves, and any other materials required for construction. Construction truck hauling to and from the site for the transport of soil/rock and construction materials regardless of the alternative would range from 5 – 15 trucks/day for a 5-day week for 2 years and takes into account any peak times when other construction materials may need to be delivered to the project site such as materials to construct the intake, junction box, and piping. Based on the Maryland SHA's AAWDT count of 16,460 vehicles, the construction vehicle traffic which includes transport of soil/rock from the site and delivery of construction materials to the site for the project would only add a range of 1 – 2.5% to the combined daily average of truck traffic in the project area. Therefore, during construction, the impacts on the local community traffic from any of the action alternatives would be adverse and short-term. Operation impacts would be negligible for all alternatives since maintenance activities for the offshore intake only occur occasionally. Because the impacts on traffic from construction and operation of the proposed submerged intake would be similar under the action alternatives and the impacts are small, this topic was dismissed from analysis.

Park Operations **–** NPS is responsible for maintaining the entire length of the C&O Canal NHP, approximately 19,586 acres of parkland. The park has designated access points to use for maintenance, law enforcement, river rescue, emergency medical, interpretive rangers, and other support staff. There are approximately 93 park personnel for the entirety of the C&O Canal NHP. Staff members include park rangers, law enforcement, historians, biologists, maintenance workers, volunteer coordinators, and

resource managers. Park personnel oversee a range of duties and responsibilities in the park, including maintenance work, law enforcement, resource management, and interpretation programs.

The impacts on park operations from construction and operation of the proposed submerged intake would be similar under the action alternatives; these impacts would be temporary and minor, as they would occur during the construction phase of the project. Construction activities would affect park personnel in that they would be involved with oversight of construction, planning and monitoring efforts, management of contractors, communication with visitors, and monitoring during blasting operations. No impacts are expected to boat operations on the C&O Canal downstream of the project site since temporary culverts would be created to maintain flow in the canal during construction. Additionally, no impacts on park operations are anticipated once the new submerged water intake is in operation. Park staff's workload would remain unchanged. Since this is not a park project and because the impacts on park operations would be temporary and minor, this topic was dismissed.

ALTERNATIVES

INTRODUCTION

This chapter describes alternatives for the proposed action to construct an offshore submerged channel intake for water supply at the Potomac WFP. Included is a description of the alternatives along with elements common to all action alternatives. The remainder of the chapter addresses the following: construction staging, mitigation measures of the action alternatives, alternatives considered but dismissed, and the environmentally preferable alternative.

NEPA requires that federal agencies explore a range of reasonable alternatives and provide an analysis of impacts the alternatives could have on the natural and human environment. The "Environmental Consequences" chapter presents the results of the impacts analyses.

Four alternatives are analyzed in this EA, including a no-action alternative. Under the no-action alternative, the existing operations at the Potomac WFP would continue, and no alterations would be made to the Potomac WFP, the C&O Canal NHP structures, or the Potomac River. Three action alternatives were developed and subsequently evaluated and determined to be technically feasible.

DESCRIPTION OF THE ALTERNATIVES

This section provides a detailed description of the alternatives that have been considered for the proposed action. Following the descriptions of the alternatives, a detailed comparison of project elements included in each alternative is presented in a table. Below are the definitions of some of the terms that are used in the descriptions of the alternatives.

Intake – the location of a structure at which raw water from the river is taken.

Intake Shaft – location of deep excavation upon which the intake structures would be built and within which vertical conduits connecting to the proposed intakes structures would be installed.

Onshore Shaft – location of deep excavation within which the junction vault structure would be built, located between the intake shaft and the existing intake conduits.

Intake Tunnel – horizontally excavated areas within which intake conduits would be installed.

Intake Trench – open trench (within a cofferdam when in the river) within which the intake conduits would be installed.

Intake Conduits – piping installed within an intake tunnel or an intake trench to convey raw water flow. Proposed intake conduits would be 96-inch steel pipe, and existing intake conduits that they would be connected to are 72-inch concrete pipe.

Junction Vault or Gate Structure – within the onshore shaft, which would house the sluice gates that are used for flow control.

Sluice Gates – mechanically-controlled devices installed within the junction vault that are used to control direction of flow, depending on the open or closed position of the gates.

Cofferdam or Embankment – a watertight barrier constructed within a watercourse (river, channel, or canal) and pumped dry so that construction within the barriers can proceed under dewatered site conditions. Where water passage through an embankment must be maintained, temporary piping would be installed.

Many of the elements including the new intake and intake shaft location, intake conduit types, cofferdams, permanent access road/boat ramp/parking area location, and connection to existing conduits are the same for each of the alternatives. However, the horizontal alignment of the new conduit, junction vault/onshore shaft location, and construction methods and sequencing vary between the alternatives. While the descriptions presented here include approximate dimensions for many of the elements, it is important to note that detailed design has not yet occurred, and there may be small changes in actual dimensions from those presented in this EA. Each alternative includes a construction area limit (limit of disturbance), which would not change during the detailed design.

ALTERNATIVE 1: NO-ACTION ALTERNATIVE

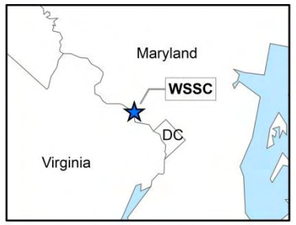
The no-action alternative is required under NEPA to compare feasible alternatives to existing conditions. Under the no-action alternative, the existing operations at the Potomac WFP would continue, and no alterations would be made to the Potomac WFP, the C&O Canal NHP structures, or the Potomac River.

The Potomac WFP draws water directly from the Potomac River and can treat up to 285 million gallons of water each day. The main facilities that support the Potomac WFP include the existing intake, diversion weir, two raw water pumping stations, and six raw water intake conduits. The existing intake is located along the shoreline of the Potomac River opposite the Unnamed Island. The diversion weir is located at the eastern end of the structure and creates a pond from which the intake draws. Water flows through the existing intake by gravity through six conduits under the C&O Canal to the raw water pumping stations. Current average and maximum day production rates are approximately 130 and 200 million gallons of water per day, respectively; however, the existing intake structure has a maximum capacity of 400 million gallons per day.

An access road to the existing intake extends from the south gate of the Potomac WFP and across the C&O Canal at the west side of the intake. The road divides into the upper access road that follows a retaining wall and the intake access road that parallels the Potomac River and terminates at the WSSC monument. The intake access road is connected to the towpath via a foot path.

The C&O Canal, operated by the NPS, runs between the intake and the pumping stations. The C&O Canal is a historic man-made structure that is the focus of the C&O Canal NHP. This is generally a linear park that occupies the north bank of the Potomac River and extends from Cumberland, MD downstream into the District of Columbia. The towpath along the canal is a popular area for hiking and the canal itself can be navigated by small nonmotorized recreational watercraft. Within the Potomac WFP site, the canal itself is a dish or trapezoidal shaped section approximately 5 ft deep at the center and approximately 60 feet wide. An approximately 10 feet wide towpath is located on the south bank of the canal. The towpath is connected to the intake access road at the WSSC interpretive monument at the east end of the intake. The canal property extends from approximately 20 feet north of the northern canal bank to the river and includes the property on which the intake is constructed.

Because the existing intake structure would remain in the same location, the tributary runoff on the north bank of the Potomac River would continue to have an impact on the raw water quality and treatment plant operations. The raw water entering the water treatment process following storm or high flow event would continue to contain increased levels of solids, chemicals, and pathogens and require higher quantities of chemicals to treat raw water during these high flow events. Figure 2 depicts the no-action alternative.



Legend

Land Parcels by Owner

- NPS
- State of Maryland
- WSSC

G:\Statewide\Local\Northeast\Maryland\WSSC_Potomac_Intake\MXD\Report\EA_Figure 2 Alternative 1 No Action.mxd

Figure 2
Alternative 1 No-Action

Source:
Black & Veatch 2013
ESRI 2012

Projection: NAD 83 Maryland StatePlane Feet
Date: January 2015

0 100 200
Feet

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COMMON TO ALL ACTION ALTERNATIVES

The construction of a new submerged channel intake is proposed under all the action alternatives. An offshore intake would improve the quality of the raw water for the Potomac WFP; however, the quality of the water supplied to the public would not change. The proposed project would not increase water withdrawals from the river, but would provide higher quality source water from an alternate location. The current shoreline intake has a greater withdrawal capacity than that for which WSSC is permitted. Likewise, the proposed submerged channel intake would have the capacity for greater withdrawals than the current permit allows. Water consumption has been static over the last 30 years, and WSSC has no reason to expect this to change. Current average and maximum day production rates are approximately 130 and 200 million gallons of water per day, respectively; the submerged intake was designed for an ultimate or future peak flow capacity of 400 million gallons per day. The construction of the submerged intake would be a major undertaking, and the intake has been designed for long-term use. A larger intake accommodates future requirements, reducing the likelihood of future construction in the river. A new permit would be required before WSSC could increase water withdrawals from the Potomac River. The project would include the following elements, regardless of the action alternative chosen.

Construction Area Limits (Limits of Disturbance)

The construction area limits or the limits of disturbance are depicted for each alternative (figures 3, 4, and 5). While the actual construction area limits vary slightly among the alternatives (8.7 – 9.1 acres), the treatment remains the same. Figure 6 presents the construction area limits of the three action alternatives, for comparison. The individual elements (e.g., temporary and permanent roads, cofferdams, embankments) would essentially be as depicted for each alternative. Location and exact dimensions may shift slightly as design progresses, but all construction activity would occur within the construction area limits, and significant changes in location or dimension are not anticipated. For the impact analysis, it is assumed that all areas within the depicted construction area limits could be affected by construction. The construction area limits for the project were designed to avoid and minimize impacts to natural resources. One of the goals of construction is to leave the existing habitat as close to natural and undisturbed as possible by constructing the project in the smallest footprint feasible.

Intake Shaft (underground)

- River intakes and the intake shaft would be constructed southwest of the existing intake facility (figures 3, 4, and 5). River intakes would be comprised of three separate structures in a side-by-side configuration at the top of the intake shaft and above the river bottom, sized for a water inflow velocity of 0.5 feet per second. Intake structures would be connected to three corresponding separate 96-inch-diameter intake conduits, constructed within the intake shafts and tunnels/trench. Construction of the intake shaft would be done using the drill and blast method.
- The intake shaft would be used to construct the river intakes and connect them to either tunneled or trenched intake conduits.
- The location of the intake shaft would be approximately 100-feet offshore of the west end of Unnamed Island.
- The intake shaft is estimated to be 80 feet in diameter and approximately 50-feet deep in partially excavated rock for the tunneling alternatives and 40-feet deep in the trenching option.
- For all alternatives, three small shafts – one down to each of the connections between a new 8-foot intake conduit and two existing 6-foot intake conduits with 6 x 8 foot diameter steel pipe tee fittings – will be constructed.

Onshore Shaft/Junction Vault

- A new onshore shaft would be constructed west of the existing intake facility for alternatives 2 and 3 (figures 3 and 4) and east of the existing intake facility for alternative 4 (figure 5).
- The onshore shaft would be used as the main access point during tunneling operations. When tunneling operations are completed, a permanent junction vault structure would then be constructed within the shaft. The gate structure would include sluice gates used to control flow to the existing piping connections and provide operational flexibility for the Potomac WFP. The junction vault will be located primarily underground with a 16 x 52 foot at grade rectangular structure containing three 12 x 12 foot chambers with at grade, removable slabs for maintenance access to the sluice gates. Each chamber will have an above grade sluice gate operator protruding approximately 3 feet above grade.

Cofferdam (Intake Shaft)

- A temporary cofferdam would be constructed to provide a "dry" working area for construction of the intake shaft and possibly to sculpt the river bottom upstream of the intake to provide optimal flow conditions to the intake. The need for and extent of this sculpting will be determined in detailed design through additional hydraulic modeling, geotechnical investigations, and bathymetry. The cofferdam would extend approximately 150 feet into the river and 200 feet across in an oval shape (figures 3, 4, and 5).
- Each side of the cofferdam cross section would include a dam-type backfill area using select material placed at 2:1 side slopes from a bottom elevation of 152 feet (corresponding approximately to river bottom) to a top of dam elevation of 175 feet. The dimensions of each side of the dam would be 23 feet high and 104 feet wide at the base. The top section would be 12 feet wide, and would serve as a temporary road for construction access. The two sides of the dam would be separated by approximately 230 feet from each other's toe to provide sufficient area to lay back trenches or to work on the intake shaft at the River. The overall width of the dams plus the piping would be approximately 400 feet.

Boat Ramp and Permanent Access Road

- A new permanent access road, boat ramp and parking area would be constructed west of the existing intake facility (figures 3, 4, and 5).
- A temporary cofferdam would be constructed around the boat ramp location to provide a "dry" working area (figures 3, 4, and 5).
- The parking area would be sized to accommodate a truck and trailer and up to three additional parking spaces for other vehicles. It would accommodate parking and maneuvering of the vehicles, as well as other equipment necessary to maintain the offshore intake. None of the equipment would be stored on the parking area. Maintenance of the offshore intake could include launching of a small barge to collect debris and deposits around the intake. The barge-hauling truck and trailer would park in the parking area while debris collection is made. The parking area could also hold a dump truck during cleaning operations to remove the debris/deposits from the site. Cleaning/Maintenance is estimated to be needed every two years or more. Between maintenance visits, no vehicle use, besides emergency vehicles, is anticipated at the boat ramp/parking area.
- Pervious materials would be used for the surface of the parking area and the portion of the boat ramp that is upland and not subject to frequent inundation.

- A permanent road would be located off of the existing intake facility access road to the location of the new boat ramp and parking area (figures 3, 4, and 5). This road will also provide access for maintenance of the junction vault. A locked security gate would be constructed restricting access from the existing intake access road to the permanent access road that leads to the junction vault and boat ramp.

Temporary Access Road and Embankment

- A temporary access road would be constructed to allow access from Potomac WFP property to construction areas (figures 3, 4, and 5). The road would provide construction access to the intake shaft on the west end of Unnamed Island and to the existing raw water conduits. The temporary access road follows the same route from the Potomac WFP property in the north to just east of the existing intake for all three alternatives. The remaining route that differs amongst the alternatives is described under each alternative. One embankment would be constructed across the C&O Canal for the temporary access road (figures 3, 4, and 5). The embankment is needed to cross the C&O Canal because the types of construction equipment required for the project would likely exceed the rated loading capacity (20 tons) of the existing bridge crossing.
- A second embankment would be constructed across the channel between Unnamed Island and the shoreline just east of the existing intake to support the construction access road.
- A protective landscape fabric barrier would be installed between the towpath and the fill and between the canal prism and the fill to protect the structural integrity of these resources where the road crosses.
- Visitor use of the towpath would be accommodated by constructing ramps on either side of the access road. The ramps would allow walkers, cyclists, strollers and wheelchair users to cross the access road as they traverse the towpath.
- Safety personnel and signs would be used to protect visitors (see health and safety section).

Public Protection Controls

- Visitors would be excluded from all construction areas by the use of construction fencing around the perimeter of the project, and if appropriate, by the use of guards. A flagger would control towpath traffic during blasting and drilling and when construction vehicles cross the towpath.
- During construction of the embankment, temporary access roads, and the cofferdams, the C&O Canal, towpath, and portions of the Potomac River would be temporarily closed to visitors; however, detours would be provided to avoid having visitors within close proximity to the construction zone.
- Signage would be installed to inform the visitors to the towpath of closures and detours. Signage would be present for the duration of the construction phase of the project. Lighting would not be installed, as construction activities would not occur at night.

Canal Operations

- For the temporary access road, temporary culverts would be installed through the embankment to maintain flow in the canal. A protective landscape fabric barrier would be installed between the fill and the canal prism to protect the structural integrity of the canal prism.

Connection to Existing Facilities

- The proposed connection to the existing facilities for all alternatives is through the existing raw water conduits between the existing intake and towpath. This connection will be made by constructing small shafts above each connection point.

Land Exchange

- A land exchange between the NPS and WSSC may occur. WSSC is planning to purchase and provide land, identified by NPS, to the NPS in exchange for a perpetual easement for the existing and proposed intake facilities (figure 7). The land for which an easement is needed has been surveyed and mapped (figure 7). Lands to be purchased and provided by WSSC to NPS in exchange for the easement will be identified and the agreement between NPS and WSSC signed prior to the issuance by NPS of the special use permit (SUP) for construction. A SUP is a document issued by the superintendent to allow special park uses that do not have their own permitting instrument (see table 1).

Land Ownership

- The project site involves three parcels of land under separate ownership (WSSC, NPS, and the state of Maryland) as depicted on figures 2 to 5. A small portion (northern portion of the construction access road) of the project is within the boundaries of the existing Potomac WFP facility owned by WSSC. The boat ramp, parking area, access road, junction vault, and onshore intake tunnels would be located on NPS property. The majority of the construction access road, the intake shaft, and in-river intake tunnel would be located on both land and riverbed that is owned by the State of Maryland.
- Unnamed Island is a small island in the Potomac River located just offshore of WSSC's existing raw water intake. The ownership of Unnamed Island was investigated by WSSC since environmental impacts are expected to the island by construction activities related to the proposed new offshore submerged channel intake. Through extensive research on the ownership of the island it was determined vacant and a title search revealed that Unnamed Island lacks ownership (Miles and Stockbridge 2014). Any unpatented land in the Potomac River is "owned" by the state; therefore, the state of Maryland owns the island.

Wetland Mitigation Site

Since implementation of the proposed project would involve impacting wetland areas, a wetland mitigation site was identified on park property within the area of Lock 13. The Lock 13 wetland mitigation site is a 1.7 acre wetland between the Potomac River and C&O Canal, near the I-495 overpass. Details on the mitigation can be found in the Statement of Findings (SOF) (appendix E). Figure 1 shows the location of the wetland mitigation area. Existing conditions at the Lock 13 wetland mitigation site is presented in the "Affected Environment" chapter and impacts to the site from mitigation activities is evaluated in the "Environmental Consequences" chapter.

Required Permits, Approvals, and Plans for Proposed Action

- Permits for construction of the Potomac Submerged Channel Intake Project are anticipated to be required from the following agencies:
    - NPS
    - U.S. Army Corps of Engineers (USACE)
    - MDE
    - Montgomery County
- A general summary of the anticipated permits and approvals required for the proposed project are summarized in table 1, and a general summary of the anticipated plans required for the proposed project are summarized in the following paragraphs.

Table 1. General Summary of Required Permits and Approvals

Permit/Approval Name	Agency	Description of Permit/Approval
Federal Issued Permits		
Section 404 Permit for Discharge of Dredged or Fill Material into Waters of the US	USACE	Permit required for any activity that involves filling Waters of the U.S., including wetlands. Authorizes only necessary and unavoidable impacts.
Section 10 of the Rivers and Harbors Act Permit	USACE	Permit required for any work in the Potomac River, including construction, excavation, or deposition of materials in, over, or under navigable waters, or any work that would affect the course, location, condition, or capacity of those waters.
Special Use Permit	NPS	Permit required for a short-term special park use that is issued by the superintendent such as an activity that provides a benefit to an individual, group, or organization rather than the public at large; requires written authorization and some degree of management control from the NPS in order to protect park resources and the public interest; and is neither initiated, sponsored, nor conducted by the NPS.
Perpetual Easement	NPS	WSSC is planning to purchase land which it would provide to the NPS in exchange for a perpetual easement for the existing and proposed intake facilities.
State Issued Permits		
Section 401 Water Quality Certification	MDE	Permit required for wetlands and waterways construction to prevent violation of water quality standards.
Nontidal Wetlands and Waterways Permit	MDE	Permit required for any activity that alters nontidal wetland or its 25-foot buffer.
Waterways Construction Permit	MDE	Permit required for construction in river and 100-year floodplain to prevent increased flooding and impacts on river channel, wetlands, floodplains, and impacts on fish and wildlife.
General Discharge Permit for Stormwater Associated with Construction Activities	MDE	Permit required in areas of disturbance >1 acre to control stormwater runoff during construction.
Water and Sewerage Construction Permit	MDE	Permit required for major modifications of public water systems.

Permit/Approval Name	Agency	Description of Permit/Approval
Memorandum of Agreement	SHPO	A Memorandum of Agreement will be prepared with stipulations that outline appropriate treatment measures to minimize or mitigate adverse effects to cultural resources.
County Issued Permits		
Sediment Control Permit	Montgomery County	Permit required for work in the Potomac River. Permit requires applicant to install booms and filter fencing in water column to reduce the quantity of solids released during construction activities.
Floodplain District Permit	Montgomery County	Permit required for any land disturbing activities within the floodplain district and for temporary or permanent construction involving the placement of a structure, regardless of the size of the disturbed area.

Erosion and Sediment Control Plan – After the detailed design has been completed, an agency approved erosion and sediment control plan would be prepared and obtained before construction begins. This plan is required by MDE to control soil erosion and sediment runoff from construction sites. It is required for projects that involve land clearing, land disturbance or grading where more than 5,000 square feet are disturbed within the limits of the project area. MDE and its Water Management Administration oversee the approval of erosion/sediment control and stormwater management plans and documentation, as well as the issuance of permits and state regulatory standards. Stormwater runoff (discharge) from Maryland construction sites are regulated under section 402 of the Clean Water Act (CWA). Section 402 outlines the National Pollutant Discharge Elimination System permitting program. MDE and Montgomery County would review and approve this plan prior to construction.

The plan typically includes:

- Environmental site design to be utilized throughout all stages of the construction project.
- Best Management Practices (BMPs) to minimize total land disturbances caused by construction activities.
- Control of vehicles and construction equipment entering and exiting the site.
- Evaluations and Inspection records throughout the duration of construction.
- Identification of disturbed or high risk locations within the construction site.
- Final and temporary stabilization methods to remedy all environmental site disturbances.
- Protective measures to ensure all discharges into the Chesapeake Bay and other Maryland water bodies are in accordance with an established Total Maximum Daily Load (TMDL).

Erosion and sediment controls, which include both stabilization and structural control measures, prevent or reduce erosion, and redirect stormwater flow during construction activities. Examples of construction stabilization include:

- Temporary seeding: Vegetation such as grass grows quickly to hold the soil in place preventing erosion due to wind current or stormwater. An NPS-approved annual grass seed mix would be used.
- Permanent seeding: Vegetation is used during construction to prevent soil erosion and remains as part of the final landscaping. An NPS-approved permanent grass seed mix would be used.
- Mulching: Material such as hay, grass, wood chips, gravel, or straw is placed on top of the soil to prevent erosion and only certified weed-free mulch would be used.

Structural control measures prevent pollutants from leaving the construction site, limit the amount of water flow, or change the direction it travels. Examples include:

- Silt fences: A trapping device captures sediment on one side of the fence while allowing water to flow through.
- Sediment traps: Sediment settles out in a specified area such as an empty pond.
- Sediment basins: Sediment basins allow sediment to settle out in a specified area but require a controlled release of the water flow.

Stormwater Management Plan – After the detailed design has been completed, an agency approved stormwater management plan would be prepared and required permits obtained before construction initiation. The plan is required by regulation if more than 5,000 square feet are disturbed to prevent stream bank erosion by controlling the rate of stormwater runoff from newly developed areas. Examples of stormwater management controls include:

- Retention Ponds: Stormwater runoff is retained in a pond and may be removed through evaporation, infiltration, or emergency bypass.
- Detention Ponds: Water is held while sediments settle and then is slowly released.
- Infiltration: Measures can include infiltration trenches, basins, and dry wells that allow water to percolate from the surface into the soil below.
- Vegetated Swales and Natural Depressions: Vegetation, usually grass, lines the swale and removes sediments from runoff, allowing it to better infiltrate into subsurface soil.

This plan would include sufficient information, drawings, computations, and notes to describe how soil erosion and off-site sedimentation would be minimized. The plan would serve as the basis for all subsequent grading and stabilization that would take place on the construction site. Coordination and approval with MDE is required based on how much impervious surface remains onsite after construction.

Construction Safety Plan – Prior to construction, a construction safety plan would be prepared that addresses appropriate elements to provide for visitor, worker, and park staff safety. A construction safety plan is important for several reasons. First, it helps protect workers and the public from injury or harm. Second, it is often required by land owners or developers to help limit their liability during construction. A construction safety plan typically includes the following topics: scope of project work, project risks and methods of control such as unauthorized public access to the site and exposure to construction site hazards and worker exposure to general site hazards, site inspections, public protection controls such as erecting fences or barricades and displaying signs “Construction Site - Do Not Enter Authorized Personnel Only,” project site rules, and emergency preparedness. These fences or barriers would also act as a visual barrier to reduce the visual impacts from vegetation removal and construction activities.

Habitat Restoration Plan – The Habitat Restoration Plan (appendix D) was developed through consultation with NPS, USACE, USFWS, and Maryland Department of Natural Resources (MDNR). This comprehensive plan provides guidelines for habitat and resource restoration and mitigation associated with the construction and operation of the new offshore intake structure. This plan includes mitigation activities associated with freshwater mussels and reforestation of the project area. Mitigation associated with wetlands can be found in the SOF (appendix E). The Habitat Restoration Plan also includes monitoring activities associated with submerged aquatic vegetation, floating paspalum (*Paspalum fluitans*), species planted for reforestation, nonnative invasive species, and freshwater mussels. Adaptive management was also included since mitigation efforts may require more advanced management and modification in order to be viable.

ALTERNATIVE 2: TUNNELING TO ONSHORE SHAFT – WEST OF EXISTING INTAKE

Figure 3 depicts the location of the project elements for alternative 2. In addition to elements common to all action alternatives, alternative 2 would include the following elements:

Construction Method

- Alternative 2 would utilize tunneling for the installation of all new piping.
- The tunneling for each of three 8-foot-diameter intake conduits (pipes) requires a 10-foot-diameter tunnel with a horseshoe-shaped cross section. The three tunnels are separated 10 feet from each other's side walls. The tunnels are 30-feet deep from the tunnel invert to the river bottom. There is a 5-foot separation at each side of the overall piping section to the boundary of the impact area.

Construction Schedule

- Phase 1 - construction (mainly onshore) before installation of the intake cofferdam: site preparation, clear and grub site (4.7 acres), install stormwater management, temporary construction laydown areas, site security, install access road embankments and culverts, and install temporary access road. This phase would take approximately 17 months. All vegetation within the construction area limit would be removed during Phase 1.
- Phase 2 - installation of intake cofferdam and associated construction within the cofferdam: install intake cofferdam, install intake shaft, install onshore shaft and construct junction vault (note: this is onshore construction), install tunnels from onshore shaft to intake shaft, install conduits in the tunnels, grout around conduits in tunnels, fill and cover intake shaft and onshore shaft, and remove intake cofferdam. This phase would take approximately 2 years.
- Phase 3 - construction (mainly onshore) after removal of intake tunnel cofferdam: construct boat ramp, parking area, and permanent access road; remove temporary embankments and temporary access road; and conduct site restoration of approximately 4.4 acres. This phase would take approximately 6 months.

Onshore Shaft

- A new onshore shaft would be constructed west of the existing intake facility (figure 3).

Intake Tunnels

- The three intake tunnels would head north from the new intakes to the onshore shaft, and then head east before connecting into the six existing 6-foot-diameter intake conduits on the downstream side of the existing intake facility (figure 3).

Temporary Access Road

- The eastern portion of the temporary access road ends northeast of the existing intake (figure 3).

Embankment

An additional temporary road embankment would be constructed across the Potomac River channel to allow construction vehicles to cross and traverse over the western portion of Unnamed Island and to continue back onshore. This would allow access to construction areas needed to construct the intakes and intake shaft and perform the pipeline connections. Culverts would be provided in the embankments (see "common to all action alternatives" section for the eastern embankment) to maintain flow in the channel.

ALTERNATIVE 3: TRENCHING/TUNNELING TO ONSHORE SHAFT – WEST OF EXISTING INTAKE

Alternative 3 is similar to alternative 2 with respect to the locations of the new intakes, onshore shaft/junction vault, horizontal alignment of the new conduits, and the connections to the existing 6-foot intake conduits. However, the installation of the new piping would be completed using both open-trench and tunneling construction. The intake conduits between the intake shaft and the onshore shaft would be installed in a trench and the intake conduits between the onshore shaft and connection to existing conduits would be installed in tunnels. Figure 4 shows the location of the project elements for alternative 3. Some of the same design features for alternative 2 also apply to alternative 3; however, those that most significantly differ include the following:

Construction Method

- Alternative 3 would utilize open-trench construction in lieu of tunneling for the installation of new piping between the intake shaft and the onshore shaft. Tunneling construction would be used to install the piping under the existing access road, adjacent to the existing bridge abutments, to minimize risk and impacts associated with open trenching and also to keep the intake road open during construction.
- The trench section for the 8-foot-diameter piping requires a 12-foot-high and 10-foot-wide backfill trench section, including pipe bedding. The trenches are 17-feet deep from trench invert to the river bottom. A 5-foot-high concrete slab extending from the river bottom down to the top of the trench would be installed to prevent flotation or scouring of pipes. The three trenches are separated 10 feet from each other's side walls. There is a 5-foot separation at each side of the piping section to the boundary of the permanent impact area. There is also a 20-foot separation from both sides of the piping section to the edge of the cofferdam toe fill sections. The 60-foot-wide section is considered the permanent impact area.
- The intake shaft is estimated to be 80-feet (diameter) wide and slightly shallower at approximately 40-feet deep within partially excavated rock.

Construction Schedule

- Phase 1 - construction (mainly onshore) before installation of the intake tunnel cofferdam: construction during this phase would be the same as alternative 2 except that there would be an additional cofferdam in the existing intake channel to provide access to Unnamed Island and there would be an additional step of installing a temporary water supply channel across Unnamed Island. This phase would take approximately 19 months. All vegetation within the construction area limit (3.7 acres) would be removed during Phase 1.
- Phase 2 – installation of intake cofferdam and associated construction within the cofferdam: construction during this phase would be the same as alternative 2 except that a trench instead of a tunnel would be excavated within the cofferdam from the intake shaft to the onshore shaft. Conduits would then be installed in the trench. This phase would take approximately 1.8 years.
- Phase 3 - construction (mainly onshore) after removal of intake cofferdam: construct boat ramp, parking area, and permanent access road; remove temporary embankments and temporary access road; and conduct site restoration of approximately 3.4 acres. This phase would take approximately 6 months.

Trenched Conduits

- Where the sections of new conduits are placed in the channel and river, a concrete cap or cover would be installed above the conduits for pipe protection. The top of the concrete cover would match the existing channel or river bottom elevation.

Cofferdam (intake shaft and trenched conduits)

- Since this alternative utilizes open-trench construction, a larger, more extensive cofferdam is required in the river and across Unnamed Island to install new conduits from the new intake. The cofferdam across the existing intake channel would serve as the channel crossing for the temporary construction road in lieu of the western embankment in alternatives 2 and 4.

Embankment

- Since the cofferdam construction would block off flow from the existing supply channel to the existing intake facility, a temporary supply channel would recreate this flow through and across Unnamed Island. An embankment with culverts that maintain supply flow is needed across the temporary supply channel to provide construction vehicle access to the east connection to existing conduits (figure 4).

ALTERNATIVE 4: TUNNELING TO ONSHORE SHAFT – EAST OF EXISTING INTAKE

For alternative 4, the method of constructing the three intake tunnels and many of the design features are similar to what is described under alternative 2; however, the horizontal alignment of the tunnels/conduits and the location of the onshore shaft/junction vault are different. Figure 5 depicts the location of the project elements for alternative 4. Some of the same design features for alternative 2 also apply to alternative 4; however, those that most significantly differ include the following:

Construction Schedule

- Phase 1 - construction (mainly onshore) before installation of the intake cofferdam: construction during this phase would be the same as alternative 2. This phase would take approximately 17 months. All vegetation within the construction area limit (4.4 acres) would be removed during Phase 1.
- Phase 2 – installation of intake cofferdam and associated construction within the cofferdam: construction during this phase would be the same as alternative 2. This phase would take approximately 2 years.
- Phase 3 - construction (mainly onshore) after removal of intake cofferdam: construct boat ramp, parking area, and permanent access road; remove temporary embankments and temporary access road; and conduct site restoration of approximately 4.1 acres. This phase would take approximately 6 months.

Onshore Shaft and Tunnels

- The onshore shaft would be located east of the existing intake facility, whereas in alternatives 2 and 3 it was located to the west of the existing intake facility. The tunneled conduits would run from the intake shaft approximately 700-feet southwest to the new river intakes located 100-feet offshore of Unnamed Island.
- Three tunneled conduits would also run to the west from the onshore shaft to connect into the six existing intake pipelines that are located downstream of the existing intake facility.

Embankment

- Similar to alternative 2 but different than alternative 3, an additional temporary road embankment would be constructed across the Potomac River channel to allow construction vehicles to cross and traverse over the western portion of Unnamed Island and to continue back onshore. This would allow access to construction areas needed to construct the intakes and intake shaft and perform the existing pipeline connections. Culverts would be provided between the embankments (see “common to all action alternatives” section for the eastern embankment) to maintain flow in the channel.

Canal Operations

- If required for construction safety and maintaining access for visitor and park staff use, temporary relocation of the towpath would be provided on the north side (left bank) of the canal (figure 5). The need for temporary towpath relocation would be determined during detailed design.

Table 2 below includes a detailed comparison of project elements included in each alternative.

Table 2. Detailed Comparison of Alternatives

Project Elements	Alternative 1 No-Action	Alternative 2 Tunneling to Onshore Shaft – West of Existing Intake	Alternative 3 Trenching/Tunneling to Onshore Shaft – West of Existing Intake	Alternative 4 Tunneling to Onshore Shaft – East of Existing Intake
Intake and Tunnel				
Intake Tunnels	• No existing tunnels	• Construction of 3 intake tunnels (10 foot diameter) via drill and blast method with "horse shoe-shaped" cross section. • Tunnels located west of the existing intake facility run approximately 600-feet south from the onshore shaft to the intakes located 100-feet offshore of Unnamed Island. • 3 tunnels would also run to the east of the onshore shaft where connection to the 6 existing intake pipelines downstream of the existing intake facility would be made.	• Construction of 3 intake tunnels (10 foot diameter) via drill and blast method with "horse shoe-shaped" cross section. • 3 tunnels would run to the east of the onshore shaft where connection to the 6 existing intake pipelines downstream of the existing intake facility would be made – this applies to the portion onshore between the junction vault structure and the existing pipe connections.	• Construction of 3 intake tunnels (10 foot diameter) via drill and blast method with "horse shoe-shaped" cross section. • Tunnels located southeast of the existing intake facility run approximately 700-feet southwest from the onshore shaft to the intakes located 100-feet offshore of Unnamed Island. • 3 tunnels would run to the west of the onshore shaft where connection to the 6 existing intake pipelines downstream of the existing intake facility would be made.
Intake Trench			• Construction of intake trench via drill and blast method. • Trench located west of the existing intake facility runs approximately 600 feet-south from the onshore shaft to the intakes located 100-feet offshore of Unnamed Island.	
Intake And Onshore Shafts	• No existing shafts	• Intake shaft is located 100-feet offshore of the west end of Unnamed Island. • Onshore shaft located west of existing intake. • Construction of 80-foot-diameter shafts, 50-feet deep.	• Intake shaft is located 100-feet offshore of the west end of Unnamed Island. • Onshore shaft located west of existing intake. • Construction of 80-foot-diameter intake shafts, 40-feet deep. • Construction of 80-foot-diameter onshore shaft, 50-feet deep.	• Intake shaft is located 100-feet offshore of the west end of Unnamed Island. • Onshore shaft located east of existing intake. • Construction of 80-foot-diameter shafts, 50-feet deep.

Project Elements	Alternative 1 No-Action	Alternative 2 Tunneling to Onshore Shaft – West of Existing Intake	Alternative 3 Trenching/Tunneling to Onshore Shaft – West of Existing Intake	Alternative 4 Tunneling to Onshore Shaft – East of Existing Intake
Junction Vault/Gate Structure	• No existing junction vault structure	• A permanent junction vault structure would then be constructed within the onshore shaft. • The gate structure would include sluice gates used to control flow to the existing piping connections.	• A permanent junction vault structure would then be constructed within the onshore shaft. • The gate structure would include sluice gates used to control flow to the existing piping connections.	• A permanent junction vault structure would then be constructed within the onshore shaft. • The gate structure would include sluice gates used to control flow to the existing piping connections.
River Intakes	• Existing intake would remain	• Installation of new river intakes.	• Installation of new river intakes.	• Installation of new river intakes.
Intake Piping	• Existing intake piping would remain	• Within each tunnel, 96-inch-diameter steel pipe conduits would be installed to convey flow from the river intakes to the existing piping connections. • New intake piping would require installation below and then connect vertically up into the existing 72-inch intake piping. • Piping from the tunneling shaft is proposed to be tunneled with small, localized open excavations around the existing piping required for these connections, involving replacement of sections of the existing 72-inch concrete piping with 96 inch x 72 inch steel pipe tee fittings.	• 96-inch-diameter steel pipe conduits would be installed in an open trench to convey flow from the river intakes to the onshore shaft. • Piping from the onshore shaft is proposed to be tunneled, with small, localized open excavations around the existing piping required for these connections. Replacement of sections of the existing 72-inch concrete piping with 96 inch x 72 inch steel pipe tee fittings would be required.	• Within each tunnel, 96-inch-diameter steel pipe conduits would be installed to convey flow from the river intakes to the existing piping connections. • New intake piping would require installation below and then connect vertically up into the existing 72-inch intake piping. • Piping from the tunneling shaft is proposed to be tunneled, with small localized open excavations around the existing piping required for these connections, involving replacement of sections of the existing 72-inch concrete piping with 96 inch x 72 inch steel pipe tee fittings.
Pipe Protection	• No pipe protection would be installed	• No pipe protection would be installed because undisturbed bedrock cover provides protection.	• A concrete cap or cover is proposed to be installed above for pipe protection. Top of concrete cover would match the existing channel or river bottom elevation.	• No pipe protection would be installed because undisturbed bedrock cover provides protection.

Project Elements	Alternative 1 No-Action	Alternative 2 Tunneling to Onshore Shaft – West of Existing Intake	Alternative 3 Trenching/Tunneling to Onshore Shaft – West of Existing Intake	Alternative 4 Tunneling to Onshore Shaft – East of Existing Intake
Road Access				
Permanent Road	Existing roads would remain	Construction of permanent road for access to gate structure and boat ramp/parking area.	Construction of permanent road for access to gate structure and boat ramp/parking area.	Construction of permanent road for access to gate structure and boat ramp/parking area.
Temporary Access Road	No construction of temporary roads	Access road to be built off of Potomac WFP property and to cross the C&O Canal via a temporary road embankment/causeway. Temporary road embankments to cross over onto and traverse across Unnamed Island, and then continuing back on shore east of the existing intake to reach the work areas needed to perform the existing pipeline connections.	Access road to be built off of Potomac WFP property and to cross the C&O Canal via a temporary road embankment/causeway. Temporary cofferdam road and road embankment to cross over onto and traverse across Unnamed Island, and then continuing back on shore east of the existing intake to reach the work areas needed to perform the existing pipeline connections. To access the work areas on the east side to perform the existing pipeline connections, the construction of a temporary road embankment/ causeway would also be needed across temporary supply channel.	Access road to be built off of Potomac WFP property and to cross the C&O Canal via a temporary road embankment/causeway. Temporary road embankments to cross over onto and traverse across Unnamed Island, and then continuing back on shore east of the existing intake to reach the work areas needed to perform the existing pipeline connections.
River and Canal Operation				
Temporary Cofferdam	No installation of cofferdam	Construction of the river intakes would require construction of temporary cofferdams around the intake location to provide a “dry” working area. Cofferdam proposed to have 2:1 slope.	Larger, more extensive cofferdam construction in the river and across Unnamed Island is required for open-trench construction to install new piping from the new intake. Cofferdam proposed to have 2:1 slope.	Construction of the river intakes would require construction of temporary cofferdams around the intake location to provide a “dry” working area. Cofferdam proposed to have 2:1 slope.

Project Elements	Alternative 1 No-Action	Alternative 2 Tunneling to Onshore Shaft – West of Existing Intake	Alternative 3 Trenching/Tunneling to Onshore Shaft – West of Existing Intake	Alternative 4 Tunneling to Onshore Shaft – East of Existing Intake
Temporary Culverts	No installation of temporary culverts	Culverts through the embankments would be provided to maintain flow in the canal and channel past the work areas.	Culverts through the embankment downstream of the weir would be provided to maintain flow in the channel past the work areas. Installation of temporary culvert piping to convey canal flow through the embankment and through embankment crossing temporary supply channel.	Culverts through the embankments would be provided to maintain flow in the canal and channel past the work areas. Temporary culverts will also be provided in the temporary embankment in the canal for the potential temporary towpath relocation.
Temporary Supply Channel	No construction of supply channel	No temporary supply channel required.	Temporary supply channel is proposed to provide flow to the existing intake through and across Unnamed Island while upstream cofferdam is in place.	No temporary supply channel required.

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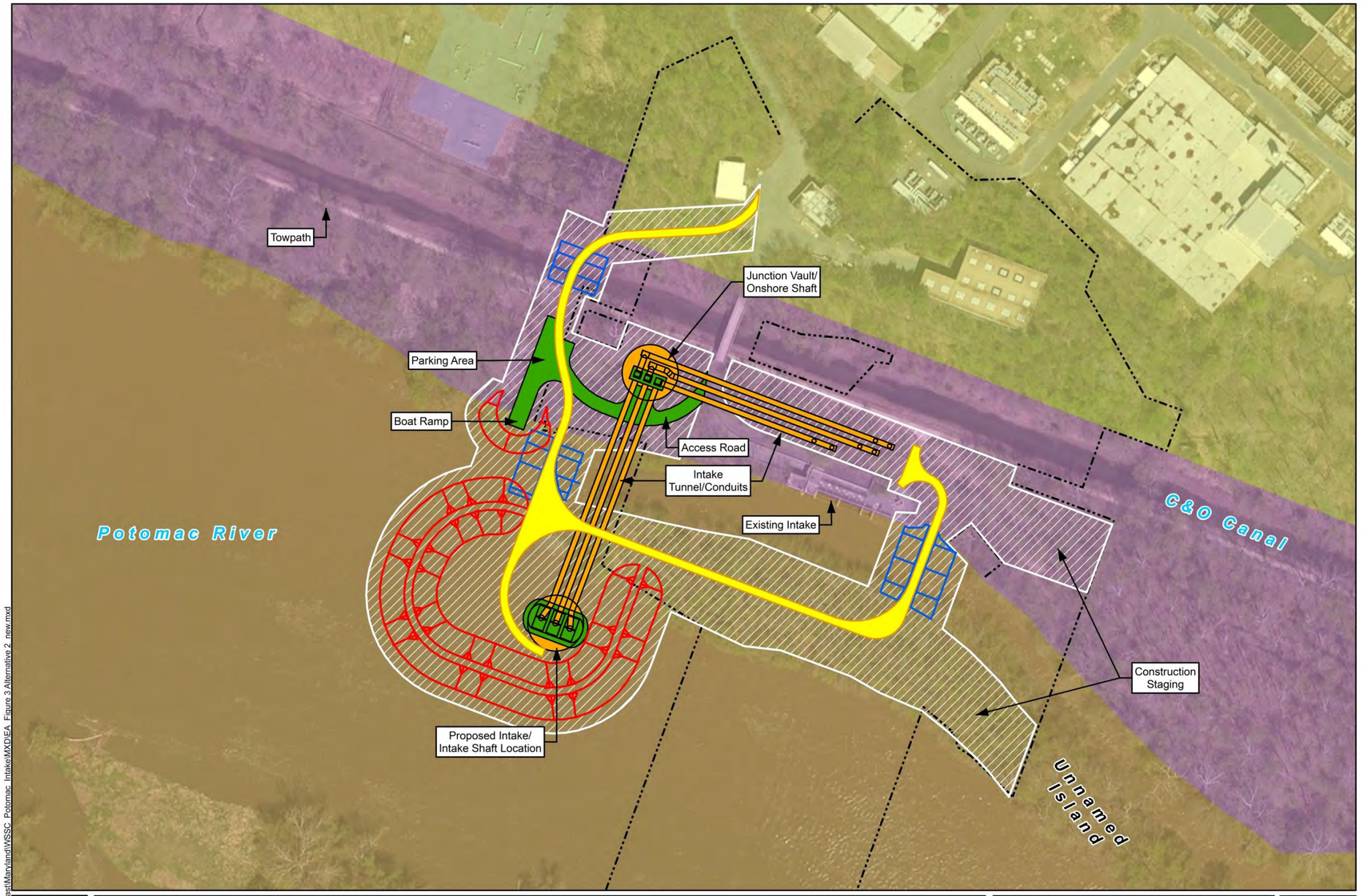

Figure 3
Alternative 2 Tunneling to Onshore Shaft - West of Existing Intake

Source:
Black & Veatch 2013
ESRI 2012

Projection: NAD 83 Maryland StatePlane Feet
Date: June 2015

0 100 200
Feet

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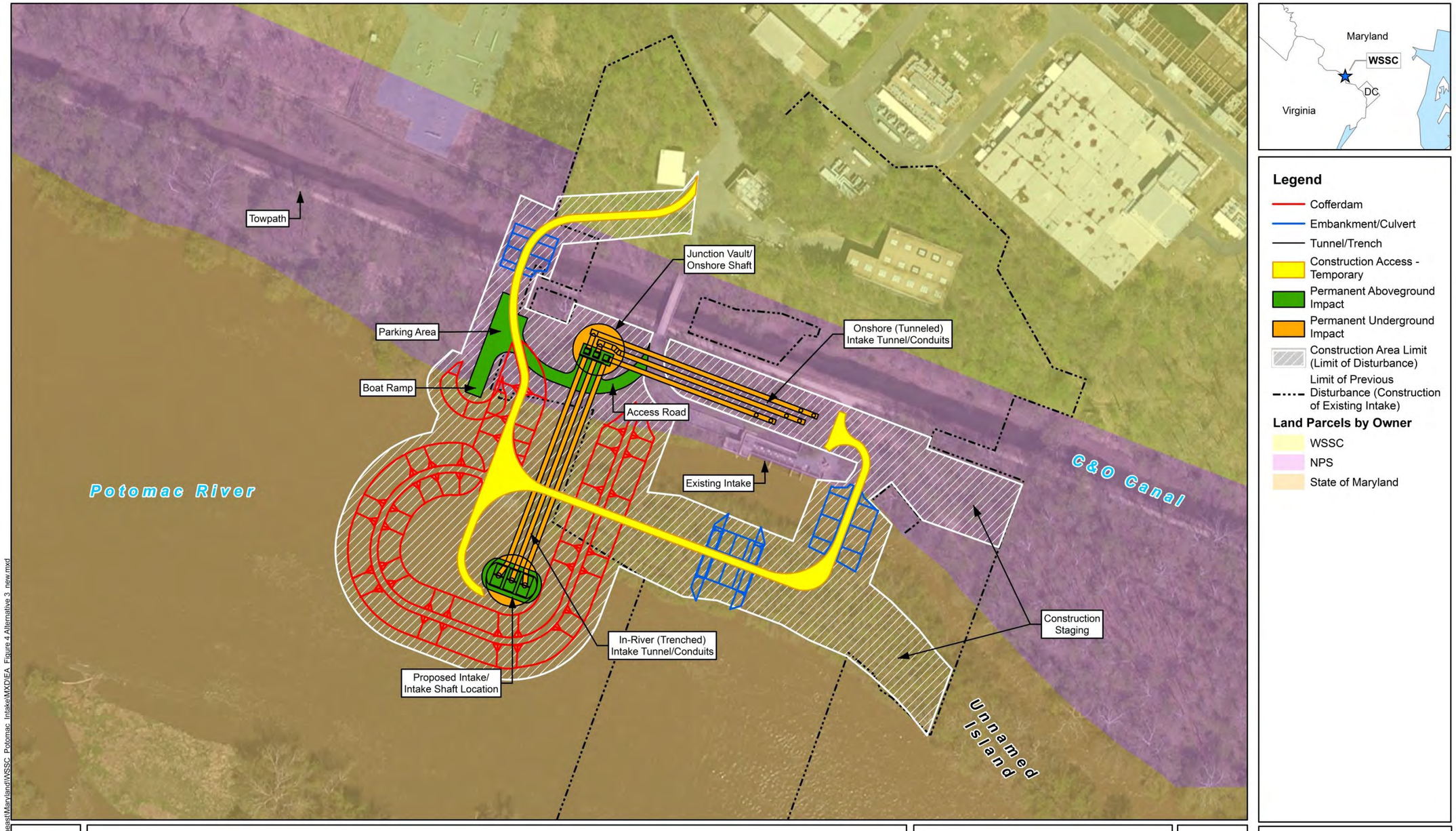

Figure 4
Alternative 3 Trenching/Tunneling to Onshore Shaft - West of Existing Intake

Source:
Black & Veatch 2013
ESRI 2012

Projection: NAD 83 Maryland StatePlane Feet
Date: December 2015

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Feet

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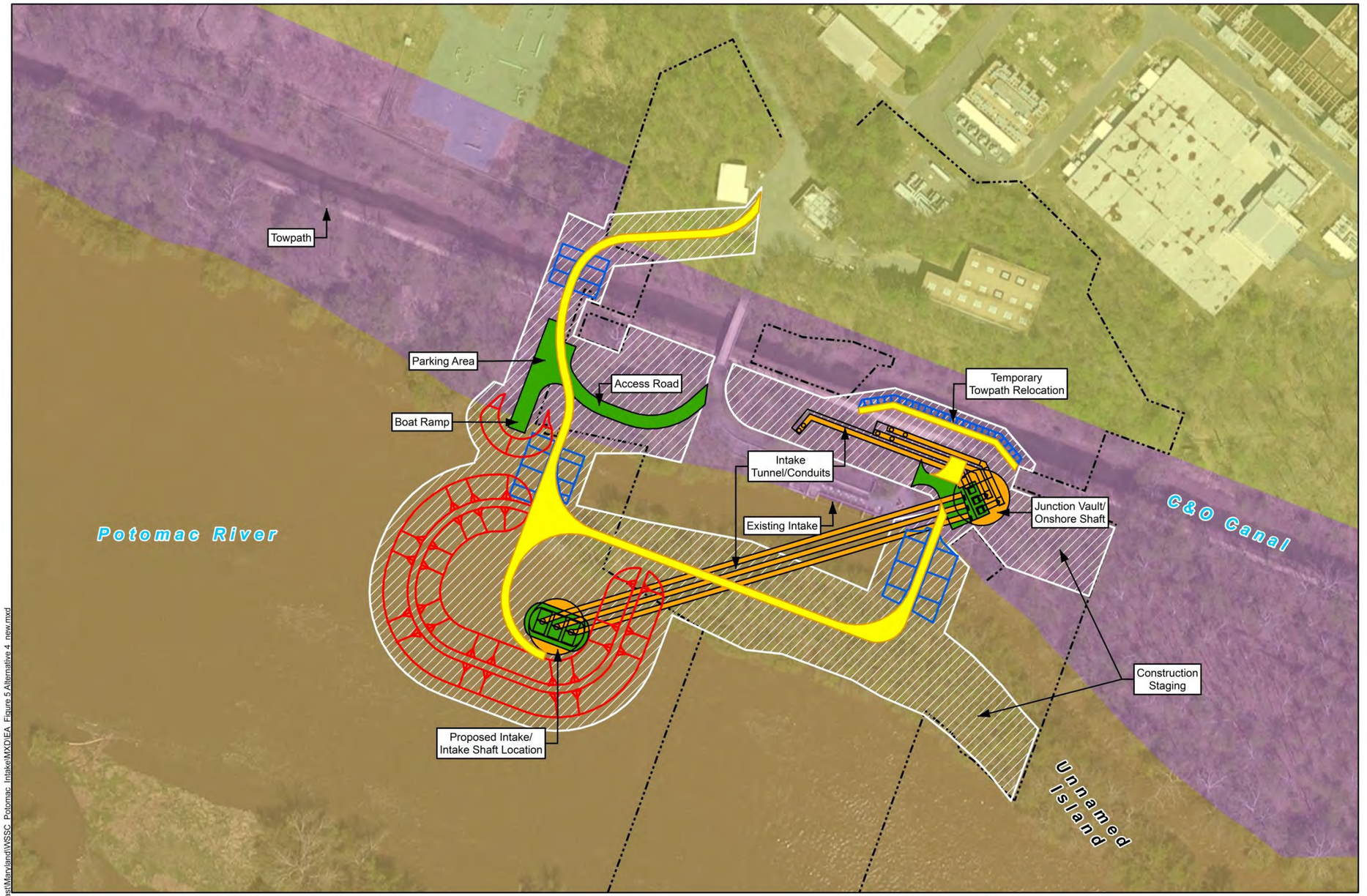

Legend

- Cofferdam
- Embankment/Culvert
- Tunnel/Trench
- Construction Access - Temporary
- Permanent Aboveground Impact
- Permanent Underground Impact
- Construction Area Limit (Limit of Disturbance)
- Limit of Previous Disturbance (Construction of Existing Intake)

Land Parcels by Owner

- WSSC
- NPS
- State of Maryland

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Figure 5
Alternative 4 Tunneling to Onshore Shaft - East of Existing Intake

Source:
Black & Veatch 2013
ESRI 2012

Projection: NAD 83 Maryland StatePlane Feet
Date: June 2015

0 100 200
Feet

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Figure 6
Comparison of
Alternatives 2, 3, and 4

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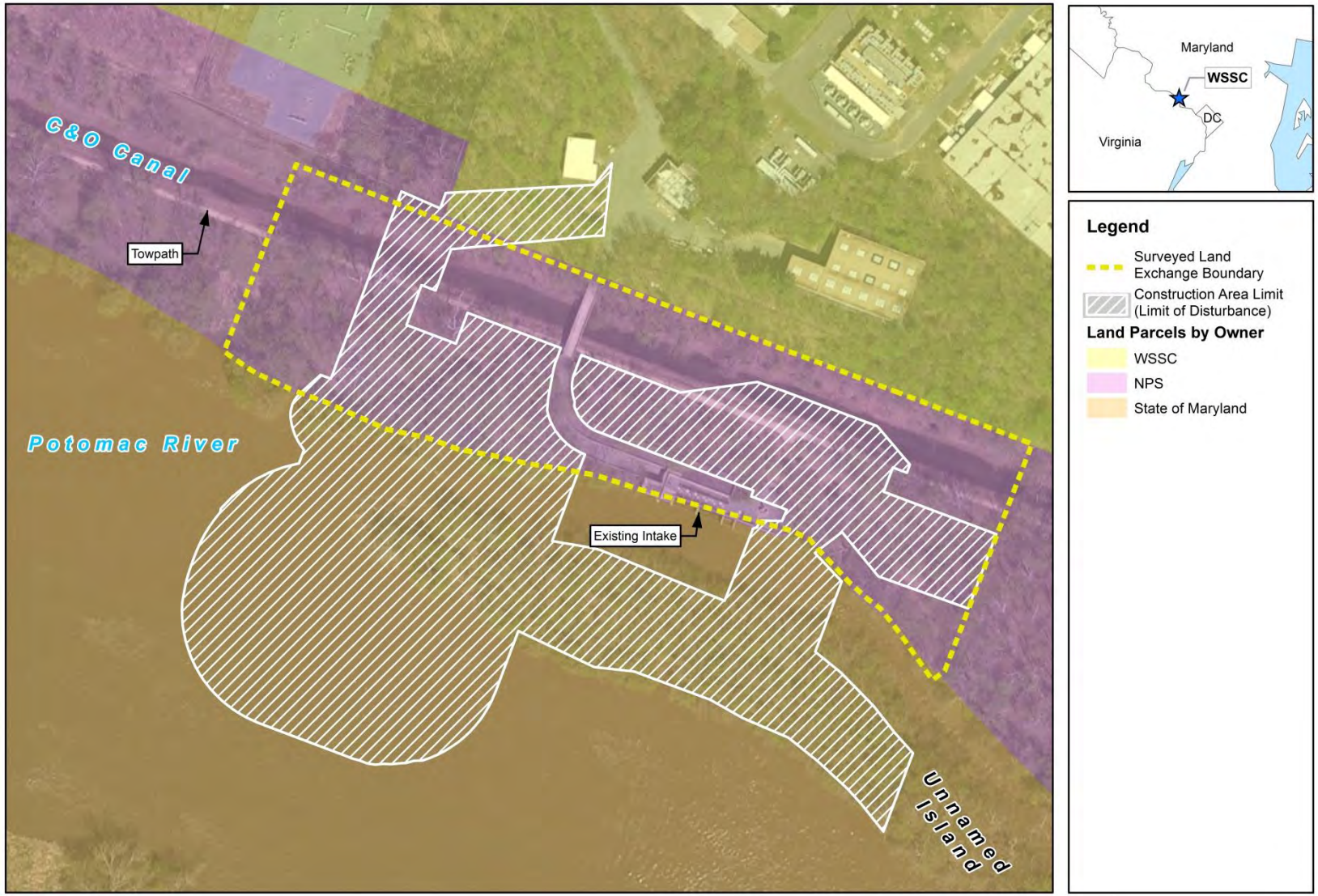

Figure 7
Surveyed Land Exchange Boundary of the Project Area

Source:
Black & Veatch 2013
ESRI 2012

Projection: NAD 83 Maryland StatePlane Feet
Date: June 2015

CONSTRUCTION STAGING

Construction staging is a designated area where vehicles, supplies, and construction equipment are stored for access and use during construction. In addition, for this project, excavation required for shafts and trenches and blasting for tunnels would generate soil and rock that would be needed to be removed from the site, but may need to be stockpiled temporarily within staging areas. For this project, construction staging would occur within the construction area limits (limits of disturbance) for each alternative (see construction area limits in figures 3, 4, 5, and 6) in order to prevent impacts to additional undeveloped areas. Scheduling the delivery of equipment/materials to the site (e.g., sections of piping) daily or weekly and scheduling removal of stockpile material (e.g., rock) on a daily basis, as needed, would be done to limit the size of construction staging areas and to prevent stockpiling of erodible materials within the 100 year floodplain. Available space for construction staging would include areas beyond where the permanent and temporary roads are planned. In addition, equipment and materials may be temporarily stored within areas of the cofferdam since the elevation (175 feet) of the cofferdam would provide the level of protection at which most high water/flood events would stay below. Measures to protect if a flooding event would occur include the scheduling of delivery of equipment to the site daily as mentioned previously. In addition, areas in the cofferdam can be designated by the Contractor for storage of equipment/materials that can be quickly mobilized prior to the onset of a potential flooding event; and the Contractor may be able to coordinate with the Potomac WFP to temporarily store equipment/materials within the Potomac WFP property.

Stockpiled materials within the staging areas would be subject to MDE and Montgomery County, Maryland Sediment and Erosion Control Regulations. During final design of the project an Erosion and Sediment Control Plan would be prepared and must be approved before construction can begin.

Overall, approximately 3.0 acres may be utilized at the site for construction staging (includes staging throughout the site). Once the project is complete and the construction access road and staging areas are no longer needed, restoration actions, such as tilling and replacing topsoil that was removed from the original ground, would occur to prepare the soil for revegetation with native species to augment the existing vegetation (see “Appendix D: Habitat Restoration Plan”).

MITIGATION MEASURES FOR THE ACTION ALTERNATIVES

The NPS places emphasis on avoiding, minimizing, and mitigating potentially adverse environmental impacts. To help ensure the protection of natural and cultural resources and the quality of the visitor experience, the following protective measures would be implemented as part of the selected action alternative. An appropriate level of monitoring would be implemented throughout the construction process to help ensure that protective measures are being properly implemented and are achieving their intended results. Mitigation, according to NEPA regulations (40 CFR 1508.20) includes:

- avoiding the impact altogether by not taking a certain action or parts of an action;
- minimizing impacts by limiting the degree of magnitude of the action and its implementation;
- rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
- compensating for the impact by replacing or providing substitute resources or environments.

Mitigation measures for natural resources would be described in detail in the construction permits (e.g., Section 404 Permit for Discharge of Dredged or Fill Material into Waters of the U.S.; Waterways Construction Permit; and Sediment Control Permit) and plans (e.g., Erosion and Sediment Control Plan and Stormwater Management Plan) that would be prepared after the detailed design has been completed, obtained before construction initiation, and approved by the relevant agencies. In addition, a Habitat Restoration Plan (appendix D) has been completed that includes mitigation for forestland, SAV, freshwater mussels, special-status species, and nonnative species. Mitigation for wetlands can be found in the SOF (appendix E). These project permits and plans were listed and summarized previously in this chapter.

The construction area limits for the project were designed to avoid and minimize impacts to natural and cultural resources. Following the internal analysis of alternatives, WSSC worked to further avoid impacts to natural and cultural resources by relocating the boat ramp closer to the existing intake. This relocation resulted in the avoidance of impacts to one archeological site, the reduction of impacts to a second archeological site, and the reduction of impacts to wetlands. One of the goals of construction is to leave the existing habitat as close to natural and undisturbed as possible by constructing the project in the smallest footprint feasible. To minimize impacts to aquatic and terrestrial species, guidelines for seasonal time-of-year restrictions, during which certain species may be most sensitive to human activities, such as construction and land clearing, have been proposed.

- Fish: time-of-year restriction for in-water construction is March 1- June 15
- SAV: time-of-year restriction for in-water construction is summer – October 15
- Floating paspalum (*Paspalum fluitans*): time-of-year restriction for in-water construction is May through October
- Northern long-eared bat (*Myotis septentrionalis*): time-of-year restriction for terrestrial vegetation clearing is April 15 – August 30
- Nesting birds: time-of-year restriction for terrestrial vegetation clearing is April 15 – August 15

The following are some of the mitigation measures that would be implemented to minimize impacts on natural and cultural resources, and visitor experience:

Water Quality: BMPs would include practices such as using clean rock for the construction of the cofferdams and embankments to minimize impacts on turbidity; using pervious pavement to allow percolation or infiltration of stormwater through the surface into the soil below where the water is naturally filtered and pollutants are removed; using temporary stormwater features such as silt fences, interceptor swales, sediment traps/ponds, stockpile covers, grate filters, or other BMPs to manage stormwater runoff during construction; replanting trees and groundcover vegetation as soon as feasible in areas that are disturbed by earthwork activities; and providing temporary erosion-control blankets or permanent rock armoring on steep terrain where vegetation is slow to get established. Details on BMPs for water quality would be included in the Erosion and Sediment Control Plan and Stormwater Management Plan that would be developed and approved before construction initiation.

Wetlands and Submerged Aquatic Vegetation: During internal alternatives development, the project footprint was revised to avoid a wetland area in the northwest corner of the site. Construction mitigation includes placing silt curtains in the Potomac River and C&O Canal to prevent impacts on the aquatic environment from silt and sediment that may be disturbed during construction. Wetland compensation for this project would occur at a nearly 4:1 ratio. Time-of-year restrictions for in-river construction activities would occur from the summer to October 15th in order to minimize impacts to SAV located beyond the

construction area limits. Monitoring would be conducted in the Potomac River to document the recovery of SAV in the project area. Details on mitigation for wetlands can be found in the SOF (appendix E).

Aquatic Wildlife: Silt curtains would be placed in the Potomac River to prevent impacts from silt and sediment that may be disturbed during construction. Freshwater mussels would be relocated from the project site prior to construction and monitoring would be conducted to document that mussels relocated from the construction area limits are still surviving. Details on mitigation for freshwater mussels can be found in the Habitat Restoration Plan (appendix D). Time-of-year restrictions for in-river construction activities would occur from March 1 – June 15 in order to protect fish species. The BMPs implemented for water quality would also benefit aquatic wildlife.

Terrestrial Vegetation: Disturbed areas (mainly forested) would be restored using native vegetation and would be monitored and managed to prevent colonization by nonnative species. Details on mitigation for vegetation can be found in the Habitat Restoration Plan (appendix D).

Special-status Species: Following construction activities, monitoring would be conducted to document the recovery of floating paspalum in the project area. Details on monitoring for floating paspalum can be found in the Habitat Restoration Plan (appendix D). Seasonal time-of-year restrictions for in-water construction and vegetation clearing would be followed for floating paspalum (May through October) and the northern long-eared bat (April 15 – August 30).

Cultural Resources: All work that would impact historic structures (canal prism and towpath) would be designed and constructed to meet the *Secretary of the Interior's Standards for Historic Preservation* (36 CFR 68 as amended by the NPS). A protective barrier would be installed to protect the canal prism from the installation of the embankment and temporary ramps that would be constructed to carry the towpath over the construction access road. Following initial project review, the project footprint was revised to avoid most of this archeology site thus reducing impacts; however, some impact cannot be avoided to the western portion of site 18MO633. The Phase II evaluation recommended that archeological site 18M0633 is eligible for listing on the National Register of Historic Places (NRHP) (Klein et al. 2015). A Memorandum of Agreement (MOA) will be prepared with stipulations that outline appropriate treatment measures to minimize or mitigate these adverse effects. The MOA would stipulate that, prior to any ground disturbing activities within the project site, data recovery excavations within the portion of the site to be impacted by construction be undertaken.

To avoid impacts to site 18MO719, there would be no ground disturbing activities associated with construction of the temporary access road at this site. Site preparation, such as tree removal prior to placement of the barrier, would be completed without ground disturbance. To minimize the traffic load on the archeological deposits, steel plates would be placed across the archeological site at the location of the temporary construction road. Placement of these weight bearing buffers on top of the site would disperse the force of the weight of the construction vehicles and prevent compaction to the deeply buried deposits.

Visitor Experience: Fencing would be present along a 0.2-mile section of the towpath on both sides of the towpath for the duration of the construction to prevent visitors from entering the construction site and would also likely block or obscure views of the ongoing construction on either side of the towpath. Temporary delays for visitors on the towpath due to construction would only be halted periodically and would not exceed 15 minutes in duration. A construction safety plan would be developed prior to initiation of construction to ensure the safety of park visitors, workers, and park personnel.

MITIGATION IMPACT FUND

WSSC is consulting with the NPS on contribution toward a mitigation fund for impacts associated with the proposed construction of this project. The funds will be used to pay for appropriate compensatory mitigation projects to minimize or offset the unavoidable impacts of this project on natural resources and visitor use within the C&O Canal NHP. For example, during construction, the experience for visitors walking or cycling through the project area would be degraded, due to the loss of trees and construction activities, when compared with current conditions; this degradation of a natural experience cannot be avoided under the action alternatives and an economic value can be estimated for this loss.

NPS and WSSC have prepared an analysis of impacts to visitor experience and natural resources that will be used by both parties to determine a fair and equitable mitigation for these impacts. The mitigation would be used to enhance visitor experience and natural resources within the C&O Canal NHP.

The analysis was conducted to assist WSSC and the NPS to formulate mitigation in monetary terms associated with alternative 2, the preferred alternative. The objectives of the analysis were to:

1. Estimate the approximate monetized value of incremental adverse impacts to use of visitor use, as identified in the EA; and,
2. Estimate the approximate scale and cost of restoration projects appropriate to offset incremental impacts to ecological resources, as identified in the EA.

Overview of Visitor Impact Analysis

To determine the value of visitor impacts, a benefit transfer analysis was conducted, this is an approach commonly used to develop dollar-denominated estimates of losses in regulatory analysis and natural resource damage assessment. Benefit transfer is the practice of using results from existing economic valuation studies and adjusting them to value changes in conditions in similar contexts. Input data used in the analysis includes the following:

- The number of visitor trips, by activity type (e.g., walking, biking), taken annually in the C&O Canal NHP that would be affected by the project;
- The monetary value for each trip type based on a review of relevant economic literature; and,
- An estimate, based on available literature, of the "per-trip" losses in value from changes in conditions. Losses include degradation of experience and also trips not taken because of construction activity.

Total loss estimates are calculated by summing annual loss estimates over time. The analysis estimated visitor impacts by group (cyclists, on-foot visitors, and through travelers – those people traveling the entire length of the towpath) from the project construction. Table 3, below, reports estimated visitor impacts by group from project construction. The analysis estimates that an average of 370,000 visitors to the C&O Canal NHP would be affected each year. We estimate that visitor impacts would be $1.6 million per year and, discounted for present value, would total approximately $5.7 million, assuming a 4-year construction period.

Table 3. Estimated Impacts on Visitor Types from Project Construction

Affected Visitor Group	Annual Affected Visitors	Undiscounted Annual Impacts (2015$)	Total Present Value Impacts over a 4-Year Construction Period (2015$)
Bicyclists	193,208	$848,775	$2,973,871
On-Foot	140,348	$616,557	$2,160,144
Through-Travelers	35,000	$153,757	$538,722
Total	**368,556**	**$1,619,089**	**$5,672,837**

Overview of Ecological Impact Analysis

To quantify ecological impacts, a Habitat Equivalency Analysis (HEA) was used to estimate mitigation for ecological impacts resulting from alternative 2. HEA is a method developed and commonly used in the natural resource damage assessment process to evaluate the impacts and restore natural and human resources from oil spills or releases of hazardous substances. HEA also has been used in other contexts, including the evaluation of mitigation requirements arising from physical changes or disturbances to the environment associated with construction projects, similar to this project.

Key inputs to HEA include estimates of the affected acreage by habitat type, as well as estimates of the duration and severity of impact attributable to the project (i.e., above and beyond "baseline" habitat conditions that would exist if the project did not go forward). Estimated impacts are summed over space and time and expressed in "discounted service acre-years" of impact. The required size of appropriate ecological mitigation projects (e.g., protection, improvement and/or creation of similar types of habitat) sufficient to offset the "acre-years" of impact is then estimated. Key inputs for this portion of the HEA include estimates of the duration and magnitude of ecological mitigation project benefits. Discounting is applied in the analysis to adjust for any differences in timing between impacts and ecological mitigation project benefits. The output of this type of HEA is the estimated number of acres or costs of one or more project types needed to offset estimated impacts. Per-acre cost information is then applied to the number of acres of ecological mitigation project(s) required, thereby providing estimates of the total amount of compensation needed for ecological mitigation. The analysis estimates a total of approximately 53 discounted service acre-years of ecological service loss as a result of construction and vegetation clearing across all habitat types and sources of service losses in the project area for the period 2018 through 2096 (time required for the forest to restore to original conditions). Applying proposed ecological restoration project costs, we estimate the total restoration costs required to offset ecological impacts to wetlands and upland forests to be approximately $151,300; the estimated cost to offset impacts to upland forests only is approximately $136,700.

Next Steps

The economic analysis presented above was completed using information available from the conceptual design of the preferred alternative, alternative 2. As WSSC moves forward with detailed design and planning for this project, they will work with NPS to further reduce impacts to natural resources and visitor use at the C&O Canal NHP. Additional design has the potential to reduce visitor and resource impacts by the footprint of the project and the duration of construction, which is currently estimated at 4 years. The design of the preferred alternative, alternative 2, for this environmental assessment is conceptual and represent the maximum impact from the project to make certain all reasonably foreseeable impacts are addressed.

Once detailed design reaches the seventy percent stage, WSSC will re-evaluate its initial analysis to determine if it needs to be modified to reflect actual mitigation. If a modified analysis is needed then it will be done in a manner consistent with the previous analysis. NPS and WSSC will use the updated analysis to determine the mitigation for impacts from the proposed construction of the preferred alternative, alternative 2. Prior to the issuance of the SUP for construction by NPS, WSSC and NPS will execute a task agreement for the NPS Impact Fund, with a qualified third party, which will specify the nature of the impacts being mitigated, the amount of compensation, and the type or nature of the compensating mitigation projects for which the funds are intended.

ALTERNATIVES CONSIDERED BUT DISMISSED

An alternative was considered early in the planning process which consisted of construction of an onshore tunneling shaft located south of the C&O Canal between the existing intake and the C&O Canal. This alternative used trenched conduits to connect the onshore shaft to the existing raw water transmission pipelines south of the C&O Canal towpath and tunneled pipelines to connect the onshore shaft to the new intake structure. This alternative was eliminated because it was determined that there was not adequate space to construct the onshore shaft between all of the existing pipelines contained in that area.

Another alternative was considered in addition to the three action alternatives presented in this EA. This alternative used a combination of some of the same design elements as alternatives 2 and 3, but the gate structure was located to the east of the existing intake facility and open-trench pipe construction was used across Unnamed Island from the river intake. However, this alternative was dismissed from further consideration due to the following:

1. Because of the open-trench construction across the channel downstream of the existing intake facility, a temporary drainage channel is needed downstream of the existing intake in order to provide passage of channel flow past the "dry" work area. Due to the closer proximity of this temporary drainage channel to the existing diversion weir, this carries a higher risk of impacts on the structural integrity of the weir.
2. Construction sequencing, particularly with respect to construction access, is more complex due to more areas requiring open-excavation (i.e., at the intake, temporary supply channel, open-trench of channel downstream of existing intake) than with the other alternatives.

Since 2002, the State of Maryland, Montgomery County, and the City of Rockville have implemented stormwater management improvements and stream restoration to reduce erosion in the watershed, including Watts Branch, Seneca Creek, and adjacent tributaries. Since 2009, the State of Maryland has required BMPs to address the Chesapeake Bay TMDL for nutrients and sediment. In addition, WSSC has made extensive repairs to their sanitary sewer system. These management actions are not considered an alternative to constructing the new submerged intake because the primary issues with the current shoreline intake are turbidity spikes and clogging by ice and vegetation. Improvement in bacterial load from mid-channel water from the Potomac River, as reducing bacterial load is not a driving force in WSSC's need for the project.

ENVIRONMENTALLY PREFERABLE ALTERNATIVE

The NPS is required to identify the environmentally preferable alternative in its NEPA documents for public review and comment. The NPS, in accordance with the Department of the Interior policies contained in the Departmental Manual (516 DM 4.10) and the *Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*, defines the environmentally preferable alternative (or alternatives) as the alternative that best promotes the national environmental policy expressed in

NEPA (Section 101(b) (516 DM 4.10). In their Forty Most Asked Questions, CEQ states that the environmentally preferable alternative is "the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources" (CEQ 1981).

After completing the environmental analysis, alternative 1 the no-action alternative, was identified as the environmentally preferable alternative in this EA because it best meets the definition established by CEQ. The no-action alternative best protects the physical and biological environments, as well as the historic and cultural resources of the C&O Canal in the project area. The no-action alternative would not involve construction activities, which would eliminate direct impacts on geology, water resources, wetlands and floodplains, vegetation, wildlife, and special-status plants. Under the no-action alternative, impacts on cultural resources, visitor use and experience, scenic resources, and human health and safety would also be avoided. The action alternatives would produce a range of adverse impacts on these resources from construction and operation of the submerged intake, specifically removal of local populations of special-status plant species, and disturbance of a cultural resources site.

For these reasons, the no-action alternative was found to cause the least damage to the biological and physical environment and would best protect and preserve the scenic, historic, cultural, and natural resources of the park involved. Therefore, the no-action alternative would best promote the national environmental policy of NEPA and must be selected as the environmentally preferable alternative.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES/IMPACT COMPARISON MATRIX

Table 4 includes a summary of each alternative's potential effects by impact topic.

Table 4. Summary of Environmental Consequences/Impact Comparison Matrix

Impact Topic	Alternative 1 No-action	Alternative 2 Tunneling to Onshore Shaft - West of Existing Intake (Preferred Alternative)	Alternative 3 Trenching/Tunneling to Onshore Shaft - West of Existing Intake	Alternative 4 Tunneling to Onshore Shaft - East of Existing Intake
Geology and Soils	**Long-term moderate adverse impacts** to geologic resources and soils since these resources were previously disturbed for construction and excavation of the existing Potomac WFP	*Construction:* **Short-term minor adverse impacts** on riverbed and canal sediments from placement of cofferdams and embankments and from construction of the boat ramp. **Short-term moderate adverse impacts** on soils from disturbance due to clearing, staging, and construction activities; however soils at the site are largely fill material from previous soil disturbance. **Long-term moderate adverse impacts** on geologic resources from permanent removal of bedrock material for installation of the intake, intake shafts, and intake conduits. *Operation:* **Long-term minor adverse impacts** on river material and sediments from localized sculpting of the river bottom and scouring of the riverbed around the submerged intake and increased sedimentation between the intake and Unnamed Island. **Long-term minor adverse impacts** on soils from new permanent structures; minor as the area is small and includes stormwater control practices.	*Construction:* **Short-term minor adverse impacts** on riverbed and canal sediments. Same as described for alternative 2. **Short-term moderate adverse impacts** on soils from disturbance. Same as described for alternative 2. **Long-term moderate adverse impacts** on geologic resources from permanent removal of bedrock material over a wider area due to trenching for installation of the intake conduits. *Operation:* **Long-term minor adverse impacts** on sediments, river material, and soils. Same as described for alternative 2.	Same type of impacts as alternative 2. The areas of geological resources (bedrock), sediments, and soils impacted would be nearly identical, and impact intensities would be the same.

Impact Topic	Alternative 1 No-action	Alternative 2 Tunneling to Onshore Shaft - West of Existing Intake (Preferred Alternative)	Alternative 3 Trenching/Tunneling to Onshore Shaft - West of Existing Intake	Alternative 4 Tunneling to Onshore Shaft - East of Existing Intake
Water Resources	**Long-term minor adverse impacts** to water resources due to the water quality of the Potomac River including runoff impacts from Watts Branch.	*Construction:* **Short-term minor adverse impacts** on water quality from potential sediment runoff from upland construction activities. **Short-term moderate adverse impacts** on water quality and water resources from turbidity during installation and removal of the cofferdams and embankments. *Operation:* **Negligible impacts** from permanent structures due to potential increase in stormwater runoff. **Long-term minor adverse impacts** on river qualities as the submerged intake would alter flow velocity and reshape the river bottom.	Same type of impacts as alternative 2. The impact intensities would be the same; however, the area of the riverbed temporarily disturbed from the cofferdams and embankments would be larger.	The areas impacted would be similar to alternative 2 with an additional embankment to allow for the temporary relocation of the towpath. Impact intensities would be the same as alternative 2.
Wetlands	**Long-term minor adverse impacts** since the existing WFP intake structure has permanently impacted the Potomac River riverine system	*Construction:* **Short-term minor adverse impacts** on the functions of wetland A from presence of the construction access road. **Short-term moderate adverse impacts** on the riverine systems (Potomac River and C&O Canal) from the installation and removal of the cofferdams and embankments. **Long-term minor adverse impacts** on the riverine systems and wetlands from construction components (construction access road, boat ramp, parking area, and new intake). *Operation:* **Negligible impacts** on the riverine systems due to the small area of permanent structures.	Same type of impacts as alternative 2. The impact intensities would be the same; however, the area of the riverine systems affected would be larger.	The areas impacted would be similar to alternative 2 with an additional embankment to allow for the temporary relocation of the towpath. Impact intensities would be the same as alternative 2.

Impact Topic	Alternative 1 No-action	Alternative 2 Tunneling to Onshore Shaft - West of Existing Intake (Preferred Alternative)	Alternative 3 Trenching/Tunneling to Onshore Shaft - West of Existing Intake	Alternative 4 Tunneling to Onshore Shaft - East of Existing Intake
Floodplains	**Long-term minor adverse impacts** since the existing WFP intake is a permanent structure in the 100-year floodplain.	*Construction:* **Short-term minor adverse impacts** on the 100-year floodplain from the installation and removal of the cofferdams and embankments. **Long-term minor adverse impacts** on the 100-year floodplain from construction of the temporary upland features and permanent structures within the floodplain. *Operation:* **Negligible impacts** on the 100-year floodplain from the operation of the submerged intake.	Same type of impacts as alternative 2. The impact intensities would be the same; however, the area of the 100-year floodplain disturbed would be larger.	Same type of impacts as alternative 2. The areas impacted would be nearly identical, and impact intensities would be the same.
Aquatic and Terrestrial Vegetation	**Negligible impacts** from the existing WFP intake and associated structures.	*Construction:* **Negligible impacts** on the aquatic and terrestrial vegetation from the construction of permanent features, which would create a permanent loss of vegetation in small localized areas. **Short-term minor adverse impacts** on aquatic vegetation from the installation and removal of the cofferdams and embankments. **Long-term moderate adverse impacts** on the terrestrial vegetation from clearing needed for construction of features and staging areas. Despite revegetation following construction, the mature deciduous woodland would not be restored in the period of analysis. *Operation:* **Negligible impacts** on the aquatic vegetation from scouring and sedimentation from operation of the submerged intake.	*Construction:* **Negligible impacts** on aquatic and terrestrial vegetation from construction of permanent features. Same as described for alternative 2. **Short-term moderate adverse impacts** on aquatic vegetation from the installation and removal of the cofferdams and embankments. **Long-term moderate adverse impacts** on the terrestrial vegetation from clearing needed for construction. Same as described for alternative 2. *Operation:* **Negligible impacts** on the aquatic vegetation from operation of the submerged intake. Same as described for alternative 2.	Same type of impacts as alternative 2. The areas of terrestrial and aquatic vegetation impacted would be nearly identical, and impact intensities would be the same.

Impact Topic	Alternative 1 No-action	Alternative 2 Tunneling to Onshore Shaft - West of Existing Intake (Preferred Alternative)	Alternative 3 Trenching/Tunneling to Onshore Shaft - West of Existing Intake	Alternative 4 Tunneling to Onshore Shaft - East of Existing Intake
Aquatic and Terrestrial Wildlife	**Negligible impacts** from the existing WFP intake and associated structures.	*Construction:* **Negligible impacts** on the aquatic and terrestrial wildlife from the construction of permanent features, which would create a permanent loss of habitat in small localized areas. **Short- to long-term minor to moderate adverse impacts** on the aquatic wildlife from the installation and removal of the cofferdams and embankments. **Long-term moderate adverse impacts** on the terrestrial wildlife from vegetation clearing needed for construction of features and staging areas. Despite revegetation following construction, the mature deciduous woodland would not be restored in the period of analysis, which could make the habitat unsuitable for wildlife species that currently inhabit the area. *Operation:* **Long-term minor adverse impacts** on aquatic wildlife from possible impingement and entrainment from operation of the submerged intake.	Same type of impacts as alternative 2. The impact intensities would be the same; however, the area of the terrestrial and aquatic habitats disturbed would be larger.	Same type of impacts as alternative 2. The areas of terrestrial and aquatic habitats impacted would be nearly identical, and impact intensities would be the same.

Impact Topic	Alternative 1 No-action	Alternative 2 Tunneling to Onshore Shaft - West of Existing Intake (Preferred Alternative)	Alternative 3 Trenching/Tunneling to Onshore Shaft - West of Existing Intake	Alternative 4 Tunneling to Onshore Shaft - East of Existing Intake
Special-Status Species	**Negligible impacts** from the existing WFP intake and associated structures.	*Construction:* **Negligible impacts** on the aquatic special-status plant southern water nymph from sedimentation during the installation and removal of the cofferdams and embankments. **Long-term minor adverse impacts** on the terrestrial special-status plants (floating paspalum, halberd-leaved hibiscus, and rough avens) from vegetation clearing needed for construction of temporary features, as well as permanent loss of habitat from construction of permanent features. Adverse impacts from clearing would be offset by restoration of the project area and time of year restrictions. ***Not likely to adversely affect*** the northern long-eared bat given vegetation clearing will not occur between April 15 and August 30. *Operation:* **No impacts** on special-status plants from operation of the new submerged intake.	Impacts would be the same as described for alternative 2.	Impacts would be the same as described for alternative 2.
Scenic Resources	**Long-term minor adverse impacts** on both towpath and river-users due to the presence of the existing WFP structures resulting in modification of the natural habitat.	*Construction:* **Short-term moderate adverse impacts** on scenic resources for towpath users from construction site fencing and for river users due to their view of the construction site from the river. **Long-term moderate adverse impacts** on scenic resources for visitors due to modification of the natural habitat. *Operation:* **Long-term minor adverse impacts** on scenic resources for all users as the mature deciduous woodland would not be restored in the period of analysis.	Impacts would be the same as described for alternative 2.	Impacts would be the same as described for alternative 2.

Impact Topic	Alternative 1 No-action	Alternative 2 Tunneling to Onshore Shaft - West of Existing Intake (Preferred Alternative)	Alternative 3 Trenching/Tunneling to Onshore Shaft - West of Existing Intake	Alternative 4 Tunneling to Onshore Shaft - East of Existing Intake
Cultural Resources *Historic Structures, Buildings, Objects, and Districts*	**Negligible impacts** on historic structures, buildings, objects, and districts from periodic maintenance on historic structures.	**Short-term minor adverse impacts** on the canal prism and towpath from construction activities. **Long-term moderate adverse impacts** on the C&O NHP historic district's landscape due to vegetation clearing and introduction of a boat ramp, parking area, and access road.	Impacts would be the same as described for alternative 2.	Impacts would be the same as described for alternative 2.
Cultural Resources *Archeological Resources*	**No impacts** on archeological resources since no ground disturbing activities would occur.	**Long-term minor adverse impact** on archeology site 18MO719 from the construction access road. Steel plates would be placed on the archeology site to minimize the traffic load on the archeological deposits. **Long-term moderate adverse impact** on archeology site 18MO633 from construction of the boat ramp, parking area and access road, and the temporary construction access road; however, the impacts would be mitigated by conducting data recovery excavations prior to ground disturbing activities. A Memorandum of Agreement will be prepared that stipulates appropriate treatment measures to minimize or mitigate these adverse impacts. Consultation with Maryland Historic Trust is ongoing.	Impacts would be the same as described for alternative 2.	Impacts would be the same as described for alternative 2.
Cultural Resources *Cultural Landscapes*	**Negligible impacts** on cultural landscapes since regular maintenance of the canal and towpath would sustain the established landscape.	**Short-term moderate adverse impacts** on the cultural landscape due to the introduction of construction equipment, temporary access road, temporary embankments, and fencing. **Long-term moderate adverse impacts** on the cultural landscape from the addition of new features (e.g., boat ramp, parking lot, access road) to the landscape and from the clearing of vegetation at the site [area cleared would not return to its current state (deciduous woodlands) in the period of analysis].	Impacts would be the same as described for alternative 2.	Impacts would be the same as described for alternative 2.

Impact Topic	Alternative 1 No-action	Alternative 2 Tunneling to Onshore Shaft - West of Existing Intake (Preferred Alternative)	Alternative 3 Trenching/Tunneling to Onshore Shaft - West of Existing Intake	Alternative 4 Tunneling to Onshore Shaft - East of Existing Intake
Visitor Use and Experience	**Long-term minor adverse impact** due to the minor intrusion of the existing WFP on the visitor experience.	*Construction:* **Short-term, moderate, adverse impacts on** visitor use during construction from altered use of the towpath and river. *Operation:* **Long-term minor adverse impacts** on visitor use and experience during operation of the submerged intake from alteration of the environment and length of time needed for full restoration of the cleared vegetation.	Impacts would be the same as described for alternative 2.	Impacts would be the same as described for alternative 2.
Human Health and Safety	**Negligible impacts** to health and safety currently at the project site.	*Construction:* **Short-term, minor, adverse impacts** on the health and safety of park visitors, NPS staff, and WSSC staff and contractors during construction from use of heavy equipment and construction activities. *Operation:* **Negligible impacts** on health and safety from the operation of the submerged intake.	Impacts would be the same as described for alternative 2.	Impacts would be the same as described for alternative 2.
Land Use	**No impacts** on land use, as existing conditions would remain unchanged.	*Construction:* **Long-term, moderate and adverse impacts** to land use along a 0.2-mile section of the towpath from vegetation clearing; the area would not be restored to current conditions within the period of analysis. *Operation:* **Negligible impacts** on land use since new properties, purchased as part of the land exchange would be comparable to current NPS lands.	Impacts would be the same as described for alternative 2.	Impacts would be the same as described for alternative 2.

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AFFECTED ENVIRONMENT

OVERVIEW

This section describes the existing environment that would be affected if the proposed action were implemented. In accordance with NEPA, CEQ guidelines, 32 CFR Part 989, and the NHPA, the description of the affected environment focuses on those resources and conditions likely subject to impacts. This includes: geology and soils; water resources (water quality and stormwater management); wetlands; floodplains; vegetation (aquatic and terrestrial); wildlife (aquatic and terrestrial); special-status species; scenic resources (aesthetics and viewsheds); cultural resources (historic structures, archeology, and cultural landscapes); visitor use and experience; human health and safety; and land use. The potential environmental effects on these resources from the alternatives being considered are presented in the "Environmental Consequences" section.

GEOLOGY AND SOILS

Geology

The project site is located within the Piedmont Geological Province. This province is composed of Eastern Piedmont Metasedimentary Rocks which includes sedimentary rock, such as sandstones and shales that have undergone compositional change due to intense heat and pressure. Based on the U.S. Geological Survey (USGS) studies and geotechnical surveys at the project site, two bedrock members are expected to be present at the project site: Upper Pelitic Schist and a Metagraywacke. Due to its high durability, Upper Pelitic Schist is anticipated to be more common within the project site. Schist is crystalline rock that has developed a definite foliation and a well-developed parallelism of more than 50% of the minerals present, commonly mica and hornblende. This member is composed of albite-chlorite-muscovite-quartz schist with sporadic thin beds of laminated micaceous quartzite. The Metagraywacke member is composed of an interbedded chlorite-muscovite metagraywacke with fine-grained chlorite-muscovite schist. The rock formation in the area is highly folded and deformed with the presence of shear zones filled with rock fragments and clay and potential locked-in tectonic stresses in rock (MWH 2004).

In general, the project site is covered with a layer of overburden fill and soil of residual origin and variable thickness underlain by parent bedrock. The overburden soils in the vicinity of the alternative onshore shaft locations were altered during construction of the WFP. Soils were removed during excavation. Fill consisting of excavated rock and soil from the WFP excavation and the original overburden material was replaced in the excavations. The ground surface was raised up to 25 feet in the vicinity of the existing intake. The thickness of fill varies from approximately 45 feet at the Raw Water Pumping Station No. 2, located at the northern edge of the project site, to approximately 20 feet approaching the C&O Canal. Between the C&O Canal and the riverbank, the thickness of overburden material varies between approximately 20 feet and 40 feet. Overburden material in the river is generally about 1-foot thick in mid-channel, but is thicker near the shores of islands and along the north riverbank. The overburden material is generally medium dense to dense silty sand, gravely sand, and hard silty clay. Large rock boulders are present where material from the previous construction has been deposited. Large rock is also present on the surface of restored surfaces (MWH 2004).

The Lock 13 wetland mitigation site is located approximately 8 miles downstream of the project site, and is also located within the Piedmont Geological Province with Upper Pelitic Schist bedrock (Maryland Geological Survey 2000); the characteristics of this member are described above.

Geotechnical Investigations

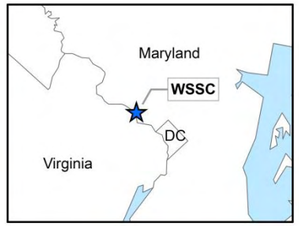
Geotechnical borings were conducted in the vicinity of the project area in 2005 (six samples) and in 1997/1999 (three samples) (MWH 2007). In 1979, Borehole WCC-1 was drilled within the footprint of the Raw Water Pumping Station No. 2. Rock was encountered at ground surface [185.9 feet above MSL] to the bottom of the boring (146.9 feet above MSL), and was described as a "Meta-sandstone-siltstone with varying degrees of mineralization, becoming harder (stronger) with depth." The bedrock was reported as folded and weathered. Observed dips were between 60 and 70 degrees, with the jointing parallel to the bedding strike.

Borehole WCC-2 was drilled on the opposite end of the Raw Water Pumping Station No. 2 footprint in 1979. Rock was encountered at a depth of 9.0 feet below ground surface, and was also described as a "Meta-sandstone-siltstone." The foliation dips were between 70 to 75 degrees, and the rock was highly contorted and weathered.

In 1999, Borehole E-1 was advanced west of the bridge over the C&O Canal. Rock was encountered at a depth of 38 feet below ground surface. The boring was advanced through the Upper Pelitic Schist and the Metagraywacke. This boring identified the subsurface bedrock as "highly folded and deformed," and encountered the Upper Pelitic Schist at a depth of 71 feet higher elevation of the overburden-rock interface.

In 2005, a series of six boreholes (A–F) were drilled at the project site to characterize the site geology along the alignment of the proposed intake conduits. The boreholes were extended to approximately 90 feet into the rock. The locations of the boreholes are described below and shown in figure 8 (MWH 2007):

- **Borehole A –** Located south of the C&O Canal NHP and west of the existing intake access road.
- **Borehole B –** Located south of the C&O Canal NHP approximately 500-feet west of Borehole A.
- **Borehole C –** Located near the proposed intake location in the river.
- **Borehole D –** Located in the river immediately south of Unnamed Island.
- **Borehole E –** Located north of the C&O Canal along an existing road.
- **Borehole F –** Located in the river immediately north of Unnamed Island.



Legend

Boring Location

L:\GIS\Data\Northeast\Maryland\WSSC_Potomac_Intake\MXD\Report\EA_Figure 7 Boring Sample Locations, 2005 Geotechnical Investigation.mxd

Figure 8
Boring Sample Locations, 2005 Geotechnical Investigation

Source:
MWH Americas 2007
ESRI 2012

Projection: NAD 83 Maryland StatePlane Feet
Date: January 2015

0 100 200
Feet

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A 45-foot-thick layer of unconsolidated residual soil consisting of fill, silty sand, sandy gravel, and silty clay was encountered in the onshore boreholes E (near the Raw Water Pumping Station) and the previously drilled E-1 south of the intake access road bridge. The overburden thickness is approximately 20 feet at borehole A, just south of the C&O Canal NHP. A thin layer of 0- to 3-feet thick unconsolidated soil and sediments was encountered in the river boreholes. The consistency of the overburden/fill material is generally medium dense to dense. Specifications for the construction of the Potomac WFP indicated that the contractor was permitted to use rock from the excavations in restoring the site after construction at the locations of borings A, E, and E-1. Some rock and boulders were encountered in boreholes A and E above the bedrock (MWH 2007).

Metasedimentary bedrock of Metaquartzite Schist/Gneiss ("Metaquartzite") and Metagraywacke Schist ("Metagraywacke") formations were encountered in layers in the boreholes below the overburden and sediment material. The Metaquartzite Schist/Gneiss is generally classified as slightly weathered, closely to moderately fractured, slightly broken to massive, fine grained with quartz veins and hard to very hard. The Metagraywacke Schist is classified as greenish gray, closely to widely fractured, occasionally massive to broken, hard, and fine to medium grained Muscovite/Chlorite Schist (MWH 2007).The upper 10 feet of the bedrock is generally found to be weathered/fractured. The Metagraywacke layer was encountered below the Metaquartzite formation in all boreholes except in borehole E-1. In borehole E-1, a lens of Metagraywacke was located within the Metaquartzite between 120 and 143 feet above MSL. A Metagraywacke lens was not found in the angle borehole A, located 15-feet east of the previously drilled borehole E-1. This difference may result from the presence of a narrow shear zone between borehole E-1 and angle hole A (MWH 2007).

Soils

The U.S. Department of Agriculture's Natural Resource Conservation Service conducted a soil survey for Montgomery County, Maryland in 1995 (NRCS 1995). The soils present in the vicinity of the Potomac WFP range from poorly drained to well drained, depending on topography and soil texture, which is mainly silt loam. None of the soils at the site are listed as hydric soils in Maryland (NRCS 2012). The land on which the project area lies is classified as Urban Land. Each soil series present in the vicinity of the Potomac WFP is described in table 5. Most of the project site is composed of the Lindside series, which consists of very deep, moderately well drained soils located within the floodplain of the Potomac River. Lindside silt loam soils have a depth to the water table of 18 to 36 inches in late winter/early spring, and the depth to bedrock of greater than 5 feet (NRCS 1995). As stated in the description of the geotechnical investigations, the soils at the project site are unconsolidated residual soils that are a mixture of fill, silty sand, sandy gravel, and silty clay (MWH 2007). These soils were disturbed from the preceding WFP construction activities.

The soils at the Lock 13 wetland mitigation site were historically classified as Rock outcrop-Blocktown complex. This complex is comprised of approximately 80% rock outcrop and 20% Blocktown and similar soils. The soils are well-drained with a slope of 0 to 15% (NRCS 2015). However, when the wetland mitigation site was delineated in December 2014, investigators noted a rock face north of the mitigation site, suggesting that rock material had most likely been removed from the area of the wetland mitigation site. During the delineation, the investigators examined the soils in the top 12 inches. The soils were determined to be silt loam with a depleted matrix. At both sample locations within the wetland mitigation site, the soils were saturated and surface water was present.

Table 5. Characteristics of Soil Series in the Vicinity of the Potomac WFP

Soil Type	Permeability (inches/hour)	Available Water Capacity	Slope Percent	Development Constraints
Brinklow-Blocktown channery silt loams	0.2 to 0.6 (Brinklow) 0.6 to 2.0 (Blocktown)	Low - Brinklow Very Low - Blocktown	15 to 25	depth to bedrock slope severe erosion
Lindside silt loam	0.2 to 0.6	Very High	0 to 3	occasional flooding wetness during excavations
Blocktown channery silt loam	0.6 to 2.0	Very Low	15 to 25	depth to bedrock slope rock outcrops
Blocktown channery silt loam	0.6 to 2.0	Moderate	25 to 45	depth to bedrock rock outcrops slope

Source: NRCS 1995

WATER RESOURCES

Water Quality

Potomac River

MDE is responsible for amending and regulating water quality standards. The purpose of water quality standards is to protect, maintain, and improve the quality of Maryland's surface waters. The components of the water quality standards include the following (MDE 2013):

- Designated Use – A designated use is a description of an appropriate intended use by humans and/or aquatic life for a waterbody.
- Water Quality Criteria – A numeric criteria that sets the minimum water quality to meet designated use.
- Antidegradation – Maryland's Antidegradation Policy assures water quality continues to support designated uses.

The Maryland Surface Water Use Designation for the waters of the Potomac River Montgomery County is Use I-P. In general Use I-P is for water contact recreation, protection of aquatic life, and public water supply (COMAR 2013). More specific designated uses that apply to Use I-P include the following:

- Water contact sports
- Leisure activities involving direct contact with surface water
- Fishing
- Growth and propagation of fish (not trout), other aquatic life and wildlife
- Agricultural water supply
- Industrial water supply

The Potomac River Montgomery County watershed is not attaining its designated use of protection of aquatic life due to biological impairments. As an indicator of designated use attainment, MDE uses Benthic and Fish Indices of Biotic Integrity developed by the MDNR Maryland Biological Stream Survey (MBSS) (MDE 2011).

Section 303(d) of the federal CWA and the USEPA's implementing regulations direct each state to identify and list waters that do not achieve water quality standards established for their designated use. These waters are known as water quality limited segments. For each water quality limited segment listed on the Integrated Report of Surface Water Quality in Maryland (Integrated Report), the State is to either establish a TMDL of the specified substance that the waterbody can support without violating water quality standards, or demonstrate via a Water Quality Analysis that water quality standards are being met (MDE 2011). A TMDL is an estimate of the amount of load of a particular pollutant that a waterbody can assimilate and still meet water quality standards (MDE 2012).

The Potomac River Montgomery County Watershed was included in the 2012 §303(d) list of impaired surface waters for several of its tributaries in different §303(d) listing categories. The Potomac River Montgomery County Watershed is listed under Category 5 of the 2012 Integrated Report as impaired for impacts on fishing due to polychlorinated biphenyls in fish tissue and impaired for aquatic life and wildlife due to total phosphorus, total suspended solids, chlorides, and sulfates. The watershed was also listed under Category 3 for the aquatic life and wildlife designated use for high pH; however, additional data are required to determine whether the elevated pH is due to natural conditions or anthropogenic stressors (MDE 2012).

The water quality of the Potomac River in the vicinity of the existing WSSC intake is affected by conditions throughout the Potomac River Basin. Turbulence and natural processes mix the water so that the effects of runoff from distant areas of the watershed cannot be distinguished at the project site. MDE and WSSC conducted a SWA for the Potomac WFP in 2002 that was performed in accordance with the 1996 Safe Drinking Water Act Amendments (Becker and O'Melia 2002). This report identified potential contaminants and their sources, and evaluated impacts of runoff from Watts Branch and Seneca Creek on water quality within the vicinity of the Potomac WFP. The conclusions of the study indicated that runoff from Watts Branch greatly impacts raw water quality at the existing intake location, particularly due to sediment concentrations. It was suggested that a submerged mid-channel intake structure would provide the flexibility to avoid the water quality impacts originating from Watts Branch runoff. The effect of runoff from Seneca Creek on water quality was not quantified and was assumed to have similar effects at the existing intake compared to a mid-channel withdrawal location. It was concluded that "...any impact of Seneca Creek on the submerged channel intake location will be very small compared to the current impact of Watts Branch on the existing intake." The SWA recommended that additional effort to define the impacts of Seneca Creek would be useful (Becker and O'Melia 2002). The *Existing Conditions and Data Report*" (MWH 2004) notes that there is a correlation between Seneca Creek conditions and existing intake raw water quality. Aerial photos of the Potomac River indicate that the effects of runoff from Seneca Creek likely extend to the Potomac WFP intake and apparently affect the existing intake site more than it would affect a mid-channel location.

The general groundwater flow is toward the Potomac River. The normal river level is approximately 160 feet above MSL. Groundwater levels are likely also influenced by the water level in the C&O Canal approximately 100-feet north of the river, which is generally at approximately 173 feet above MSL. The C&O Canal is contained within a clay liner, which may limit its influence on groundwater levels. Groundwater in borehole A, located approximately 50 feet from the river, was encountered at 161+/- feet above MSL or just above the river (MWH 2007).

WSSC Water Quality Studies

Water quality studies were performed by WSSC that reflect the Potomac River Basin conditions offshore of the Potomac WFP between the existing intake and Watkins Island, as well as the effects of runoff from upstream tributaries, mainly Watts Branch. Studies and detailed water quality analyses were performed to determine the relationship between offshore raw water quality and hydrologic conditions within the Potomac River that assisted in selecting a suitable location for a submerged offshore intake. The following is a summary of the study results presented in the *Existing Conditions and Data Report* (MWH 2004).

Water quality samples collected by WSSC showed that during storms, runoff from Watts Branch has a rapid negative effect on water quality in the vicinity of the current Potomac WFP intake along the shoreline. In general, impacts on offshore water quality are minor compared to near shore. More specifically, during and after storm events, water discharging from Watts Branch, 1,500-feet upstream, results in higher concentrations of pollutants along the shoreline of the Potomac River at the current intake location, and concentrations diminish with distance downstream and with distance offshore. Figure 9 is a conceptual diagram of the Potomac River in the vicinity of the Potomac WFP intake illustrating the plume from Watts Branch and how the impact on water quality varies with distance offshore (darker shades indicate higher concentrations of contaminants). The drawing is conceptual and the plume size is intended to be illustrative. Plume geometry would vary with hydrological and meteorological conditions.

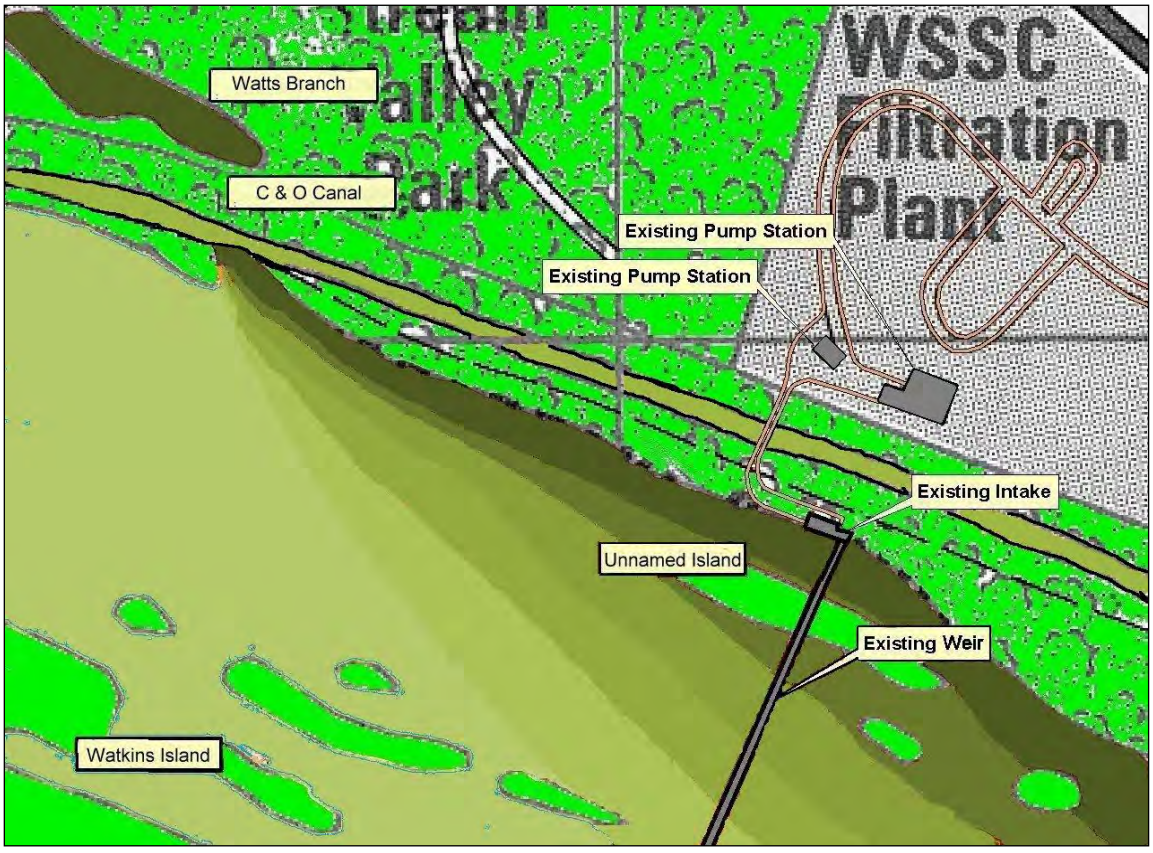


Figure 9. Schematic of Watts Branch Runoff Influence on Water Quality in the Potomac River (darker shades indicate poorer water quality)

Table 6 summarizes raw water quality data collected by WSSC between 1996 and 2002 in the Potomac River. The data demonstrate the effect of Watts Branch, on water quality at the existing intake. The data presented compare water quality during periods of high Watts Branch influence during local storms, and periods of moderate Watts Branch influence (all other conditions) (MWH 2004).

Table 6. Potomac River Water Quality Data

Parameter	During Periods of High Watts Branch Influence	During Periods of Moderate Watts Branch Influence
Occurrence (% of time)	20	80
Turbidity (NTU)	42.7	25
Total Organic Carbon (mg/L)	3.9	3.3
pH	7.9	8.0
Alkalinity (mg/L as $CaCO_3$)	76.2	83.3

$CaCO_3$ = calcium carbonate
mg/L - milligrams per liter
NTU = nephelometric turbidity units

Table 7 (MWH 2004) illustrates both the influence of Watts Branch and the difference between near-shore and off-shore locations. It is apparent that upstream tributaries affect water quality during periods of both high and moderate Watts Branch influence, indicating that a mid-channel intake would improve raw water quality throughout the year.

Table 7. Effects of Flow Conditions on Raw Water Quality Average Daily Values of Key Water Quality Parameters

Parameter	During Periods of High Watts Branch Influence		During Periods of Moderate Watts Branch Influence	
Percent of Time	20		80	
	Nearshore	**Offshore**	**Nearshore**	**Offshore**
Suspended Solids (mg/L)	97	30	47	41
Turbidity (NTU)	59	23	28	29
pH	7.6	8.1	7.8	8.0
Alkalinity (mg/L as $CaCO_3$)	74	78	77	80
Total Organic Carbon (mg/L)	5.0	4.6	4.3	4.0
Fecal Coliform (MPN)	20,000	600	600	600

$CaCO_3$ = calcium carbonate
mg/L = milligram per liter
MPN = most probable number
NTU = nephelometric turbidity units

The *Existing Conditions and Data Report* (MWH 2004) also compared plant performance data during periods of high and moderate Watts Branch influence as shown in table 8.

Table 8. Potomac WFP Plant Performance Data

Parameter	During Periods of High Watts Branch Influence	During Periods of Moderate Watts Branch Influence
Occurrence (% of time)	20	80
Raw Water Solids Load (tons/day)	27.6	17
PACl Usage (tons/day)	2.8	2.1
Lime Usage (tons/day)	2.8	2.3
Coagulant Aid (tons/day)	0.2	0.2

PACl = polyaluminum chloride

The most noticeable effect of Watts Branch runoff on water quality is the increase in turbidity during local storms. Turbidity is affected by numerous factors, including the concentration of suspended solids and color. More water treatment chemicals must be used at the Potomac WFP during periods of high influence from Watts Branch than during periods of moderate influence.

Table 9, which is based on data collected from 1999 to 2000 by WSSC, presents the variation in key water quality parameters with increasing distance from the shoreline. Water quality samples were taken on nearly 60 occasions during a variety of conditions. The samples collected 50-feet offshore best represent the conditions at the existing intake.

Table 9. Water Quality Parameters in Relation to Distance Offshore

Parameter	Distance Offshore (feet)			
	50	285	585	885
Suspended solids (mg/L)	126	41	28	16
Turbidity (NTU)	64	23	15	13
pH (standard units)	7.8	8.1	8.2	8.2
Alkalinity (mg/L as $CaCO_3$)	73	83	86	87
Total organic carbon (mg/L)	4.3	3.7	3.5	3.4
Fecal Coliform (MPN)	6,163	756	592	734

$CaCO_3$ = calcium carbonate
mg/L = milligram per liter
MPN = most probable number
NTU = nephelometric turbidity units

As the distance from the shoreline increases, suspended solids, turbidity, and total organic carbon concentrations decrease, while alkalinity and pH increase or remain relatively constant. The water quality data were further analyzed to relate the effects of runoff from Watts Branch, Seneca Creek, and the mainstem of the Potomac River on offshore contaminant concentrations. Reasons for variability in contaminant concentrations included seasonal variations in temperature, vegetation, soil erosion, and basin-wide management practices.

Runoff from Watts Branch results in a rapid change in raw water quality conditions at the existing intake. Raw water changes occur rapidly nearshore because of the proximity of Watts Branch. Hourly records of plant operation during late 1999, 2000, and 2002 show that, during local storms, the raw water turbidity values frequently change at rates between 200 and 400 nephelometric turbidity units (NTU)/hour and can change by up to 1,000 NTU per hour. Values of pH frequently change by rates of 0.3 to 0.5 standard units

per hour and can change by up to 1.4 standard units per hour. Alkalinity frequently changes by rates of 2 to 4 mg/L/hour [equivalent calcium carbonate (CaCO3)] and can change by up to 6 mg/L/hour. Suspended solids values can be expected to change in relation to turbidity values at rates up to 1,500 mg/L/hour.

Changes in raw water quality occur much more gradually offshore because of the mixing and dispersion of the upstream tributaries. The hourly rate of change in the offshore suspended sediment concentration was estimated from USGS records for the Potomac River at Point of Rocks for the 2002 to 2003 period. Typical rates of change during storms ranged from 10 to 30 mg/L/hour. The maximum estimated rate was approximately 50 mg/L per hour. The maximum hourly rate during less frequent storms and floods is expected to be approximately 200 mg/L/hour, approximately an order of magnitude less than the maximum recorded rate for the WFP intake. Rates of change in turbidity, pH, alkalinity, and pathogens also likely would be significantly less offshore than near shore.

Overall, the results demonstrate that an offshore submerged channel intake would provide access to water that is of substantially better quality and less susceptible to rapid changes in water quality than the existing intake throughout the year (MWH 2004).

Water Quality Permits

The Potomac WFP currently has an MDE Permit for discharging solids into the Potomac River. The amount allowed to be discharged depends upon Potomac River flows, as recorded at the Little Falls gage, as well as intake solids loads. The solids are discharged from an outfall located downstream of the diversion weir, a barrier designed to alter its flow characteristics (MWH 2004).

Stormwater Management

Regional

Stormwater runoff generates flow and carries pollutants to receiving water bodies. Because of the close connection between stormwater and water quality, stormwater management is necessary to protect and improve water quality. Stormwater management techniques help reduce poor water quality in streams, which partially results from an increase in impervious surface covering a watershed. State and county monitoring data show that water quality is continuing to degrade in many portions of Montgomery County and regionally as growth continues, especially in older developed areas and areas with increasing impervious cover (Montgomery County Planning Department 2009). For Montgomery County, water quality issues can be addressed by retrofitting older development, installing pollution prevention techniques, implementing Environmental Site Design, and accommodating growth through redevelopment. Designing redevelopment projects to reduce impervious cover such as parking lots, and improving stormwater management would also help to improve water quality (Montgomery County Planning Department 2009).

According to the 2003 Watts Branch Watershed Restoration Study (Montgomery County DEP 2003), the Watts Branch watershed is close to fully developed and consists of residential land uses with pockets of high density commercial, and research and development centers. The streams within the Watts Branch watershed generally flow through a narrow, forested, riparian parkland corridor interspersed with residential, commercial, transportation (including Interstate 270), and recreational uses. The City of Rockville is situated at the headwaters of Watts Branch, while the I-270 corridor traverses the upper western section of the watershed. The Watts Branch watershed outside of the City of Rockville is primarily composed of large-lot residential properties. The watershed study also indicated that 33 of the 62 subwatersheds are greater than 10% impervious (Montgomery County DEP 2003). Impervious surface

cover and development within the Watts Branch watershed was found to be the main cause of the increasing occurrence and severity of high stream flows. The resulting increase in erosion and suspended solids loading from stormwater runoff has altered the hydrologic conditions of Watts Branch, and is expected to continue until the streambed reaches a steady hydrologic state, which may take several decades (Becker and O'Melia 2002).

The Watts Branch watershed contains 25 stormwater management facilities that control a drainage area of greater than 25 acres and numerous facilities that treat smaller drainage areas. Montgomery County regulations require stormwater management on all developed lot sizes (Montgomery County DEP 2003).

WSSC Potomac WFP

The Potomac WFP manages stormwater using stormwater drains, a stormwater management pond, and buried sand filters. The ground elevation of the Potomac WFP site is relatively steep, sloping from the north side of the plant near River Road to the C&O Canal NHP. Runoff from impervious surfaces throughout the plant travels to plant stormwater drains. Water in these storm drains travel to the main plant drain that ultimately discharges to the Potomac River. Runoff on pervious areas infiltrates into the ground, or runs along the surface to the C&O Canal and the Potomac River.

WSSC has incorporated a stormwater management pond at the Solids Handling Facility, located at the highest elevation of the plant's property. The stormwater pond collects water from surrounding impervious areas; and holds water within the pond so solids can settle out to the bottom. The pond water then flows into a storm drain which discharges into Watts Branch.

The third stormwater program includes a buried sand filter that was constructed for the hydropneumatic surge tanks to treat stormwater. The buried sand filter discharges to the main plant drain, which ultimately discharges to the Potomac River.

There are no stormwater management structures in the area south of the C&O Canal where it slopes toward the Potomac River. Stormwater runoff from this area generally follows the ground surface to the Potomac River. The ground surface between the existing intake at the Potomac River and the C&O Canal was regraded following intake construction and slopes to the C&O Canal, so that stormwater runoff from this area follows the ground surface to the C&O Canal.

WETLANDS

Section 404 of the CWA and a number of state laws and provisions regulate activities in wetlands. Executive Order 11990, "Protection of Wetlands", directs all federal agencies to avoid, to the extent possible, long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. In the absence of such alternatives, federal agencies must modify actions to preserve and enhance wetland values and minimize degradation. Consistent with Executive Order 11990 and Director's Order 77-1: *Wetland Protection*, NPS adopted a goal of "no net loss of wetlands." Director's Order 77-1 states that for new actions where impacts on wetlands cannot be avoided, proposals must include plans for compensatory mitigation that restores wetlands on NPS lands, where possible, at a minimum acreage ratio of 1:1.

In Maryland, wetlands are protected under the following regulations: the CWA (Section 404), Maryland Nontidal Wetlands Protection Act, and the Maryland Tidal Wetlands Act. The Nontidal Wetlands Protection Act, enforced by MDE, seeks to protect nontidal wetlands by regulating and restricting activities that could impact nontidal wetlands or waters of the state. The Act also helps to render "no net

loss" in wetlands, by requiring mitigation or compensation for any wetland loss. All activities within a nontidal wetland or its 25 ft buffer require a nontidal wetland permit or a letter of exemption. MDE regulates activities within nontidal wetlands including grading or filling, excavating or dredging, changing existing drainage patterns, disturbing the water level or water table, and destroying or removing vegetation.

For the purpose of implementing Executive Order 11990, an area in an NPS unit that is classified as a wetland, according to the USFWS *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979), is subject to Director's Order 77-1 (with the exception of deepwater habitats). The Cowardin et al. (1979) wetland definition encompasses more aquatic habitat types than the definition and delineation manual used by the USACE for identifying wetlands subject to Section 404 of the CWA. The 1987 *USACE Wetlands Delineation Manual* and the regional supplement require that three parameters (hydrophytic vegetation, hydric soil, wetland hydrology) must all be present in order for an area to be considered a wetland. The Cowardin et al. (1979) definition includes such wetlands, but also adds some areas that, though lacking vegetation and/or soils due to natural physical or chemical factors like wave action or high salinity, are still saturated or shallow inundated environments that support aquatic life (e.g., unvegetated stream shallows, mudflats, and rocky shores). This document presents wetlands as defined by Cowardin et al. (1979) and consistent with Director's Order 77-1. Under the Cowardin definition, a wetland must have one or more of the following three attributes:

1. The land supports predominantly hydrophytes (wetland vegetation), at least periodically.

2. The substrate is predominantly undrained hydric soil.

3. The substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

In addition, under the Cowardin definition, wetland deepwater habitat boundaries are described as a depth of up to two meters (6.6 feet) at low water for riverine wetlands. Areas containing SAV would be characterized as riverine wetland areas. Details on SAV can be found in the "Vegetation" section.

The USFWS' National Wetlands Inventory (NWI) produces information on the characteristics, extent, and status of the nation's wetlands and deepwater habitats. The USFWS definition of wetlands is similar to the NPS definition of wetlands in that only one of three parameters (hydric soils, hydrophytic vegetation, and hydrology) is required to characterize an area as a wetland, based upon the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979). The USFWS's objective of mapping wetlands and deepwater habitats is to produce "reconnaissance-level information on the location, type, and size of these resources" (USFWS 2013). NWI maps are prepared by the USFWS from the analysis of high altitude imagery and wetlands are identified based on vegetation, visible hydrology, and geography. According to the NWI wetlands mapper, two wetland areas were identified in the project area, not including the Potomac River. One wetland area was classified as a freshwater pond and labeled as palustrine unconsolidated bottom, permanently flooded, and excavated (PBUHx). The second wetland area was located within the Unnamed Island and classified as a forested wetland and labeled as palustrine forested, broad-leaved deciduous, and temporarily flooded (PFO1A) (USFWS 2013). NWI maps are not always consistent with the exact wetland type or accurate when ground-truthing of the site is conducted. Therefore, a wetland delineation of the site was conducted to determine exact locations and current Cowardin Classification of wetlands in the project area; results are discussed below.

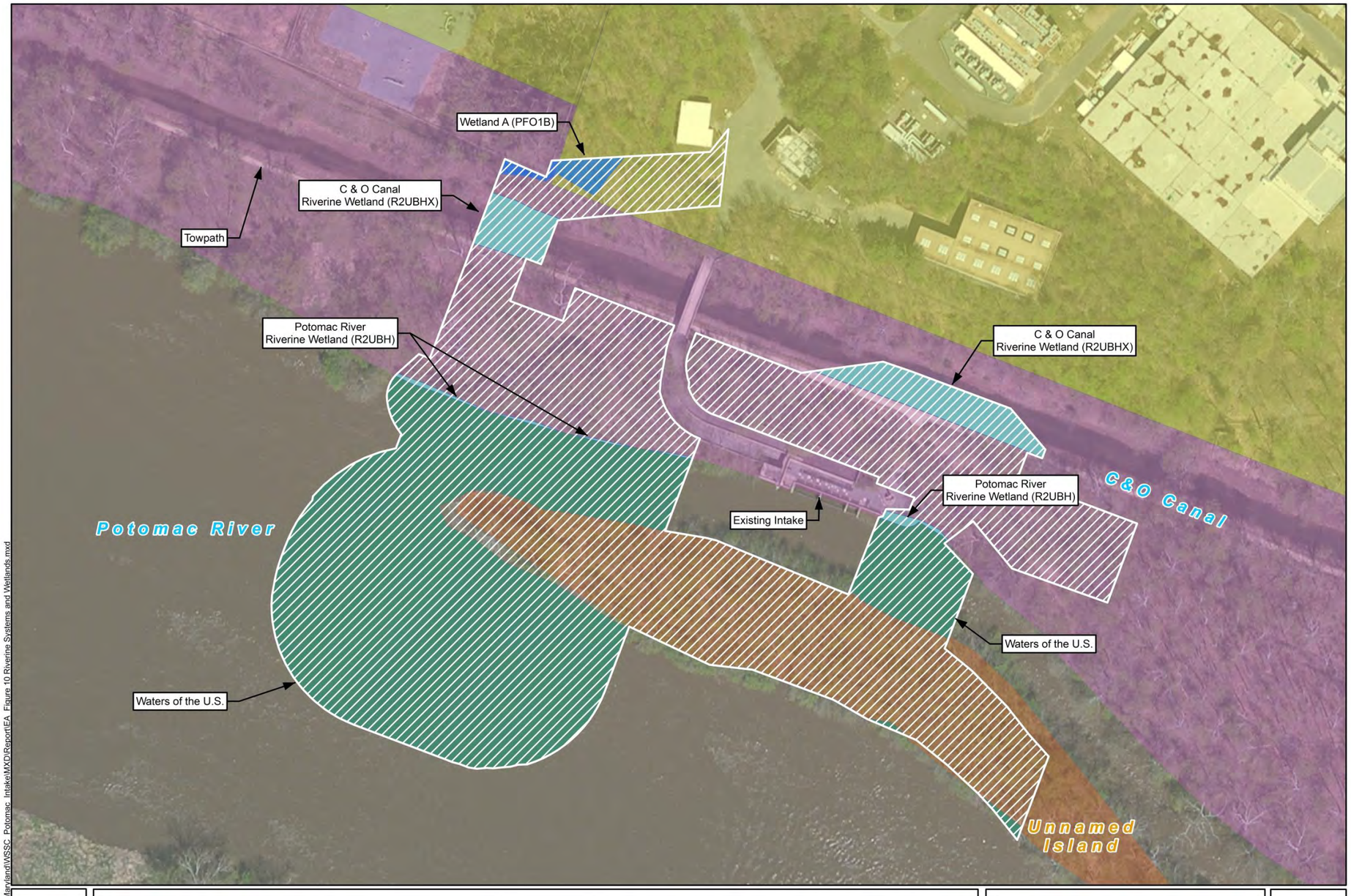
In November 2013 natural and artificial wetlands in the project area were delineated according to the guidance in NPS Director's Order 77-1: *Wetland Protection* (2002). Wetlands were identified in accordance with the 1987 *Corps of Engineers Wetland Delineation Manual* (USACE 1987) and in

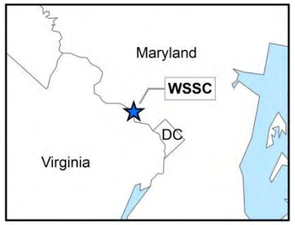
conjunction with USFWS's Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). One wetland (wetland A) and Waters of the U.S. (Potomac River and C&O Canal) were identified and flagged during the survey. According to the wetland delineation, the mapped riverine systems (also considered Waters of the U.S.) did not have associated wetlands beyond the channels above the ordinary high water mark (OHWM). Wetland A is described briefly in the paragraphs that follow and in table 10. Wetlands described meet the NPS definition of a wetland described above as well as the definition of the USACE wetlands/Water of the U.S. The wetlands on the project site are either located on NPS land, WSSC land, or land belonging to the State of Maryland (figure 10). For a more detailed description of wetland A, see the SOF in appendix E.

Table 10. Wetlands and Waters of the U.S. Delineated in the Project Area

Delineated Feature	Resource/Cowardin Classification	Dimensions within the Project Area (acres)	Dimensions within the Project Area (square feet)
Wetland A (NPS only)	PFO1B	0.020	871.2
Wetland A (WSSC only)	PFO1B	0.057	2,482.92
Wetland A (Total)	PFO1B	0.077	3,354.12
Riverine System (Potomac River- NPS only)[(a)(b)]	R2UBH	0.032	1,393.92
Riverine System (C&O Canal) [(a)(b)]	R2UBHx	0.381	16,596.36
Waters of the U.S.[(a)(b)]	W.U.S.	3.869	168,533.64
Potomac River (Total)	R2UBH/W.U.S.	3.899	169,840.44
Total Wetlands and Riverine Wetlands Mapped in Project Area		**0.49**	**21,344.40**
Total Waters of the U.S. Mapped in Project Area[(a)]		**3.869**	**168,533.64**

(a) Area values in acres have been rounded for brevity; this may cause area values in square feet to appear not to be a direct conversion from the acre value.
Wetland Definitions:
PFO1B – Palustrine, forested, broad-leaved deciduous
R2UBH – Riverine, lower perennial, unconsolidated bottom, permanently flooded
R2UBHx – Riverine, lower perennial, unconsolidated bottom, permanently flooded, excavated
W.U.S. – Waters of the U.S.





Legend

Construction Area Limit (Temporary)

Wetlands

Riverine Wetland (NPS)

Wetland

Waters of the U.S. (USACE)

Land Parcels by Owner

NPS

State of Maryland

WSSC

L:\GISData\Northeast\Maryland\WSSC_Potomac_Intake\MXD\Report\EA_Figure 10 Riverine Systems and Wetlands.mxd

Figure 10
Wetlands Including Riverine Wetlands Delineated in the Project Area

Source:
Black & Veatch 2013, PEER 2013
ESRI 2012

Projection: NAD 83 Maryland StatePlane Feet
Date: January 2015

0 100 200
Feet

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Wetland Descriptions and Values

Wetland A – Wetland A is identified as a PFO1B wetland located in the northwest corner of the project area. The portion of wetland that lies within the project area totals 3,354.12 square feet (0.077 acre); however, the wetland extends outside of the project area to the north and west. Wetland A is located along the bank of the C&O Canal and extends beyond an existing fenceline, which is located outside of the project area. The wetland lies on both NPS and WSSC property. There are 871.20 square feet (0.020 acres) of the wetland on NPS property and 2,482.92 square feet (0.057 acre) of the wetland on WSSC property. The three parameters (soils, hydrology, and vegetation) were found at this site. Change in vegetation and surrounding slopes were the used to define the limits of wetland A. This wetland is adjacent to the C&O Canal and contributes to its hydrology and water quality. Therefore, under the USACE Jurisdictional Determination requirements, this wetland would be classified as a relatively permanent water (RPW) or wetland directly abutting RPWs that flow directly or indirectly into traditional navigable waters (TNWs). During flood events, and heavy rains, there is a direct overland connection from wetland A to the C&O Canal.

As a wetland adjacent to a TNW, wetland A performs several functions, and has its own intrinsic value. This wetland acts to help recharge the ground water, by storing overland flow and keeping it from joining the C&O Canal. This runoff retention also acts to remove nutrients which would otherwise run into the canal, as well as provide an area where sediments can settle out of the stormwater runoff. The value of wetland A comes from its ability to act as a wildlife habitat. A green frog (*Rana clamitans*) was noted during the rare plant survey in fall 2013 along the fence at the edge of the NPS property. Wetland A may act as a habitat for small amphibians, birds, and insects, due to a lack of other suitable wetland habitats observed in the immediate area (MARA 2015).

Wetland Mitigation Site

A wetland delineation of the Lock 13 wetland mitigation site was completed in December 2014. The site contains an emergent wetland dominated by the invasive reed canarygrass (*Phalaris arundinacea*) with several standing dead American sycamore trees. The presence of the dense coverage of reed canarygrass appears to prevent the establishment of sycamore saplings or new tree species. Several wetland hydrology indicators as well as hydric soil indicators were observed at the site. Two perennial stream channels were identified within the vicinity of the mitigation site, which were identified to the east and west of the mitigation area and convey flow to the Potomac River that results in the Lock 13 wetland mitigation site being bound by three large perennial stream channels to the south, east, and west.

Riverine Wetlands/Waters of the U.S. Descriptions

As previously mentioned, there were two waterways noted during the field investigation. These were delineated by global positioning system (GPS). Field survey locations of the OHWM of these waterways within and just beyond the project areas were identified. Approximately 16,596.36 square feet (0.381 acre) of the C&O Canal was within the project area and approximately 169,840.44 square feet (3.899 acres) of the Potomac River was within the project area. According to the USACE (used by the State of Maryland), these waterways are considered jurisdictional since they are TNWs. Under the Cowardin Classification system (used by NPS), the Potomac River is classified as riverine, lower perennial, unconsolidated bottom, permanently flooded, or R2UBH. There are 1,393.92 square feet (0.032 acres) of this riverine wetland on NPS property within the construction area limits or limit of disturbance, located along the shoreline of the Potomac River. The remaining 168,533.64 square feet (3.869 acres) of the Potomac River within the project area are on State of Maryland property and are considered Waters of the U.S. The C&O Canal is similar in nature, but has the excavated component and is considered a riverine, lower perennial, unconsolidated bottom, permanently flooded, excavated

(R2UBHx) system. This entire riverine wetland is on NPS property within the construction area limits, located at the embankments that would be built on the C&O Canal.

FLOODPLAINS

Executive Order 11988 "Floodplain Management" requires federal agencies to develop policies for the minimization of impacts on floodplains, loss due to flooding, and the restoration and preservation of natural and beneficial values of floodplains. This Executive Order defines floodplains as "the lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands, including at a minimum, that area subject to a 1% greater chance of flooding in any given year." The area with a 1% chance of flooding every year is referred to as the 100-year floodplain. Flooding in the 100-year zone is expected to occur once every 100 years, on average.

Director's Order 77-2: *Floodplain Management* presents the NPS policy on floodplain management in compliance with Executive Order 11988. Specifically, NPS policies state that floodplain management will provide for the protection and preservation of floodplain functions and natural resources, and will avoid environmental effects (both long-term and short-term) of use and alteration of floodplains, including development that could adversely affect the functions and/or resources of floodplains and increase the risk of flooding. In addition, NPS policy recommends restoration of affected natural floodplain functions where possible.

All federal agencies are required to avoid building in a 100-year floodplain unless no other practical alternative exists. NPS has adopted guidelines pursuant to Executive Order 11998 stating that NPS policy is to restore and preserve natural floodplain values and avoid environmental impacts associated with the occupation and modification of floodplains. The guidelines also require that, where practicable alternatives exist, Class I actions be avoided within a 100-year floodplain. Class I actions include the location or construction of administration, residential, warehouse, and maintenance buildings, non-excepted parking lots, or other man-made features that, by their nature, entice or require individuals to occupy the site.

According to the Federal Emergency Management Agency (FEMA) Digital Flood Insurance Rate Maps (Map ID 24031C0320D, dated September 2006), the low-lying riparian corridor along the Potomac River and the C&O Canal NHP within the project area are within the 100-year floodplain. This area is described as Zone A, where base flow elevations and flood hazard factors have not been determined (FEMA 2006). Basically, the entire project site or the construction area limits (limit of disturbance), except for a small (0.07 acre) portion of the northwest corner of the construction access road and the temporary relocation of the towpath in alternative 4 (0.244 acre), is located within the 100-year floodplain. The Potomac River's floodplain contains vegetation that provides stability to the riverbank and act as a travel route for migrating and resident wildlife. Riparian areas reduce erosion and trap sediments from runoff, replenishing the soils of the riparian corridor. By slowing the velocities of floodwaters, these natural corridors reduce the potential damage to downstream areas.

Implementation of the proposed project would involve permanently impacting floodplain areas therefore an SOF was prepared to comply with Director's Order 77-2: *Floodplain Management* and can be found in appendix E.

The Lock 13 wetland mitigation site is situated between the C&O Canal and the Potomac River and is located within Zone A of the 100-year floodplain, as described above for the project site.

Flood Stages and Frequencies

The Potomac River has flooded on numerous occasions, and flooding is most often caused by heavy rain, snowmelt, or severe storms. Historically, flood stage for the Potomac River is measured at numerous USGS gauging stations including USGS gauge 01646500 near the Little Falls Pumping Station, Montgomery County, Maryland approximately 12 miles downstream from the Potomac WFP, and USGS gauge 01638500 at Point of Rocks, Maryland, approximately 32 miles upstream. Both of these gauges provide data on flood stages and frequencies for the vicinity of the Potomac WFP (USGS 2013a, b). Data review for both gauges from 1889 through 2012 provides a comparison for flood discharges and stages occurring at both locations for the ten greatest annual floods (table 11). Records of both gauges indicate that there is a probability of 50% that flood stage would be exceeded in any one year. Floods occur with the same frequency at the Potomac WFP project site. Since the C&O Canal NHP was established in 1971, there have been four major floods: June 1972, November 1986, January 1996, and September 1996 (USGS 2012).

Table 11. Ten Greatest Floods of the Potomac River

Date	Peak Discharge (cfs)		Stage (feet)[a]		Water Level at Potomac WFP (feet)[b]
	Point of Rocks	Little Falls	Point of Rocks	Little Falls	
3/19/1936	480,000	484,000	41.03	28.1	188
6/2/1889	460,000	N/A	40.2	NA	N/A
10/16/1942	418,000	447,000	40.43	26.88	N/A
6/23/1972	347,000	359,000	37.43	22.03	184
4/27/1937	310,000	347,000	33.86	23.3	N/A
1/21/1996	310,000	347,000	36.34	19.29	N/A
11/7/1986	309,000	317,000	36.28	17.99	N/A
5/13/1924	277,000	N/A	32.2	N/A	N/A
3/2/1902	219,000	N/A	29	N/A	N/A
8/20/1955	214,000	216,000	29.08	17.6	N/A

(a) Stage is measured in feet above the gauge datum (0-level on the gauge). Flood stages are defined as 16 feet at Point of Rocks and 10 feet at Little Falls. Flood stage is reached at a discharge of approximately 90,000-100,000 cfs.
(b) High water marks indicated on plaque at the existing Potomac WFP intake.
cfs = cubic feet per second
N/A - not applicable

AQUATIC AND TERRESTRIAL VEGETATION

The project area is located in a transition zone between two physiographic regions: the Coastal Plain and the Piedmont. The WSSC Potomac WFP is located in a transitional zone between vegetation and wildlife species with northern and southern affinities. Species ranges found within the transition zone overlap as the species reach the southern or northern limits of their ranges.

Aquatic Vegetation

SAV are vascular plants that grow completely underwater or just up to the surface of shallow water. SAV provides great habitat value for juvenile and adult fish and shellfish by protecting them from predators; providing food for waterfowl, fish, and mammals; absorbing wave energy and nutrients, producing oxygen, and improving water clarity; and aiding in the settlement of suspended sediment in water. SAV is

also provides recreational benefits, including fishing, waterfowl hunting, and bird watching (NOAA 2013).

As part of evaluating the feasibility of constructing a new offshore intake structure, a qualitative survey of SAV within the vicinity of the proposed project area was conducted in July and September 2013 (EAEST 2013c). The purpose of the SAV survey was to investigate and document the presence/absence of SAV within the area of disturbance of the project. The project area was confined by the left bank of the mainstem and the shoreline of Watkins Island, and the area from the mouth of Watts Branch to the upstream side of the existing intake weir (figure 11).

During the surveys, five native species of SAV were collected and recorded in the project area, including common waterweed (*Elodea canadensis*), water star grass (*Heteranthera dubia*), southern water nymph (*Najas guadalupensis*), sago pondweed (*Stuckenia pectinata*), and wild celery (*Vallisneria americana*) (EAEST 2013c). One native multi-cellular algae was also collected and recorded. All five species of SAV observed during the surveys are considered native to the Chesapeake Bay and not nuisance species. One species, southern water nymph, is ranked as a G5S3 species, one which is globally secure but rare to uncommon in Maryland (MDNR 2010). SAV was recorded throughout the area sampled, but was most dense along the shorelines, particularly the northern shoreline of Watkins Island (figure 11).

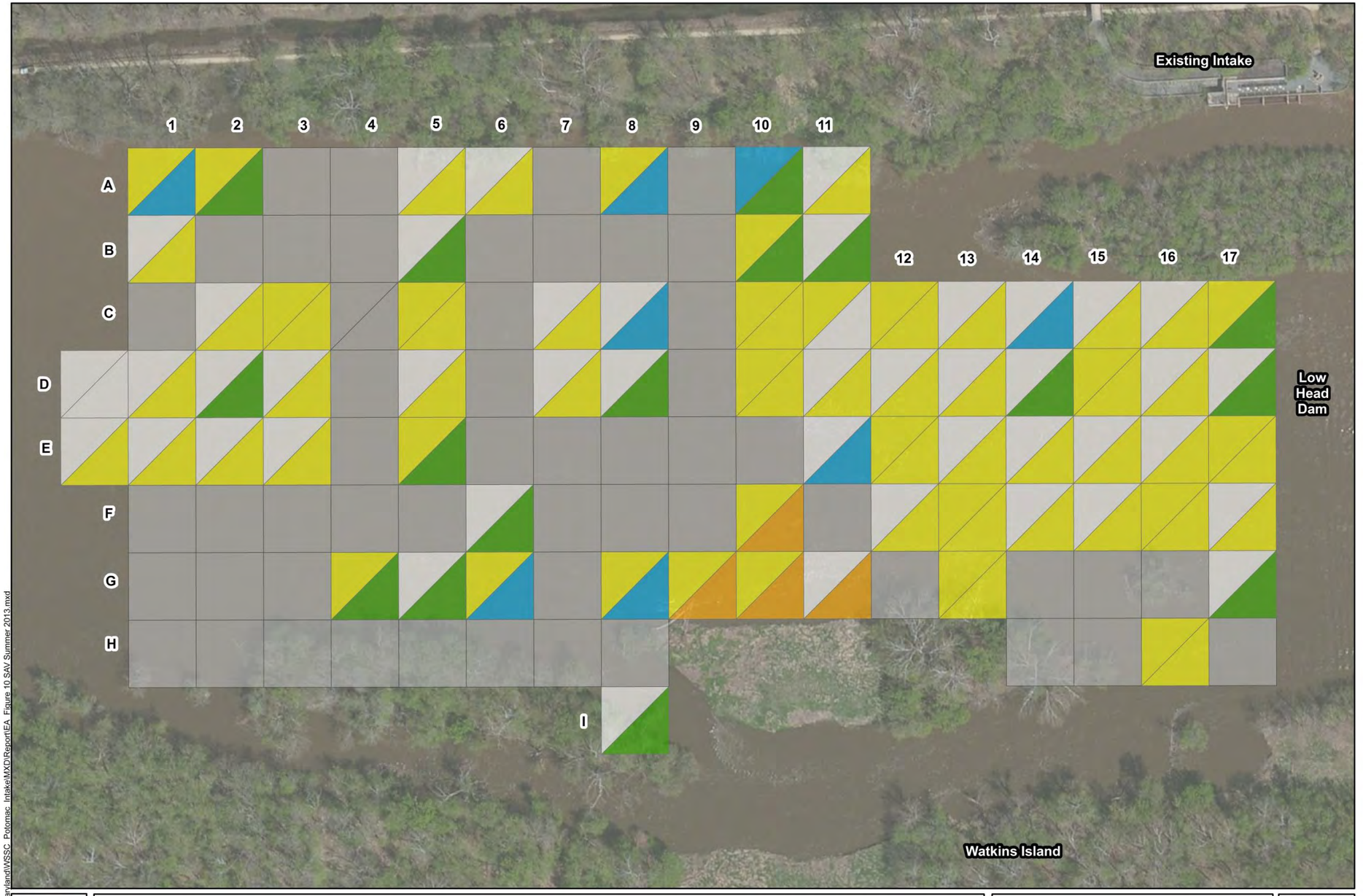
In the canal, hydrilla (*Hydrilla verticillata*) was observed covering most of the water surface (EAEST 2013c). Hydrilla is a nonnative species that is often considered a nuisance species because of its tendency to form dense impenetrable beds that impede recreational uses of waterways. Hydrilla has lower light requirements than other SAV species and is able to grow in more turbid water (MDNR 2010).

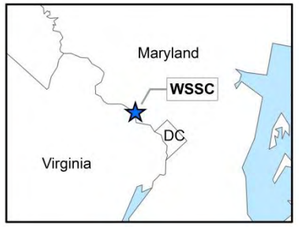
Terrestrial Vegetation

All plant species were inventoried at the project site during the 2013 rare plant survey and also during the 2014 FSD (EAEST 2013a and EAEST 2014b, respectively). During both surveys, the project area was divided into segments and classified based on vegetation.

The rare plant survey divided the project area into habitat stations, ranging in size from 0.8 to 2.4 acres. Each habitat station was characterized based on the tree, shrub, and herbaceous species present. The FSD survey identified similar plant species as the rare plant survey. The results of the 2013 plant survey are presented below.

Habitat Station 1 (Unnamed Island) – The dominant canopy species within this station was box elder (*Acer negundo*) and the dominant herbaceous species observed were garlic mustard (*Alliaria petiolata*) and ground ivy (*Glechoma hederacea*). Other deciduous trees observed included red maple (*Acer rubrum*), sycamore (*Platanus occidentalis*), black walnut (*Juglans nigra*), slippery elm (*Ulmus rubra*), and river birch (*Betula nigra*). The canopy trees were approximately 2 to 8 inches in diameter at breast height (DBH) and approximately 50-feet tall, thus representing a relatively young stand of deciduous trees. Trees heights were measured qualitatively by visual observation. The sapling/shrub stratum was dominated by paw paw (*Asimina triloba*). Herbaceous species observed included wingstem (*Actinomeris alternifolia*), stinging nettle (*Urtica dioica*), Nepalese browntop (*Microstegium vimineum*), Dame's rocket (*Hesperis matronalis*), white snakeroot (*Eupatorium rugosum*), and beefsteak plant (*Perilla frutescens*) (EAEST 2013a).





Legend

- Grid Not Sampled
- No Areal Coverage
- 1-10 % Areal Coverage
- 10-40 % Areal Coverage
- 40-70 % Areal Coverage
- 70-100 % Areal Coverage

Areal Coverage
2013 Sample Month Results

July / Sept.

L:\GISData\Northeast\Maryland\WSSC_Potomac_Intake\MXD\Report\EA_Figure_10.SAV Summer 2013.mxd

Figure 11
Submerged Aquatic Vegetation in the Potomac River, Summer 2013

Source:
ESRI 2012

Projection: NAD 83 Maryland StatePlane Feet
Date: January 2015

0 100 200
Feet

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Habitat Station 2 (West of Existing Intake) – The dominant canopy species included box elder, sycamore, slippery elm, and silver maple (*Acer saccharinum*). The canopy trees were approximately 4 to 8 inches in DBH and approximately 60 to 75-feet tall, with some very large specimen trees of sycamore and tulip poplar (*Liriodendron tulipifera*) scattered throughout the site. The sapling/shrub stratum was dominated by paw paw. Herbaceous species that dominated the understory included Virginia wildrye (*Elymus virginicus*), beefsteak plant, and Nepalese browntop. Poison ivy (*Toxicodendron radicans*), wingstem, paw paw, spicebush (*Lindera benzoin*), Japanese honeysuckle (*Lonicera japonica*), among other species, were also present (EAEST 2013a).

Habitat Station 3 (North and East of Existing Intake) – This station was characterized as deciduous woods located within the floodplain of the Potomac River, between the Potomac River and the tow-path. The dominant canopy species included pin oak, (*Quercus palustris*), red maple, silver maple, and black locust (*Robinia pseudoacacia*). The canopy trees were approximately 4 to 8 inches in DBH and approximately 60- to 70-feet tall. The sapling/shrub stratum was dominated by paw paw. Herbaceous species that dominated the understory included Virginia wildrye and Nepalese browntop. Bush honeysuckles (*Diervilla lonicera* and *Lonicera maackii*), Japanese honeysuckle, poison ivy, multiflora rose (*Rosa multiflora*), wingstem, paw paw, and ground ivy, among other species, were also present (EAEST 2013a).

A narrow fringe of emergent wetland dominated by water willow (*Justicia americana*) and nutsedge species (*Cyperus* spp.) is located along the flat portions of the Potomac River shoreline within Habitats 1, 2, and 3. SAV species within the water along the shoreline included sago false pondweed, wild celery, water stargrass, and southern water nymph. Other portions of the shoreline were steep and rocky with historically placed riprap to likely reduce erosion (EAEST 2013a).

Habitat Station 4 (Northeast of the C&O Canal) – This station included a narrow, deciduous woods located within a disturbed floodplain between the C&O Canal NHP and an existing WSSC road. The canopy was dominated by silver maple, box elder, sycamore, black walnut, and black locust. The canopy trees were approximately 3 to 6 inches in DBH and approximately 50-feet tall, thus representing a relatively young stand of deciduous trees. Nepalese browntop, bottlebrush grass, and Virginia wildrye dominated the understory along with other species including Japanese honeysuckle, wingstem, bush honeysuckle, multiflora rose, paw paw, and garlic mustard (EAEST 2013a).

Habitat Station 5 (Northwest of the C&O Canal) – The dominant canopy species included box elder and sycamore while the understory was dominated by Nepalese browntop, Virginia wildrye and bottlebrush grass (*Hystrix patula*). Similar to Station 4, the canopy trees were approximately 3 to 6 inches in DBH and approximately 50-feet tall, thus representing a relatively young stand of deciduous trees. A wetland area exists within Station 5 and is dominated by false nettle (*Boehmeria cylindrica*), clearweed (*Pilea pumila*), creeping Jenny (*Lysimachia nummularia*), and two polygonum species (*Polygonum lapathifolium* and *P. persicaria*). Within the canal, hydrilla was observed covering most of the water surface (EAEST 2013a).

The FSD process includes rating forest stands based on their water retention abilities. Forest stands that play a significant role in flood control are classified as Priority Retention Areas. The entire project area was given the highest Priority Retention Area rating because of the proximity of the Potomac River and the C&O Canal. During flood events, it is likely that forest stands in the project area reduce flood damage that could be caused to surrounding land by the Potomac River and C&O Canal.

Nonnative invasive plant species have been introduced in Montgomery County, Maryland from other geographical regions. These plants are free from herbivores, disease, and other environmental influences that prevent them from over growing. Without these environmental controls, nonnative plants can quickly

expand their range and they have the ability to out compete and replace native plant species. Impacts of nonnative plant species include (Montgomery County Department of Parks 2007):

- Rapidly invade new areas and out-compete native plants for light, water, and nutrients
- Produce changes in ecosystem composition, structure, and/or function
- Alter ecosystem processes (e.g., prevent seedling establishment of native plants)
- Replace native food sources depended upon by wildlife and reduce or eliminate host plants for native insects and other wildlife

Nonnative plant species found during the rare plant surveys 2013 surveys include Norway maple (*Acer platanoides*), tree-of-heaven (*Ailanthus altissima*), garlic mustard, wild garlic (*Allium vineale*), mugwort (*Artemisia vulgaris*), Japanese barberry (*Berberis thunbergii*), oriental bittersweet (*Celastrus orbiculatus*), spotted knapweed (*Centaurea maculosa*), bull thistle (*Cirsium vulgare*), autumn olive (*Elaegnus umbellate*), English ivy (*Hedera helix*), Japanese hops (*Humulus japonicas*), Japanese honeysuckle, amur honeysuckle, morrow's honeysuckle, Japanese stiltgrass, mile-a-minute (*Polygonum perfoliatum*) and multiflora rose (EAEST 2013a). Hydrilla, found in the canal at Stations 4 and 5, is also an invasive species.

During the wetland mitigation of the Lock 13 wetland mitigation site, investigators recorded the plant species of the 1.7-acre area. The site is dominated by the invasive species reed canarygrass. There were several standing dead American sycamore trees as well as living sycamore and sweetgum (*Liquidambar styraciflua*) trees. Common understory species other than reed canarygrass include Pennsylvania smartweed (*Polygonum pensylvanicum*) and arrowleaf tearthumb (*Polygonum sagittatum*). Other understory and herbaceous species include narrowleaf cattail (*Typha angustifolia*).and the nonnative species wine raspberry (*Rubus phoenicolasius*). All of the dominant plant species are hydrophytic.

AQUATIC AND TERRESTRIAL WILDLIFE

As stated previously, the WSSC Potomac WFP is located in a transitional zone between vegetation and wildlife species with northern and southern affinities. In addition, the riparian corridor along the adjacent Potomac River acts as a seasonal travel corridor for many migratory birds in spring and summer.

Aquatic Species

Aquatic habitat within the WSSC Potomac WFP vicinity includes the Potomac River, Watts Branch, and the C&O Canal. The area is part of the larger Potomac-Washington Metro River Basin as delineated by the MBSS program conducted by MDNR. Montgomery County DEP uses bioassessments as their primary tool to evaluate the biological condition of a waterbody. The Potomac River Montgomery County watershed is listed under Category 5 of the 2012 Integrated Report as impaired for impacts on biological communities (MDE 2012). Within this watershed, approximately 67% of stream miles are estimated of having fish and/or benthic indices of biological impairment in the very poor to poor category. The closest survey station to the project site is located just upstream of the Potomac WFP (Station COCA-308-N-2003). The biological communities are strongly influenced by urban land uses and the probable causes and sources of the biological impairment including sediment/instream habitat stressors and inorganic pollutants (MDE 2011).

Macroinvertebrates

Macroinvertebrates play an important role in the ecosystem by serving as food for fish, amphibians, and water birds, and they also breakdown organic matter and nutrients. Freshwater macroinvertebrates are used to assess the "health" of a stream. Macroinvertebrates serve as an indicator of the water quality for several reasons:

- Some are sensitive (intolerant) to pollution, habitat changes, and severe natural events, while others are more tolerant
- Many live in the water for over a year.
- They are generally sessile – they cannot escape pollution like fish and birds.
- They are easy to collect.

The MDNR runs a macroinvertebrate monitoring program to monitor the aquatic environment by sampling macroinvertebrates within selected sites across Maryland. Four benthic macroinvertebrate community measures, including taxa number, percent Ephemeroptera, Plecoptera, or Trichoptera (EPT), biotic index and diversity index values were utilized to assess status and long-term trends in water quality. Sampling from 1976 to 2006 at the three stations closest to the Potomac River WFP (Seneca Creek, Potomac River below the dam at Little Falls, and Potomac River at Whites Ferry) indicated a slight improvement at the Potomac River station at Whites Ferry with good water quality. The stations at Seneca Creek and Potomac River at Little Falls showed no significant trend with good water quality (MDNR 2009).

In 2007, Montgomery County DEP collected benthic macroinvertebrates from two stations in the vicinity of the Potomac WFP, including a station in Watts Branch (WBSB 310); and Sandy Branch, a tributary to Watts Branch (WBSB 305) (Van Ness, pers. comm. 2013). From these data, metrics were calculated, scored, and then summed to obtain a final Benthic Index of Biotic Integrity or Benthic Index of Biotic Integrity score. There are a total of eight metrics that measure biological structure and function, including (Montgomery County DEP 2012):

3. Taxa richness (total number of taxa)
4. Biotic index
5. Ratio of scrapers
6. Proportion of *Hydropsyche* sp. and *Cheumatopsyche* sp.
7. Proportion of dominant taxa
8. Total number of EPT taxa
9. Proportion of EPT individuals
10. Proportion of shredders

Each metric is scored either as a one, three, or five with the highest possible final score as 40. The Sandy Branch station ranked good and the Watts Branch station ranked fair. Species observed during the sampling event are provided in table 12 (Van Ness, pers. comm. 2013).

Table 12. Benthic Macroinvertebrates Observed by Montgomery County DEP during the 2007 Sampling Event

Taxa	Number of Individuals	
	Station WBSB 305	Station WBSB 310
Enchytraeidae	1	0
Tubificidae	0	1
Crangonyx sp.	0	2
Cambaridae	1	0
Baetis sp.[(a)]	0	2
Stenonema sp.[(a)]	0	3
Leuctra sp.[(a)]	0	1
Amphinemura sp.[(a)]	12	0
Acroneuria sp.[(a)]	1	0
Carabidae	1	0
Psephenus sp.	3	0
Helichus sp.	1	0
Ancyronyx sp.	0	3
Dubiraphia sp.	0	2
Macronychus sp.	1	0
Optioservus sp.	9	4
Oulimnius sp.	2	0
Stenelmis sp.	5	8
Chimarra sp.[(a)]	4	0
Dolophilodes sp.[(a)]	2	0
Cheumatopsyche sp. [(a)]	1	2
Hydroptila sp.[(a)]	0	1
Ironoquia sp.[(a)]	1	0
Simulium sp.	2	3
Clinocera sp.	2	0
Empididae	3	0
Chironomini	9	24
Diamesinae	23	2
Orthocladiinae	53	109
Tanypodinae	6	4
Tanytarsini	8	10

(a) Indicates an EPT species

Fish

The WSSC Potomac WFP is located on the Potomac River upstream of Great Falls, where the Fall Line boundary between the Coastal Plain and the Piedmont physiogeographic regions occurs. Great Falls creates a natural geologic barrier to anadromous fish species that migrate from the ocean to fresh water to spawn. American eel (*Anguilla rostrata*), a catadromous species that migrates from freshwater to the ocean to spawn, is the only species that is able to travel upstream past the falls.

MDNR biologists conducted electrofishing surveys from 2003 through 2005 in the Potomac River near River Bend Regional Park, Fairfax County, Virginia (approximately 1 mile downstream from the Potomac WFP) and seining in the vicinity of Seneca Creek (approximately 5 miles upstream of the Potomac WFP). Data are presented in table 13 and table 14.

A total of 13 fish species were collected near Riverbend Regional Park in June 2005; 25 fish species were collected in 2003 and 2004 near the confluence of Seneca Creek and the Potomac River. Abundant species in both samples included bluntnose minnow (*Pimephales notatus*), spotfin shiner (*Cyprinella spiloptera*), spottail shiner (*Notropis cornutus*), redbreast sunfish (*Lepomis auritus*), white sucker (*Catostomus commersoni*), and tessellated darters (*Etheostoma olmstedi*). No threatened or endangered fish species were found in any of the Potomac River collections.

Table 13. Fish Species Sampled by Electrofishing in the Potomac River, Near River Bend Park, Virginia, June 2005 – MDNR

Scientific Name	Common Name	Occurrence[(a)]
Catfishes (Siluriformes)		
Ameiurus natalis	Yellow Bullhead	Common
Ictalurus punctatus	Channel Catfish	Common
Eels (Anguilliformes)		
Anguilla rostrata	American Eel	Common
Perchlike Fishes (Perciformes)		
Etheostoma blennioides	Greenside Darter	Common
Lepomis auritus	Redbreast Sunfish	Abundant
Micropterus dolomieui	Smallmouth Bass	Common
Nocomis micropogon	River Chub	Rare
Suckers and Minnows (Cypriniformes)		
Catostomus commersoni	White Sucker	Abundant
Hypentelium nigricans	Northern Hog Sucker	Common
Cyprinella spiloptera	Spotfin Shiner	Abundant
Moxostoma erythrurum	Golden Redhorse	Common
Moxostoma macrolepidotum	Shorthead Redhorse	Common
Pimephales notatus	Bluntnose Minnow	Common

(a) - Rare: <5 collected; Common: between 5 and 100 collected; Abundant: > 100 collected

Table 14. Fish Species Sampled by Seine in the Potomac River (Near Seneca Creek), 2003 to 2004 – MDNR

Scientific Name	Common Name	Occurrence[a]
Catfishes (Siluriformes)		
Ameiurus natalis	Yellow Bullhead	Common
Ictalurus punctatus	Channel Catfish	Common
Eels (Anguilliformes)		
Anguilla rostrata	American Eel	Rare
Killfishes and Livebearers (Cyprinodontiformes)		
Gambusia holbrooki	Eastern Mosquitofish	Common
Perchlike Fishes (Perciformes)		
Etheostoma blennioides	Greenside Darter	Common
Etheostoma olmstedi	Tessellated Darter	Abundant
Lepomis auritus	Redbreast Sunfish	Common
Lepomis cyanellus	Green Sunfish	Rare
Lepomis gibbosus	Pumpkinseed	Common
Lepomis macrochirus	Bluegill	Common
Lepomis megalotis	Longear Sunfish	Rare
Micropterus dolomieui	Smallmouth Bass	Common
Micropterus salmoides	Largemouth Bass	Common
Pomoxis nigromaculatus	Black Crappie	Rare
Suckers and Minnows (Cypriniformes)		
Campostoma anomalum	Central Stoneroller	Common
Catostomus commersoni	White Sucker	Common
Cyprinella spiloptera	Spotfin Shiner	Abundant
Hybognathus nuchalis	Mississippi Silvery Minnow	Rare
Hypentelium nigricans	Northern Hog Sucker	Common
Luxilus cornutus	Common Shiner	Common
Moxostoma erythrurum	Golden Redhorse	Common
Notropis hudsonius	Spottail Shiner	Abundant
Notropis procne	Swallowtail Shiner	Common
Notropis rubellus	Rosyface Shiner	Common
Pimephales notatus	Bluntnose Minnow	Abundant

(a) - Rare: <5 collected; Common: between 5 and 100 collected; Abundant: > 100 collected

In 2007, Montgomery County DEP conducted fish sampling at two stations in the vicinity of the Potomac WFP: WBSB 305 and WBSB 310 (Van Ness, pers. comm. 2013). WBSB 305 is located northwest of the existing intake in Sandy Branch. WBSB 310 is located northeast of the existing intake in Watts Branch. Fish species were identified during the sampling event and a Fish Index of Biotic Integrity was used to rank the stream in relation to reference stream conditions; the metrics used to rank the area are listed below (Montgomery County DEP 2012):

- Total number of species
- Total number of riffle benthic insectivore individuals
- Total number of minnow species
- Total number of intolerant species
- Proportion of tolerant individuals
- Proportion of individuals as omnivores
- Proportion of individuals as pioneering species
- Total number of individuals (excluding tolerant species)
- Proportion of individuals with disease/anomalies

Both stations were ranked as good. Species identified during the 2007 sampling event are shown in table 15 (Van Ness, pers. comm. 2013).

Table 15. Fish Species Observed by Montgomery County DEP during 2007 Sampling Event

Order	Species		Number of Species	
	Scientific Name	Common Name	Pass 1	Pass 2
Station WBSB 305				
Perchlike Fishes (Perciformes)	*Etheostoma blennioides*	Greenside darter	1	0
	Etheostoma flabellare	Fantail Darter	17	7
Searobins and Sculpins (Scorpaeniformes)	*Cottus caeruleomentum*	Blue Ridge sculpin	13	3
	Cottus girardi	Potomac sculpin	77	34
Suckers and Minnows (Cypriniformes)	*Campostoma anomalum*	Central stoneroller	4	1
	Catostomus commersonii	White sucker	1	0
	Exoglossum maxillingua	Cutlips minnow	1	0
	Rhinichthys atratulus	Blacknose dace	61	36
	Rhinichthys cataractae	Longnose dace	37	12
	Semotilus sp.	Creek chub	1	0
Station WBSB 310				
Catfishes (Siluriformes)	*Ameiurus natalis*	Yellow bullhead	1	2
	Noturus insignis	Margined madtom	1	0
Eels (Anguilliformes)	*Anguilla rostrata*	American eel	0	1
Perchlike Fishes (Perciformes)	*Etheostoma blennioides*	Greenside darter	1	0
	Etheostoma flabellare	Fantail darter	12	8
	Etheostoma olmstedi	Tessellated darter	2	4
	Lepomis auritus	Redbreast sunfish	0	1
	Lepomis cyanellus	Green sunfish	19	16
	Lepomis gibbosus	Pumpkinseed	5	2
	Lepomis macrochirus	Bluegill	4	0

Order	Species		Number of Species	
	Scientific Name	Common Name	Pass 1	Pass 2
Searobins and Sculpins (Scorpaeniformes)	*Cottus caeruleomentum*	Blue Ridge sculpin	1	2
	Cottus girardi	Potomac sculpin	18	15
Suckers and Minnows (Cypriniformes)	*Campostoma anomalum*	Central stoneroller	22	7
	Catostomus commersonii	White sucker	3	5
	Clinostomus funduloides	Rosyside dace	3	2
	Exoglossum maxillingua	Cutlips minnow	14	3
	Luxilus cornutus	Common shiner	3	1
	Notropis buccatus	Silverjaw minnow	17	11
	Notropis procne	Swallowtail shiner	1	1
	Pimephales notatus	Bluntnose minnow	47	37
	Rhinichthys atratulus	Blacknose dace	18	19
	Rhinichthys cataractae	Longnose dace	20	10
	Semotilus sp.	Creek chub	8	3

Fishing is a popular activity along the C&O Canal. There are a number of species, both native and introduced game fish within the C&O Canal. Introduced game fish include smallmouth and largemouth bass, bluegill, sunfish (*Lepomis* sp.*)*, blue catfish (*Ictalurus furcatus)*, and rock bass (*Ambloplites rupestris)*. Native fish include black crappie, white crappies (*Pomoxis annularis*), chain pickerel (*Esox niger*), yellow perch (*Perca flavescens*), pumpkinseed, channel catfish, and American eel (IRMA 2015).

An inventory of fish in NPS parks within the National Capital Region was conducted between 2000 and 2003 and included stations within the C&O Canal NHP from near MM 14 north of Great Falls to Pennyfield Lock near MM 20, approximately 3 miles upstream of the Potomac WFP. The inventory also included fish within Watts Branch. Table 16 presents the fish species found during qualitative sampling at the three C&O Canal stations and fish species found during both qualitative and quantitative sampling on Watts Branch.

Table 16. Fish Species Identified in the C&O Canal NHP Survey 2000 to 2003

Order	Species		Location
	Scientific Name	Common Name	
Catfishes (Siluriformes)	*Ameiurus catus*	White Catfish	W
	Ameiurus natalis	Yellow Bullhead	C, W
	Ameiurus nebulosis	Brown Bullhead	W
	Ictalurus punctatus	Channel Catfish	W
	Noturus insignis	Margined Madtom	C, W
Eels (Anguilliformes)	*Anguilla rostrata*	American Eel	C, W
Killfishes and livebearers (Cyprinodontiformes)	*Gambusia holbrooki*	Eastern Mosquitofish	C
Perchlike Fishes (Perciformes)	*Etheostoma blennioides*	Greenside Darter	C, W
	Etheostoma flabellare	Fantail Darter	C, W

Order	Species		Location
	Scientific Name	Common Name	
	Etheostoma olmstedi	Tessellated Darter	C, W
	Lepomis auritus	Redbreast Sunfish	C, W
	Lepomis cyanellus	Green Sunfish	C, W
	Lepomis gibbosus	Pumpkinseed	C
	Lepomis macrochirus	Bluegill	C, W
	Lepomis megalotis	Longear Sunfish	C, W
	Lepomis X *Lepomis*	Sunfish hybrids	C
	Micropterus dolomieu	Smallmouth Bass	C
	Micropterus salmoides	Largemouth Bass	C, W
Searobins and Sculpins (Scorpaeniformes)	*Cottus girardi*	Potomac Sculpin	W
Suckers and Minnows (Cypriniformes)	*Campostoma anomalum*	Central Stoneroller	C, W
	Catostomus commersoni	White Sucker	C, W
	Clinostomus funduloides	Rosyside Dace	C, W
	Cyprinella analostana	Satinfin Shiner	C,
	Cyprinella spiloptera	Spotfin Shiner	C, W
	Exoglossum maxillingua	Cutlips Minnow	W
	Hypentelium nigricans	Northern Hogsucker	C, W
	Moxostoma erythrurum	Golden Redhorse	W
	Nocomis micropogon	River Chub	C, W
	Notemigonus crysoleucas	Golden Shiner	C
	Notropis buccatus	Silverjaw Minnow	W
	Notropis hudsonius	Spottail Shiner	C, W
	Notropis procne	Swallowtail Shiner	W
	Pimephales notatus	Bluntnose Minnow	C, W
	Rhinichthys atratulus	Blacknose Dace	C, W
	Rhinichthys cateractae	Longnose Dace	C, W
	Semotilus atromaculatus	Creek Chub	W
	Semotilus corporalis	Fallfish	W

Source: Raesly et al. 2004
C = Canal
W= Watts Branch

A total of 37 species were found in the stretch of canal encompassing the vicinity of the Potomac WFP. Redbreast sunfish were the most abundant species followed by bluntnose minnow, spotfin shiner, tessellated darter, and yellow bullhead. Qualitative sampling results for Watts Branch identified central stoneroller as the most numerous species followed by yellow bullhead, longnose dace, white sucker, and golden redhorse. Quantitative sampling in Watts Branch found bluntnose minnow to be the most numerous followed by spotfin shiner, Potomac sculpin, silverjaw minnow, and longnose dace. No threatened or endangered species of fish were found in the collections from the C&O Canal during the 2000 and 2003 surveys (Raesly et al. 2004).

Freshwater Mussels

Mussels are important to freshwater communities by providing food for mammals and birds and helping to maintain good water quality by filtering nutrients, contaminants, and sediments from the water. According to C&O Canal NHP information, ten species of freshwater mussels have been identified in the C&O Canal throughout its length. Species requiring calm water habitat such as the creeper (*Strophitus undulates*) and the paper pondshell (*Utterbackia imbecillis*) are well established in parts of the canal. NPS literature considered one species, the eastern elliptio (*Elliptio complanata*) to have a secure population (NPS 2005).

The Potomac River, upstream of Great Falls, supports limited communities of freshwater mussels. A visual survey of the project area indicated that various riverine substrates were available to support mussel survival and reproduction, including sand, gravel, and silt particles. In July 2005, a freshwater mussel survey was conducted that included an area approximately 328-feet (100-meters) upstream and 656-feet (200-meters) downstream of the existing intake structure (EAEST 2005b). During this survey, live freshwater mussels were collected for identification and aging. Sixteen sample stations were identified, of which 4 were upstream stations and 11 were downstream stations. A single station was added at the new intake structure location to survey mussels in the direct area of impact. The study resulted in the collection of 151 mussels comprised of five species (table 17). Of the 151 mussels collected, 95% were eastern elliptio. Creeper is considered by the State of Maryland as "in need of conservation", and only one individual was collected at an upstream station. Additionally, triangle floater (*Alasmidonta undulata*), a state listed endangered species, and yellow lampmussel (*Lampsilis cariosa*), a state listed rare species were collected during the survey.

Table 17. Freshwater Mussel Species Collected During Surveys Conducted in July 2005

Scientific Name	Common Name	Status	Total Collected
Elliptio complanata	Eastern Elliptio	-	144
Lampsilis cardium	Plain Pocketbook	-	4
Strophitus undulatus	Creeper or Squawfoot	S2	1
Lampsilis cariosa	Yellow Lampmussel	SU	1
Alasmidonta undulata	Triangle Floater	S1	1

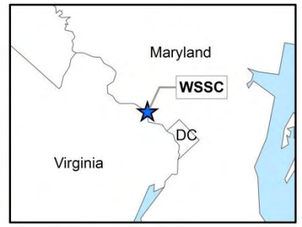
Source: EAEST 2005b

S1 - Highly State rare. Critically imperiled in Maryland because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation.

S2 - State rare. Imperiled in Maryland because of rarity or because of some factor(s) making it vulnerable to becoming extirpated.

SU - Possibly rare in Maryland, but of uncertain status for reasons including lack of historical records, low search effort, cryptic nature of the species, or concerns that the species may not be native to the State.

In August 2013, a qualitative mussel survey within the Potomac River was conducted to establish baseline conditions and determine the presence of live mussels in the project area (EAEST 2013c). The survey was primarily conducted by snorkeling using tactile and visual searches and also by using underwater viewing scopes to survey the shallow riffle areas where snorkeling was not possible. A total of seven upstream and downstream stations within the project area were surveyed in August 2013. Stations were selected specifically in relation to proposed construction activities including the placement of the new intake structure (station 4), boat ramp (station 3), and temporary access roads (stations 5 and 7).



Legend

- Dam
- Survey Area
- Construction Road
- Intake

NOTE: Number of mussels collected at each station given in ( )

L:\GIS\Data\Northeast\Maryland\WSSC_Potomac_Intake\MXD\Report\EA_Figure 11 Mussel Survey Stations.mxd

Figure 12
Mussel Survey Stations, Summer 2013

Source:
Black & Veatch 2013
ESRI 2012

Projection: NAD 83 Maryland StatePlane Feet
Date: January 2015

0 100 200
Feet

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Stations located outside of these areas were included as part of the upstream buffer (station 6) and any short-term sedimentation loads from construction activities (stations 1 and 2). Figure 12 depicts the stations sampled. A total of 88 live individuals comprising two species were collected from the seven stations (table 18). Neither of these two mussel species is currently listed as threatened or endangered by MDNR or USFWS. Eastern elliptio (*Elliptio complanata*) dominated the collection with 99% of the individuals collected from all seven stations (EAEST 2013c).

Table 18. Abundance of Freshwater Mussel Collected in the Potomac River during a Qualitative Survey, August 2013

Species	Station							Total
	1	2	3	4	5	6	7	
Eastern elliptio (*Elliptio complanata*)	23	0	4	18	0	27	15	87
Pocketbook (*Lampsilis cardium*)	0	0	0	1	0	0	0	1
Total	**23**	**0**	**4**	**19**	**0**	**27**	**15**	**88**

Terrestrial Species

Amphibians and Reptiles

Amphibians are sensitive bio-indicators of degraded stream habitats and water quality (Welsh and Ollivier 1998). They are sensitive to changes in their environment because they spend their entire lives in or near streams and adults breathe exclusively through their skin. Reptiles are important in controlling pests such as mice, rats, slugs, crickets, termites, and other insects. The Montgomery County DEP recognizes the importance of amphibians and reptiles as indicators of water quality and includes these species in their biological monitoring program. Amphibians and reptiles are monitored to assess stream conditions and evaluate watershed health (Montgomery County DEP 2012).

Reptile and amphibian species have been recorded within the C&O Canal NHP and entered into the NPSpecies database. Species recorded within the database are listed in table 19 (NPS 2007). Additionally, the following species have been recorded in the vicinity of the Potomac River WFP by the Montgomery County DEP biological monitoring program and the USEPA MBSS surveys: northern dusky salamander (*Desognathus fuscus*), red salamander (*Pseudotriton ruber*), stinkpot turtle (*Sternotherus odoratus*), and broad-head skink (*Eumeces laticeps*).

Table 19. Reptile and Amphibian Species Recorded by NPS within the C&O Canal NHP

Order	Family	Scientific Name	Common Names
Reptiles			
Squamata	Colubridae	*Carphophis amoenus amoenus*	Eastern Worm Snake
		Coluber constrictor constrictor	Northern Black Racer
		Diadophis punctatus edwardsii	Northern Ringneck Snake
		Elaphe obsoleta obsoleta	Black Rat Snake
		Nerodia sipedon sipedon	Northern Water Snake
		Regina septemvittata	Queen Snake, Queensnake
		Storeria dekayi dekayi	Northern Brown Snake
		Thamnophis sauritus sauritus	Eastern Ribbon Snake
		Thamnophis sirtalis sirtalis	Common Garter Snake
	Phrynosomatidae	*Sceloporus undulatus hyacinthinus*	Northern Fence Lizard
	Scincidae	*Eumeces fasciatus*	5-Lined Skink
	Teiidae	*Cnemidophorus sexlineatus sexlineatus*	Eastern Six-lined Racerunner
	Viperidae	*Agkistrodon contortrix mokasen*	Northern Copperhead
Testudines	Chelydridae	*Chelydra serpentina serpentina*	Common Snapping Turtle
	Emydidae	*Chrysemys picta marginata*	Midland Painted Turtle
		Chrysemys picta picta	Eastern Painted Turtle
		Clemmys guttata	Spotted Turtle
		Clemmys insculpta	Wood Turtle
		Pseudemys rubriventris	Redbelly Turtle
		Terrapene carolina carolina	Eastern Box Turtle
	Kinosternidae	*Sternotherus odoratus*	Common Musk Turtle
Amphibians			
Anura	Bufonidae	*Anaxyrus fowleri*	Fowler's Toad
		Bufo americanus americanus	Eastern American Toad
		Bufo terrestris	Southern Toad
		Bufo woodhousii fowleri	Fowler's Toad
	Hylidae	*Acris crepitans crepitans*	Eastern Cricket Frog
		Hyla chrysoscelis	Cope's Gray Treefrog
		Hyla versicolor	Common Gray Treefrog
		Pseudacris crucifer crucifer	Northern Spring Peeper
	Ranidae	*Lithobates catesbeianus*	American Bullfrog
		Lithobates clamitans	Green Frog
		Lithobates palustris	Pickerel Frog
		Lithobates sylvaticus	Wood Frog
		Rana catesbeiana	Bull frog
		Rana clamitans melanota	Green Frog
		Rana sylvatica	Wood Frog
		Rana utricularia	Southern Leopard Frog

Order	Family	Scientific Name	Common Names
Caudata	Ambystomatidae	*Ambystoma jeffersonianum*	Jefferson Salamander
		Ambystoma maculatum	Spotted Salamander
		Ambystoma opacum	Marbled Salamander
	Plethodontidae	*Eurycea bislineata*	Northern 2-Lined Salamander
		Hemidactylium scutatum	Four-toed Salamander
		Plethodon cinereus	Redback Salamander
		Plethodon glutinosus	Northern Slimy Salamander
		Plethodon hoffmani	Valley and Ridge Salamander
	Salamandridae	*Notophthalmus viridescens viridescens*	Red-spotted Newt

Birds

Bird species are observed throughout the year at the C&O Canal NHP; some thrive in or near the park year-round and others are seasonal visitors to the park. The National Capital Region Network Inventory and Monitoring Program has monitored birds within the forest areas along the C&O Canal since 2007. There are 91 plots within the C&O Canal NHP forest and each plot is rated for habitat quality using the Bird Community Index. The stations closest to the Potomac WFP show a medium integrity habitat (NPS 2011). The most commonly found birds in the C&O Canal NHP's forest include white breasted nuthatch (*Sitta carolinensis*), common grackle (*Quiscalus quiscula*), Carolina wren (*Thryothorus ludovicianus*), Acadian flycatcher (*Empidonax virescens*), red-eyed vireo (*Vireo olivaceus*), eastern tufted titmouse (*Baeolophus bicolor*), northern cardinal (*Cardinalis cardinalis*), American goldfinch (*Carduelis tristis*), chickadee species, and blue-gray gnatcatcher (*Polioptila caerulea*). The Acadian flycatcher is a Partners in Flight watch list species and the Carolina wren is a stewardship species, meaning that the species is declining or vulnerable (NPS 2011). Appendix F includes a list of bird species found along the Potomac River and C&O Canal NHP within the vicinity of the Potomac WFP.

A Memorandum of Understanding between NPS and USFWS has been developed to promote the conservation of migratory birds. Pursuant to the Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds" (66 FR 3853, January 17, 2001), the Memorandum of Understanding outlines a collaborative and proactive approach to promote the conservation of migratory bird populations (NPS and USFWS 2010). Both parties agree that it is important to: (1) focus on bird populations; (2) focus on habitat restoration where actions can benefit specific ecosystems and the migratory birds dependent upon them; (3) focus on reducing the effects of climate change on migratory birds and their habitats; and (4) recognize that actions that may provide long-term benefits to migratory bird populations as a whole may result in short-term negative impacts on individual birds (NPS and USFWS 2010).

The National Audubon Society established the Important Bird Areas Program (IBA) to identify areas most essential for sustaining native bird populations and to focus on conservation efforts on these places. An IBA is a site that provides essential habitat for one or more species of vulnerable birds. These areas include nesting sites, migration stop-over sites, or wintering grounds (Audubon Maryland-DC 2010). The IBA program uses scientifically based criteria to define a nominated location as an IBA. The C&O Canal NHP was selected as an IBA because it supports an exceptional diversity of bird species during migration (Audubon MD-DC 2010). The entire C&O Canal was surveyed three times from 1995 to 2001, resulting in documenting 108 breeding species of a potential 113 species expected to breed (generally comprised of both year-round resident and summer resident species (NPS 2005). Maryland state species of concern that may be found along the entire C&O Canal in appropriate habitat include golden-winged warbler

(*Vermivora chrysoptera*), cerulean warbler (*Dendroica cerulea*), and wood thrush (*Hylocichla mustelina*). Of these species, only the wood thrush is found in the vicinity of the WSSC Potomac WFP.

MDNR's Forest Interior Dwelling Bird Species (FIDS) Program was established by the Chesapeake Bay Critical Area Commission in 1986 and recognizes the importance of large unfragmented tracts of forested land important to bird species that nest and live within woodlands. The *Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area* (MDNR 2001) defines FIDS habitat as (1) existing riparian forests of at least 300 feet in width adjacent to streams, wetlands, or the Bay shoreline; or (2) forested areas of 100 acres or more. FIDS species may use smaller parcels of forested area or may be absent in larger parcels depending on specific characteristics of the forested area such as age, shape, edge to forest ratio, vegetative characteristics, and the amount of human disturbance. Sections of the Potomac River riparian corridor contain undisturbed forested habitat that supports FIDS species. Appendix F includes a list of species within the project area with FID species indicated in boldface text.

Mammals

Mammals found within the C&O Canal NHP and undeveloped areas in the vicinity of the Potomac WFP are likely to be common species found in eastern woodlands. The C&O Canal and adjacent riparian forest of the Potomac River provides a transportation corridor for wildlife. The areas provide unfragmented habitat that allows movement of species between habitats. Terrestrial species such as white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), eastern gray squirrel (*Sciurus carolinensis*), eastern chipmunk (*Tamias striatus*), Virginia opossum (*Didelphis virginiana*), eastern cottontail rabbit (*Sylvilagus floridanus*), and red fox (*Vulpes vulpes*) are expected to occur in the vicinity of the Potomac WFP. Also likely within the C&O Canal NHP, and undeveloped habitats surrounding the site, are small mammals such as bats and a variety of rodents. Bat species within the C&O Canal NHP include silver-haired bat (*Lasionycteris noctivagans*), red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), Keen's bat (*Myotis keenii*), eastern small-footed myotis (*Myotis leibi*), little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*), Indiana bat (*Myotis sodalis*), and tricolored bat (*Perimyotis subflavus*) [formerly eastern pipistrelle (*Pipistrellus subflavus)*] (NPS 2007 and Carter 2015). Aquatic mammals such as beaver (*Castor canadensis*) and muskrat (*Ondatra zibethicus*) also likely occur near the project area (MDNR 2013).

SPECIAL-STATUS SPECIES

The Endangered Species Act (ESA) of 1973, as amended, requires impacts on all federally listed threatened or endangered species be considered in planning for federal actions. NPS policy also requires examination of the impacts on federal candidate species, as well as state-listed threatened, endangered, candidate, rare, declining, and sensitive species. The primary state law that allows and governs the listing of species is the Maryland Nongame and Endangered Species Conservation Act (Annotated Code of Maryland, 10-2A-01). This Act is administered by MDNR's Natural Heritage Program and is supported by regulations (Code of Maryland Regulations 08.03.08) that contain the official State Threatened and Endangered Species list.

Several plant species that have been listed as special-status species by natural resource agencies have the potential to exist within the project site. Due to specific habitat requirements, these species require special attention when evaluating natural resources in a given area. According to the USFWS Office of Endangered Species, in accordance with the Endangered Species Act, the following are definitions of federally endangered and federally threatened species:

- Federally Endangered: Taxa in danger of extinction throughout all or a significant portion of their range.
- Federally Threatened: Taxa likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

State status is the legal protection status of a species as determined by MDNR in accordance with the Nongame and Endangered Species Conservation Act (MDNR 2010). These species are not considered federally endangered or threatened. Definitions for the following categories have been taken from Code of Maryland Regulations (08.03.08):

- State Endangered: a species whose continued existence as a viable component of the State's flora or fauna is determined to be in jeopardy.
- State Threatened: a species of flora or fauna that appears likely, within the foreseeable future, to become endangered in the State.

Pursuant to Section 7 of the ESA, information on the potential existence of special-status plant species was requested from the MDNR Natural Heritage Program. In an email dated May 20, 2013, MDNR provided results from their Wildlife and Heritage database. Their records indicated that the state-listed endangered yellow water-crowfoot (*Ranunculus flabellaris*) is located in close proximity to the project site. In a follow up email dated June 12, 2013, MDNR provided an additional record for the state-listed endangered Virginia mallow (*Sida hermaphrodita*) that was also documented in close proximity to the project site. In addition, the northern long-eared bat (*Myotis septentrionalis*) was recently listed by the USFWS as threatened throughout its range under the ESA (80 FR17974). However, the USFWS did not designate critical habitat for the species because it found that such habitat was not determinable at the time of listing.

In 2013, seasonal rare plant surveys were conducted within the project area during June, August, and September (EAEST 2013b). A list of the plant species of interest identified during this survey can be found in appendix G. The project area included the proposed construction area limits for the proposed project, the Unnamed Island, and the south bank of the C&O Canal (figure 13).

During the rare plant surveys, three watch list species, rough avens (*Geum laciniatum*), halberd-leaved hibiscus (*Hibiscus laevis*), and southern water nymph were observed (EAEST 2013b). Watch list species are not officially listed as threatened or endangered by the State of Maryland nor are they considered rare enough in Maryland to currently warrant reporting and tracking by the Maryland Natural Heritage Program database; however, they are considered uncommon species in Maryland and are often significant on a local level (MDNR 2010). Additionally, a state endangered plant, floating paspalum (*Paspalum fluitans*), was observed along the muddy shorelines of the Potomac River and the mosquito fern (*Azolla caroliniana*), a Maryland established plant was observed floating in the Potomac River (EAEST 2013a). Established species, such as the mosquito fern, are those that are not native to Maryland, but may be native elsewhere in North America.

Northern Long-eared Bat (*Myotis septentrionalis*) – The northern long-eared bat (NLEB) is found across much of the eastern and north central United States and its range includes 37 states. White-nose syndrome, a fungal disease known to affect bats, is currently a threat to this bat, especially throughout the northeast where the species has declined by up to 99 percent from pre-white-nose syndrome levels at many hibernation sites (USFWS 2015a). During summer, NLEBs roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees; they may also roost in cooler places, like caves and mines (USFWS 2015a). They emerge at dusk to feed on moths, flies, leafhoppers, caddisflies, and beetles, which they catch while in flight using echolocation and by gleaning motionless insects from

vegetation and water surfaces (USFWS 2015a). NLEBs spend winter hibernating in caves and mines, called hibernacula and breeding begins in late summer or early fall when males begin swarming near hibernacula (USFWS 2015a). Pregnant females migrate to summer areas where they roost in small colonies and give birth to a single pup (USFWS 2015a).

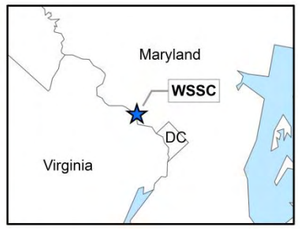
Gates and Johnson (2005) reported that one female NLEB was captured in a mist net at C&O Canal NHP during an inventory of bats within 11 National Capital Region National Parks in 2003–2005. The submerged channel intake project site is located to the south of the location where the NLEB was captured.

Mosquito Fern (*Azolla caroliniana*) – Mosquito fern is a delicate, mosslike floating aquatic plant with pinnately branched axis covered with small, scalelike, 2-lobed leaves. Mosquito fern can be locally common in shallow ponds, canals, ditches, and sluggish streams and occurs from New England to the Pacific coast (Muenscher 1944). Propagation by fragmentation of the plants is rapid and a whole pond or large area of water can become completely covered with a blanket of these floating plants (Muenscher 1944). Mosquito fern has not been tracked since 2009 after it was determined that it was being spread by waterfowl to different parts of the state. Mosquito fern has been spread to man-made ponds and ditches and there is a general belief or concern within the region that this species is an ephemeral, nonnative cultivar that is spreading by way of waterfowl and milder winters (Stango 2013). It is unlikely that permanent impacts on the mosquito fern, a "Maryland Established Plant," would occur due to the floating nature of this plant and the fact that it is possibly a nonnative cultivar that is well established and no longer tracked by MDNR; therefore, this species is not included in the analysis in the "Environmental Consequences" section.

Southern Water Nymph (*Najas guadalupensis*) – The southern water nymph is ranked as a G5S3 species (MDNR 2010). The species is globally secure, but in the State of Maryland, southern water nymph is a watch list species, meaning that it is rare to uncommon in its range. It is important to note that watch list species are not officially listed as threatened or endangered by the State of Maryland, nor are they considered rare enough in Maryland to currently warrant reporting and tracking by the Maryland Natural Heritage Program database. They are however, considered uncommon species in Maryland and are often significant on a local level (MDNR 2010). Southern water nymph is a submerged species, though it is often found as floating fragments. This species is found in ponds, lakes, and slow moving streams and is an excellent food source for waterfowl (MDNR 2010).

Floating Paspalum (*Paspalum fluitans*) – The state endangered floating paspalum is an annual, aquatic or subaquatic plant species, with sprawling, often elongate, spongy stems. Floating paspalum grows in mud or in shallow water along the margins of sluggish streams, ditches, swamps, ponds, and lakes. Colonies grow outward from the shore and form mats that may break loose and form floating islands (USACE 2011). In some areas, floating paspalum may block waterbodies and flow and is thus listed on the USACE Engineer Research and Development Center in the noxious and nuisance Plant Management Information System (EAEST 2013b).

Additional surveys for floating paspalum were conducted in September 2014 to determine the extent of the species along the Potomac River in the vicinity of the project area to better understand the context of the potential impacts and the opportunity for recolonization of the species following construction (EAEST 2014a). The population of floating paspalum identified in the 2013 surveys was observed in the same general location and this population appears to be healthy following the September 2014 survey.



Legend

- Floating Paspalum (*Paspalum fluitans*) Locations
- Halberd-leaved hibiscus (*Hibiscus laevis*) Location
- Mosquitofern (*Azolla caroliniana*) Locations
- Station

L:\GIS\Data\Northeast\Maryland\WSSC_Potomac_Intake\MXD\Report\EA_Figure 12 Rare Plants Survey Results_2013.mxd

Figure 13
Rare Plants Survey Results, 2013

Source:
ESRI 2012

Projection: NAD 83 Maryland StatePlane Feet
Date: January 2015

0 100 200
Feet

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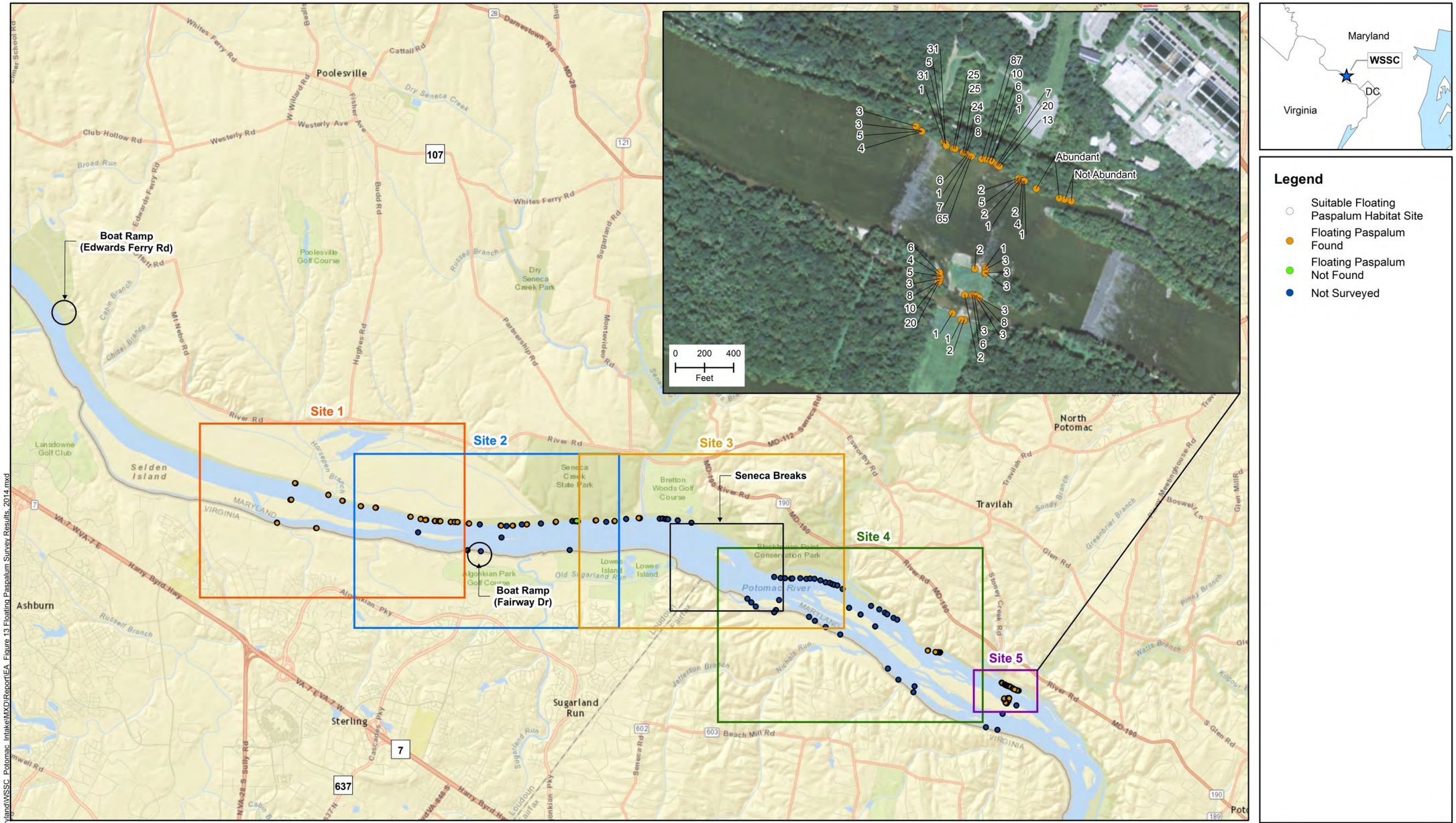

L:\GISData\Northeast\Maryland\WSSC_Potomac_Intake\MXD\Report\EA_Figure 13 Floating Paspalum Survey Results, 2014.mxd

Figure 14
Floating Paspalum Survey Results, 2014

Source:
ESRI 2012

Projection: NAD 83 Maryland StatePlane Feet
Date: January 2015

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Thirty-eight locations upstream of the Potomac WFP were surveyed in September 2014 for presence or absence of floating paspalum, and all but three supported floating paspalum. The three locations where floating paspalum was not present did not provide the habitat requisites of this plant species. An additional 13 sites upstream of the Potomac WFP to the edge of Seneca Breaks were surveyed in October 2014 for presence or absence of floating paspalum, and all 13 locations supported floating paspalum. Figure 14 presents the results of the October 2014 floating paspalum survey.

Halberd-leaved Hibiscus (*Hibiscus laevis*) – The halberd-leaved hibiscus is a state watch list species and locations are not actively tracked by the Wildlife and Heritage Service (MDNR 2010). The halberd-leaved hibiscus is an herbaceous perennial wildflower with large showy flowers. This wetland species can be found along streams, around ponds and lakes, in sloughs, roadside ditches, sometimes in shallow standing water (USGS 2013c).

Virginia mallow (*Sida hermaphrodita*) – The Virginia mallow can be found in unstable habitats with loose sandy or rocky soils of scoured riversides and floodplains, and disturbed areas along roadsides and railroad banks. This species is an extremely rare perennial plant found in a few locations along the Potomac River and along the Susquehanna River (MDNR n.d.). Virginia mallow is a perennial flowering herb, 3.3 to 9.8 feet (1 to 3 meters) in height. The flowers are made up of five white petals that grow in a clustered formation. This species blooms in late summer. The leave resemble stretched maple leaves and grow in an alternate pattern along a hairy stem. The hair stem diminishes with age. This species was not observed during three plant surveys; therefore, this species is not included in the analysis in the "Environmental Consequences" section.

Yellow Water Crowfoot (*Ranunculus flabellaris*) – Yellow water crowfoot is an aquatic herb found in shallow, open water, marshes, and muddy shores. The stem is hollow, smooth, and elongate. The leaves are highly variable. Submerged leaves are flattened and dissected into many segments and the emergent leaves, if present, are three-parted. Flowers are golden yellow, located on the emergent, long stalk. Flowers contain five petals (USGS 2013d). This species was not observed during three plant surveys; therefore, this species is not included in the analysis in the “Environmental Consequences” chapter.

Rough Avens (*Geum laciniatum*) – Rough avens is a spring-flowering state watch list species. This perennial forb blooms in late spring. It is found in a variety of habitats, including floodplains, forest edges, forests, meadows, fields, and disturbed areas (New England Wildflower Society 2013).

SCENIC RESOURCES (AESTHETICS AND VIEWSHEDS)

The viewshed is defined as areas with a line of sight looking toward and away from the proposed project. The viewshed is based on geography in addition to built and natural features, which determine what can and cannot be seen from a given location. The C&O Canal NHP offers a serene natural environment for visitors to enjoy while using the towpath, with forested areas that provide wildlife habitat located on both sides of the canal and towpath. The Potomac River is also visible from portions of the towpath. A scenic overlook and memorial, that are accessible to the public from the towpath, is located just east of the existing Potomac WFP intake. The overlook provides park visitors with a view of the Unnamed Island and beyond, across the Potomac River to the Virginia shoreline. Beyond the Unnamed Island is Watkins Island, which is also visible from parts of the northern shoreline. Both islands are uninhabited, forested, and inundated under high river flows.

The towpath viewshed consists mainly of forested or grassed areas along most of the WSSC property, which shields most of the water treatment plant’s structures from sight. However, there is a bridge and paved road that cross above the towpath and canal for WSSC to access the existing intake along the Potomac River. The road to the intake south of the towpath is lined with a solid fence that is visible from

the towpath, and portions of the WSSC raw water pumping stations are visible looking uphill through a thinly forested area and a chain-link fence located north of the towpath and canal.

The viewshed for boaters on the Potomac River differs from that of on the towpath. Boaters have a greater field of vision due to the open nature of the river. The project area only affects approximately 0.2-mile of the towpath, as much of the development on the WSSC property is screened by forested area; however, boaters can see the project area from a greater distance.

CULTURAL RESOURCES

This section discusses the historic background of C&O Canal NHP, the historic structures located within the project area, archeological resources, and cultural landscapes.

Historic Structures and Districts

Historical Overview of the C&O Canal – The C&O Canal emerged out of a general national interest in improving transportation and communication during the first part of the nineteenth century. Various plans for tying newly settled interior regions to the east coast were discussed in the United States. The National Road, authorized by Congress in 1802, was one plan for linking the Potomac and Ohio rivers. The C&O Canal was envisioned as a parallel trunk line (Meinig 1993). Eventually state support for a canal connecting the Chesapeake Bay to the Ohio Valley emerged and the Maryland Legislature incorporated the Chesapeake and Ohio Canal Company in 1824. Early plans were to connect the canal to the Ohio River at Pittsburgh, but Cumberland, Maryland became the western terminus. A proposed canal between Georgetown and Baltimore never materialized (Mackintosh 1991; Unrau 1974; Van Ness 1983).

Built on the Maryland side of the Potomac River between 1828 and 1850, the canal reached a total length of 184.5 miles and gained 605 feet in elevation by way of 74 lift locks. Aqueducts carried the canal across major streams, while culverts enabled small streams to flow underneath it. Associated features included lock houses, river locks, stop locks, bridges, shops, wharfs, and basins (Gray 2009). When the canal opened in 1850, the railroad had made many of its functions obsolete but the canal provided a better means of shipping heavy freight such as coal, produce, stone, lumber, and cement (Gray 2009; Mackintosh 1991; Van Ness 1983). The canal operated through the nineteenth century, despite competition from the railroad and a yearlong stoppage following a flood in 1889. Flooding in 1924 finally led to its permanent closure (Mackintosh 1991).

The canal encouraged various subsidiary economic and social activities. Canals in general supported local trade and commerce. Merchants and innkeepers often set up near locks to supply waiting boats and some of these stops grew into communities. Industrial concerns also took advantage of easy access to supplies and shipping. Canal-based towns often developed with factories and warehouses along the canal and commercial and residential districts radiating outward (Gordon and Malone 1994).

Historic Structures – The NRHP is an official list, maintained by the NPS, of buildings, structures, sites, districts, and objects that are important to the nation's history, architectures, archeology, engineering, and culture. Properties in or eligible for the NRHP may have historic importance to the community, state, or nation. The C&O Canal was proclaimed a National Monument by President Eisenhower in 1961. It was subsequently listed in the NRHP Places in 1966 as a historic district. The nomination lists many historic properties within the project area that are also within the district. These are also listed in the NPS List of Classified Structures, an inventory of all historic structures owned or under easement by the NPS. Historic properties that could be affected by the proposed action are listed in table 20.

Table 20. List of Classified Structures in or Adjacent to the Project Area

Structure Mileage	Structure Name	Primary Historic Function	National Register Status[(a)]
17.02	Milepost (1830)	Original Mile Marker	Entered-Contributing
17.74	Culvert #25 (Watts Branch) (1830)	Carries Watts Branch under Canal	Entered-Contributing
17.50	Mile 17-18, Canal Prism	Canal	Entered-Contributing
17.50	Mile 17-18, Canal Towpath	Canal	Entered-Contributing

(a) National Register Status: Entered-Contributing designates resources listed in the National Register that contribute to the historic character of the C&O Canal but are not eligible for individual listing

The Area of Potential Effects (APE) is limited for the project and extends for 0.2 mile up and down the park (MM 17.3-17.7) from the proposed intake; approximately halfway between MM 17 and MM 18. Comprehensive surveys for historic structures have been completed in the project area. There are likely no unrecorded historic buildings or structures present within the APE.

Archeological Study and Resources

Historic structures in the project area have been documented as part of the park's National Register nomination and management. A single comprehensive archeological survey was conducted for the entire park from 2002 to 2010. The goal of the survey was not to identify all of the archeological sites within the park, but rather to survey locations that would address regional issues and problems in what was termed "archeological triage" (Fiedel et al. 2005). Focusing on areas that were assessed as having the greatest potential to yield results that addressed the research design, the APE for this project was not surveyed during the 2002 to 2010 survey.

However, an archeological survey was conducted at the project site between 2005 and 2007. The investigations identified site 18MO633 on the T-1 terrace south of the canal prism. The prehistoric site occurs in sediments buried under historic flood deposits approximately 2- to 2.6-feet thick. The majority of the recovered artifacts are attributed to the Early Woodland Period, but Late Woodland and Late Archaic Period artifacts were also present in potentially stratified cultural deposits. Upcast material from the excavation of the canal prism may be present in proximity of the canal. Additional investigation was necessary to assess the site's eligibility for the NRHP.

Limited Phase I testing of the T-2 terrace within the APE north of the canal prism was conducted in 2013. The investigation identified prehistoric site 18MO719 below 1 foot of historic and modern fill. No diagnostic prehistoric material was recovered from the limited testing. Historic artifacts recovered in the fill may relate to the construction of the canal. Additional investigation was necessary to assess the site's eligibility for the NRHP.

The Phase 1 archeological surveys identified two archeological sites (18MO633 and 18MO719) that would be impacted by the proposed action alternatives (Cheek et al. 2007; Klein et al. 2015). A Phase II Evaluation of these sites was conducted during the spring and summer of 2014 (Klein et al. 2015). The Phase II evaluation of site 18MO633 demonstrated that the depositional context on the T-1 landform resulted in stratigraphically discrete occupations ranging in age from the Terminal Archaic or Early Woodland through the Late Woodland, and possibly Contact Periods at site 18MO633. At site 18MO719, the Phase II excavation demonstrated disturbance of the upper strata by the construction of the C&O Canal and other historic activity. Although these upper, disturbed backdirt deposits on site 18MO719 contain artifacts associated with the construction and maintenance of the C&O Canal (Criterion A), the complete loss of archeological integrity makes the resources unable to be securely associated with any

particular event, activity, or specific time period. The disturbed upper deposits of site 18MO719; therefore, are not eligible for listing on the NRHP. Nevertheless, the lower strata contained artifacts dating to the Late Woodland or Contact eras, and possible cultural features were identified at the surface of the Bwb horizon. Based on the potential contribution of sites 18MO633 and 18MO719 to the study of the late prehistory of the Potomac River Valley and the Middle Atlantic Region, the Phase II Evaluation recommended both sites eligible for listing on the NRHP under Criterion D. Avoidance or Phase III mitigation was also recommended in the Phase II Evaluation.

Because it has been well documented, archeological investigation of the C&O Canal prism was not conducted during these surveys. The canal and any remnant structures associated with it are considered among the historic structures impacts.

Cultural Landscapes

The C&O Canal NHP at the project site does not have a delineated cultural landscape. However, in combination the various elements of the canal (e.g., towpath, culvert, prism) form a distinct landscape that is relatively intact adjacent to the project site. However, the canal's viewshed includes the intake structure for the Potomac WFP, the plant, pumping stations, and access roads and a bridge over the canal prism, which detracts from the sense of a historic place.

VISITOR USE AND EXPERIENCE

During 2014, 5,066,219 recreational visitors were reported to use the C&O Canal NHP (from Cumberland, Maryland to Georgetown, D.C.) (NPS 2015). The busiest months were May, June, July, and August, when monthly attendance exceeded 550,000 visits. January and February were the least visited months with approximately 197,495 visitors to the park in January and 172,468 visitors in February (NPS 2015). Since the park extends for 184.5 miles along the Potomac River from Georgetown to Cumberland, it is divided into five districts. The five districts include Washington D.C., Montgomery County, Frederick County, Allegheny County, and Washington County. The project area lies within the Montgomery County District. Within this district, visitor counts are recorded at 20 sites either by vehicle count or trail use count. In 2012, a total of 992,478 visitors were estimated within the Montgomery County District (NPS 2013a). Visitor estimates through November 2013 are 1,365,432 (NPS 2013a).

The park offers a variety of natural, cultural, and recreational resources, including a towpath that provides a nearly level, continuous trail for biking and hiking through the Potomac River Valley. The park helps to preserve the unique natural resources of the Potomac River watershed and allows visitors to enjoy the scenery along the river and historic canal. Other activities offered include camping, picnicking, cross-country skiing, fishing, kayaking, boating, and horseback riding. Throughout the park, there are seven visitor centers with seasonal operations containing various exhibits. Additionally, a viewing area for the Great Falls is located near the Great Falls Tavern Visitor Center in Potomac, Maryland, which is the closest visitor center to the project site (3.4 miles downstream).

The facilities within the Potomac WFP are mostly not visible to visitors due to trees, the slope of the land, and the security fence. An access road to the existing intake extends from the south gate of the Potomac WFP and across the C&O Canal at the west side of the intake. The road divides into the upper access road that follows a retaining wall and the intake access road that parallels the Potomac River and terminates at the WSSC monument. The intake access road is connected to the towpath via a foot path.

Park visitors will hear a combination of natural, cultural, historic sounds, as well as non-natural human-caused sounds. Within the C&O Canal NHP, dominant natural sounds are calls and sounds from wildlife, sounds generated from the flow of the C&O Canal and Potomac River, and sounds from the wind

blowing through the trees. Within the project site, non-natural human-caused sounds may include noise in the surrounding area from equipment and activities associated with WSSC's WFP. In addition, park visitors who are fishing, hiking, biking, and picnicking in the area are secondary sources of noise. Noise is defined as a sound that is either unwanted or inappropriate in a particular environment (NPS 2012a).

The recreational resources in the vicinity of the WSSC Potomac WFP are the C&O Canal NHP waterway, the canal's towpath, and the Potomac River. Certain stretches of the canal are used for canoeing and boating, and canoeists must portage around each lock. Motorized watercraft are prohibited along most of the canal, including the stretch of canal near the project site; however, electric motorized craft are allowed in certain stretches of the canal. Swimming, hunting, and trapping are all prohibited in the park. Fishing in the canal is subject to state regulations. The towpath is used for biking, hiking, cross-country skiing, and horseback riding. Other activities that take place within the park include picnicking, camping, bird watching/wildlife viewing, and canal boat rides (NPS 2013b).

The project site includes the North Channel of the Potomac River, which is approximately 700-feet wide between the Maryland shoreline and Watkins Island. The South Channel of the Potomac River between Watkins Island and the Virginia shoreline is approximately 1,200-feet wide. There is approximately 100 feet between Unnamed Island and the northern shoreline of the Potomac River where the existing intake is located, which can be seen by boaters on the Potomac River. The shortest distance across the North Channel where the submerged offshore intake is proposed to be located is approximately 550 feet. The North Channel and the smaller channel north of Unnamed Island have limited navigational use because of the diversion weir that crosses the entire width of both channels, the rocky nature of the river, and the lack of places to launch boats. The diversion weir has three "notches" in it to allow passage of kayakers and canoeists. The Potomac River is not a federal channel used for commercial shipping. Marine traffic along this stretch of the Potomac River is mainly limited to small recreational watercraft, canoes, and kayaks. Although access to the Potomac River in the vicinity of the project site is limited, the Potomac River is used for boating, canoeing, kayaking, rafting, tubing, and fishing. Fishermen access the fishing areas by using boat ramps, wading, and from the shoreline, which is aided by the presence of extensive federal public lands along the Maryland Potomac River shoreline.

Two public boat ramps are located near the project site. One ramp is at Seneca Creek within the C&O Canal NHP, approximately 5 miles upstream, and the other ramp is 1.7 miles downstream on the Virginia side of the Potomac River at Riverbend Regional Park. Other parks in the vicinity of the project include the Northern Virginia Regional Park and the Riverbend Regional Park located in Fairfax County, Virginia, across the river and downstream from the project site. Watts Branch Stream Valley Park is also located just upstream of the project site in Maryland and extends northward.

HUMAN HEALTH AND SAFETY

The park is well maintained and the towpath and canal structures are kept in good condition in the vicinity of the project site. In 2012, there were 43 incidents in the park requiring first aid and 37 incidents requiring medical treatment. In 2013 (through November 17, 2013) the numbers of incidents were 20 and 27, respectively. There were also five fatalities within the park in 2013, but none were attributed to park conditions. Four of these fatalities were persons who drowned in the river, two of whom gained access from the C&O Canal. The other fatality was due to a heart attack that occurred while the person was riding a bike along the towpath.

WSSC owns a bridge that crosses over the C&O Canal and towpath and is used for vehicle access to and from the existing shoreline intake. The bridge is 98 feet long with a 12.5 feet wide traffic lane (curb to curb), and has a load limit of 20 tons. There is a locked gate that prevents public access to the bridge and

the plant facilities. There are no safety concerns for users of the towpath from the bridge or other WSSC facilities.

LAND USE

The project area is located near the town of Potomac (Montgomery County, Maryland). The project area consists of industrial (the Potomac WFP and natural gas companies) and recreational land uses. WSSC property is surrounded by NPS parkland. Several gas mains are located upstream that are owned by three separate natural gas transmission companies. These gas mains cross NPS parkland as easements that are maintained as open fields/mowed areas. The natural gas transmission lines closest to the Potomac WFP are owned by Transco and are about 800-feet upstream of the diversion weir. These transmission lines cross the Potomac River to Virginia. Watkins Island and Unnamed Island are uninhabited and forested. Residential property borders the Potomac WFP to the east and north; however, the project site itself is heavily shielded from residences by tree cover along the river shoreline, and the likelihood of nearby residences being able to view construction activity is remote. The closest residential land use is about 0.25-mile from the project site.

The Potomac Subregion encompasses three planning areas: Potomac, Travilah, and Darnestown. The subregion is bounded by I-270 and I-495 on the east, the Potomac River on the south, Seneca Creek to the west, and Darnestown Road and the City of Rockville to the north. The subregion is composed of two geographic components that are defined by the Montgomery County General Plan, including suburban communities and residential wedge. The Potomac WFP is located in the residential wedge which is characterized by 2- to 5- acre residential areas with small-scale commercial uses (M-NCPPC 2002).

The Potomac Subregion is rich in natural resources with many protected parklands and unique environmental resources, including wetlands, steep slopes along stream valleys, rock outcrops, and meadow-like environments. Almost a quarter of the subregion is forested. Of the 11,000 acres forested, 80% is dominated by deciduous species, 8%is a mix deciduous and coniferous habitat, 7% is characterized as successional woodland habitat, and 3% is classified as coniferous habitat. The forested areas are contained within large blocks consisting of at least 100 acres or with riparian widths of at least 300 feet. The unfragmented tracts are suitable habitat for forest interior-dwelling birds (M-NCPPC 2002). WSSC, the State of Maryland, and NPS own property in the project area (see figure 2).

The proposed Potomac submerged channel intake facilities, as well as a major portion of the existing intake facilities, reside on NPS property as part of the C&O Canal NHP. WSSC is planning to purchase and provide land to NPS in exchange for a perpetual easement for the intake facilities (figure 7). An appraisal would be completed for the property that is being proposed for the perpetual easement. The appraisal would address all areas that would be subject to the perpetual easement. NPS maintains information on properties and willing sellers within NPS's identified boundaries and would provide WSSC with a list of properties that they would like to acquire. Prior to the issuance by NPS of the SUP for construction, a signed legally binding agreement between WSSC and NPS describing the easement, the associated monetary value and the plan for land acquisition as compensation would be complete, as would the acquisition and transfer of the land to NPS.

The USACE oversees construction within the waters of the United States, including the Potomac River. The Potomac River in the project area is within the boundaries of the State of Maryland and the public has the right to use state waters for recreational activities. Riparian rights are the rights of landowners to use water that is on or adjacent to their property. Publicly owned riparian lands within the project area in Maryland include NPS parkland and the surrounding state-owned islands. There are no private landowners along the river in the project area.

ENVIRONMENTAL CONSEQUENCES

OVERVIEW

This "Environmental Consequences" chapter analyzes both beneficial and adverse impacts that would result from implementing any of the alternatives considered in this EA. This chapter also includes definitions of impact thresholds (e.g., negligible, minor, moderate, and major), methods used to analyze impacts, and the analysis methods used for determining cumulative impacts. As required by CEQ regulations implementing NEPA, a summary of the environmental consequences for each alternative is provided in table 4, which can be found in the "Alternatives" chapter. The resource topics presented in this chapter, and the organization of the topics, correspond to the resource discussions contained in the "Affected Environment" chapter.

GENERAL METHODOLOGY FOR ESTABLISHING IMPACT THRESHOLDS AND MEASURING EFFECTS BY RESOURCE

The following elements were used in the general approach for establishing impact thresholds and measuring the effects of the alternatives on each resource category:

- general analysis methods as described in guiding regulations, including the context and duration of environmental effects;
- basic assumptions used to formulate the specific methods used in this analysis;
- thresholds used to define the level of impact resulting from each alternative;
- methods used to evaluate the cumulative impacts of each alternative in combination with unrelated factors or actions affecting park resources; and
- methods and thresholds used to determine if impairment of specific resources would occur under any alternative

These elements are described in the following sections.

General Analysis Methods

The analysis of impacts follows CEQ guidelines and Director's Order 12 procedures (NPS 2001). Overall, the impact analyses and conclusions for this project were based on the review of existing literature and studies, information provided by on-site experts and other government agencies, the results of site-specific surveys (wetlands, SAV, mussels, special-status plant species, and archeology), best professional judgment, and park staff insight.

Assumptions

Several guiding assumptions were made to provide context for this analysis. These assumptions are described below.

Geographic Area Evaluated for Impacts (Area of Analysis)

The geographic area evaluated for impacts for the alternatives includes the areas within the construction area limit (limit of disturbance) for the project unless otherwise stated (see figures 2-5).

Impact Thresholds

Determining impact thresholds is a key component in applying NPS *Management Policies* and Director's Order 12. These thresholds provide the reader with an idea of the intensity of a given impact on a specific topic. The impact threshold is determined primarily by comparing the effect to a relevant standard based on applicable, relevant, or appropriate regulations or guidance, scientific literature and research, or best professional judgment. Because definitions of intensity vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this document. Intensity definitions are provided throughout the analysis for negligible, minor, moderate, and major impacts. In all cases, the impact thresholds are defined for adverse impacts. Beneficial impacts are addressed qualitatively.

Potential impacts of all alternatives are described in terms of type (beneficial or adverse), context, duration (short- or long-term), and intensity (negligible, minor, moderate, major) for long-term effects. Definitions of these descriptors include:

Beneficial: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.

Adverse: A change that declines or degrades the resource, and/or moves the resource away from a desired condition or detracts from its appearance or condition.

Context: Context is the affected environment within which an impact would occur, such as site-specific, local, park-wide, regional, global, affected interests, society as whole, or any combination of these. Context is variable and depends on the circumstances involved with each impact topic. As such, the impact analysis determines the context, not vice versa.

- **Site-specific:** The impact would affect the project site.
- **Local:** The impact would affect areas within the general vicinity of the project area.
- **Park-wide:** The impact would affect areas outside the project site yet within the park.
- **Regional:** The impact would affect localities, cities, or towns surrounding the park.

Duration: The duration of the impact is described as short-term or long-term. Duration is variable with each impact topic; therefore, definitions related to each topic are provided in the specific impact analysis narrative.

Intensity: Because definitions of impact intensity (negligible, minor, moderate, and major) vary by impact topic, intensity definitions are provided separately for each impact topic analyzed.

Cumulative Impacts Analysis Method

The CEQ regulations to implement NEPA require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). As stated in the CEQ handbook, *Considering Cumulative Effects,* cumulative impacts should to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on effects that are truly meaningful (CEQ 1997). Cumulative impacts are considered for all alternatives, including the no-action alternative.

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects and plans at C&O Canal NHP, WSSC's Potomac WFP, and the surrounding area.

The analysis of cumulative impacts was accomplished using four steps:

> *Step 1* — Identify Resources Affected - Fully identify resources addressed in affected environment and environmental consequences sections affected by any of the alternatives.
>
> *Step 2* — Set Boundaries - Identify an appropriate spatial and temporal boundary for each resource.
>
> *Step 3* — Identify Cumulative Action Scenario - Determine which past, present, and reasonably foreseeable future actions to include with each resource.
>
> *Step 4* — Cumulative Impact Analysis - Add the impacts of these other actions (x) to impacts of the proposed action (y) to arrive at the total cumulative impact (z). This analysis is included for each resource in the "Environmental Consequences" chapter.

The following list of projects and actions (past, present, and reasonably foreseeable) was considered in the cumulative impact analysis for each resource:

C&O Canal National Historical Park General Plan - The NPS began management of the 184-mile historical park resource in January 1971. With a boundary expanded from 5,257 to 20,239 acres, a mandate to provide for the enjoyment of the park's recourses in such a manner as to leave them unimpaired for future generations, and the advice of a 19-member citizen's advisory commission, the NPS prepared a plan for the park. The general plan for managing the park is the result of a planning process which began when the advisory commission was established in December 1971, and was based on earlier studies. The plan established an overall management philosophy which was followed by more specific action plans. The general plan for the park calls for the stabilization and partial restoration of the historic canal and its structures, the preservation of its charming natural setting, the interpretation of the rich array of historical and natural values found along the canal, and provisions for as much outdoor recreation as will not intrude upon or impair the resources which the park was established to protect. The initial task of the plan was to clarify the purpose of the park and establish management objectives for it.

Washington Aqueduct Dam - The Washington Aqueduct is the District of Columbia's first public water system. It was designed and developed by Montgomery C. Meigs and built by the USACE from 1853 to 1863. In November of 1853, ground was broken at Great Falls, Maryland for a public water system for Washington. Meigs' plan was to divert the water from the Potomac River (12 miles upstream) into a brick conduit. Gravity and pumping stations would direct water through the conduit to retaining reservoirs where it could then be pumped to the city's pipelines. To accomplish this plan, the USACE constructed a masonry dam across the Potomac River, a control gatehouse at Great Falls, a 12-mile conduit, 11 tunnels, six bridges, pump stations, pipelines, and two reservoirs. The dam is located near MM 15. The conduit is the largest structure of the water system. It stretches almost 12 miles downriver from the intake at Great Falls to the Georgetown Reservoir. It was constructed by tunneling and by deep rock cuts. A road was built parallel to the conduit to facilitate cleaning repairs and inspections. The Washington Aqueduct, constructed over 140 years ago, is still supplying the nation's capital with public water. The Aqueduct produces millions of gallons of filtered water per day, has a storage capacity of 44 million gallons, and serves 1.1 million customers. The Aqueduct provides public water for all of Washington, Arlington County, and Falls Church; 50 square miles of Fairfax County; and all federal installations including the Pentagon, Fort Meyer, the Defense Mapping Agency, and National Airport (NPS 2013c).

Potomac River Watershed Restoration Projects in Montgomery County - Montgomery County continues ongoing efforts to address channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stormwater pond improvements, stream restoration and enhancement, stormwater retrofit, and low impact development. Aspects of these projects would include: stabilizing stream banks and enhancing riparian habitats; improving fish passage; improving aquatic habitat conditions; constructing wetlands; using features such as curb extensions, bioswales, tree box filters and modified stormdrain inlets; and employing low impact development techniques.

Sharpsburg Water Intake Upgrades - The Washington County Division of Environmental Management has requested to upgrade a raw water pipeline for their water intake at Mile 74.3 of within the park. The intake provides water for the community of Sharpsburg, Maryland. The existing 6-inch line is 30-years old and has reached the end of its service. The pipeline conveys raw water from the intake to the Sharpsburg Water Treatment Plant. The project will replace the existing 6-inch line with two 6-inch waterlines, along with underground power and communication conduits within the existing easement. An additional component of the project will be the construction of a dike within the canal prism. This will provide Washington County's Water Treatment Plant staff a more direct route to the intake from the water plant. Currently, plant staff must use the park's historic towpath to access the intake. Entering at Lock 38, they currently travel over one mile along the towpath which is not always passable due to weather conditions. An EA was developed to evaluate potential impacts on park resources and a Finding of No Significant Impact was signed on June 25, 2012. The project has been approved to move forward (NPS 2013d). Construction has started on this project including the clearing of a large forested area.

CSX Lock 74 North Branch Bridge Replacement – CSX has replaced a two track bridge across the North Branch of the Potomac River adjacent to Lock 74 of the C&O Canal NHP. This bridge serves the main line of CSX and Amtrak with approximately 30 trains a day crossing the bridge. The proposed work involved the construction of the new span on temporary falsework adjacent to the existing bridge. Access for the bridge replacement work will be across lands of the C&O Canal NHP. The project involved multiple projects on park lands. The modern vehicle bridge that spans across Lock 74 and rests on the lock wall has been removed and replaced with a new bridge. An access road was created around the staging area to provide a one-way path for the contractor to get both equipment and materials to the railroad bridge. Approximately 0.5 acre of parkland was cleared of vegetation including trees to allow for the installation of the bridge falsework. The contractor is planning to replant the area to park specifications in the spring of 2016 and will treat for invasive species for multiple years.

CSX 72-inch Culvert Installation and Erosion Control - The park partnered with CSX for the mitigation of the impacts of a 72-inch storm water runoff culvert leading from the CSX Rail Yard just north of park property in Cumberland, Maryland. An existing swale caused by extensive erosion of soil from the historic canal prism and towpath accelerated in the past couple of years. Nearly 3,500 tons of soil washed into the Potomac River leaving a scar on the historic landscape and threatened the continuity of the historic towpath that now links the C&O Canal towpath with the Alleghany Passage to form a 335-mile long greenway from Pittsburgh to Washington. Construction was phased to allow visitors to use the towpath with minimal delays. The phased approach utilized the area already washed out from the erosion as the excavation for the placement of the new pipe. The eroded towpath was excavated in a step-like manner to facilitate the compaction of the earthen embankment. This resulted in an upside down prismatic shape that measured approximately 60 feet along the towpath level and approximately 20 feet at the bottom where the pipe exited. A mechanically stabilized earth structure (MSE) that matched the historic slope and grade of the towpath embankment was used. The MSE product is environmental friendly (i.e., it was hydro-seeded with native vegetation that completely covered the MSE structure). This product has been used previously by the park and has proven to be a very sustainable and acceptable means to achieve the steep grades along the towpath that are so common to the historic towpath.

Resurface the Capital Crescent Trail - The Capital Crescent Trail is a paved bike trail that serves as a primary commuter route. The trail runs from Montgomery County into Georgetown. The trail was constructed in 1992 and has not been resurfaced since. As a result, tree roots have infiltrated the pavements base and have buckled and cracked the existing pavement. This has created a safety concern for the commuters that travel the trail each day. The goal of this project is to create a safe sustainable trail that will require limited maintenance. This project will resurface 3.5 miles of the Capital Crescent Trail from the D.C. line to the trail head in Georgetown after the Upper Potomac Interceptor is relined. The project will involve the following work: the entire length of this section of trail will be topped with a new 2-inch-thick asphalt pavement; all root damaged pavement will be cut and removed; the intrusive roots will be pruned and a new 6-inch compacted base will be installed at these areas, also 4 inches of new pavement will be placed at these areas; the trail shoulders (2-feet wide on each side) will be scraped down 2 to 4 inches of new stone dust will be installed in its place; all vegetation will be cleared 12 feet from the center line of the trail on each side; and all tree canopy will be removed to a height of 30 feet.

Repair Canal Structures, Water Areas, Locks 5 to 22 - The park is planning to repair primary canal structures in the longest watered segment of the park from Lock 5 through the upstream end of Level 22. This corresponds to an area of the canal generally between Mileposts (or Mile Markers) 5.02 and 22.12. This segment of the park provides daily recreational opportunities for walking, hiking, riding, running, biking, boating, fishing, and enjoyment of the extensive cultural and natural resources of the park. These historic canal features must be in good condition both to maintain the water level required for the interpretive canal boat program and also to provide other interpretive and educational resources to visitors. Historic features to be treated include:

- Lock 7 - Milepost 7.00 - Install fuse plug upstream of lock due to frequent towpath washouts.
- Waste Weir Upstream of Lock 7 - Milepost 7.10 - Replace waste weir with larger water control structure.
- Rock Run Culvert - Milepost 8.93 - Stabilize/rebuild dry stone wall on towpath side.
- Lock 13 - Milepost 9.37 - Rebuild armored wall on towpath side.
- Lock 14 - Milepost 9.47 – Rebuild armored wall on towpath side.
- Historic Culvert No. 15 – Milepost 10.42 – Repair leakage on berm side.
- Lock 15 – Milepost 13.45 – Repair and repoint stone masonry. Replace lock gates and hardware.
- Lock 16 – Milepost 13.63 – Repair and repoint stone masonry. Replace lock gates and hardware.
- Lock 17 – Milepost 13.99 – Repair and repoint stone masonry. Replace lock gates and hardware.
- Lock 18 – Milepost 14.09 – Rebuild dry stone wall. Repair and repoint masonry. Replace lock gates and hardware.
- Lock 19 – Milepost 14.17 – Repair and repoint stone masonry. Replace lock gates and hardware.
- Lock 20 Waste Weir – Milepost 14.34 – Replace waste weir timber bridge, abutments, etc.
- Towpath Breach – Milepost 16.90 – Install water control structure.
- Blockhouse Point – Milepost 21.02 to 21.07 – Replace cap stones and rebuild historic stone wall on towpath side. Raise towpath grade to mitigate potential for future washouts.

DC Water Potomac River Tunnel - Under a federal consent decree with the USEPA, the District of Columbia Water and Sewer Authority (DC Water) has plans to construct a 58-million gallon storage tunnel and supporting infrastructure for conveyance and storage of combined sewer overflows when the

sewer system capacity is exceeded. This is the largest construction project in D.C. since the Metro was built. The $2.6 billion Clean Rivers Project aims to nearly eliminate combined sewer overflows to the Anacostia and Potomac rivers and Rock Creek, also improving the health of the Chesapeake Bay. The first tunnel system, and the largest, will serve the Anacostia River. The first part of that system, named the Blue Plains Tunnel, is 23 feet in diameter, and runs more than 100-feet deep. It will extend from Blue Plains in Southwest D.C., roughly along the east bank of the Potomac, crossing under the Anacostia and extending along the west bank to about RFK Stadium. That tunnel will also be instrumental in DC Water's effort to reduce nutrient pollution to the Potomac River and Chesapeake Bay. Additional tunnels are also planned to reduce combined sewer overflows in the Potomac and Rock Creek sewersheds. Washington, D.C. parks that will be affected by the project include C&O Canal, Rock Creek, and the National Mall. An Environmental Impact Statement (EIS) has been initiated to evaluate impacts.

Existing Developments - Within 10 miles north and 10 miles south of MM 17.5 (project site is in the vicinity of MM 17.5), an approximate average distance a park visitor would travel on the park's towpath, several utility corridor ROWs cross over the C&O Canal towpath. In addition the Capital Beltway (495) crosses above the towpath and the Potomac River between Locks 12 and 14. Other developments visible from the towpath and river include WSSC's Potomac WFP. There is a bridge and paved road that cross above the towpath and canal for WSSC to access the existing intake along the Potomac River. The road to the intake south of the towpath is lined with a solid fence that is visible from the towpath, and portions of the WFP raw water pumping stations are visible looking uphill through a thinly forested area and a chain-link fence located north of the towpath and canal.

Table 21 lists which past, present, and reasonably foreseeable future actions are included with each resource.

Table 21. Cumulative Impact Scenario Table

Impact Topic	Project Area	Past Actions	Present Actions	Future Actions
Geology and Soils	C&O Canal NHP and the project area in the vicinity of MM 17.5[(a)]	C&O Canal NHP General Plan	Potomac River Watershed Restoration Projects; Washington Aqueduct Dam	
Water Resources	C&O Canal NHP and the project area in the vicinity of MM 17.5	C&O Canal NHP General Plan	Potomac River Watershed Restoration Projects; Washington Aqueduct Dam	
Wetlands and Floodplains	C&O Canal NHP and the project area in the vicinity of MM 17.5	C&O Canal NHP General Plan	Potomac River Watershed Restoration Projects	
Vegetation and Wildlife Aquatic and Terrestrial	C&O Canal NHP and the project area in the vicinity of MM 17.5	C&O Canal NHP General Plan	Potomac River Watershed Restoration Projects; Washington Aqueduct Dam	
Special-status Species	C&O Canal NHP and the project area in the vicinity of MM 17.5	C&O Canal NHP General Plan	Potomac River Watershed Restoration Projects; Washington Aqueduct Dam	
Cultural Resources	C&O Canal NHP and the project area in the vicinity of MM 17.5	C&O Canal NHP General Plan		
Scenic Resources	C&O Canal NHP and the surrounding area 10 miles to the north and south of MM 17.5[(b)]	C&O Canal NHP General Plan; Existing developments: utility ROWs, 495 Beltway, WSSC Potomac WFP	Potomac River Watershed Restoration Projects; Washington Aqueduct Dam	Repair Canal Structures – Lock 5 to 22
Visitor Use and Experience	C&O Canal NHP and the surrounding area 10 miles to the north and south of MM 17.5[(b)]	C&O Canal NHP General Plan; Existing developments: utility ROWs, 495 Beltway, WSSC Potomac WFP		Repair Canal Structures – Lock 5 to 22
Human Health and Safety	C&O Canal NHP and the project area in the vicinity of MM 17.5			
Land Use	C&O Canal NHP and future land exchange property			

(a) The project site is in the vicinity of MM 17.5 of the park's towpath.

(b) 10 miles north and 10 miles south of MM 17.5 was used to cover the average distance a park visitor would travel on the park's towpath. The parks' General Plan defines a short-term towpath user as a visitor that enters "the park to walk, hike, bike, jog, canoe, ride horseback, or to study nature and history. They are day users who may spend 15 minutes or all day in the park. Most use it frequently and many are residents of the communities adjacent to the area of the park which they are using. Some are seeking a remote experience, while others feel more comfortable with a higher density of visitors around them. This is an extremely diverse group which presently makes up the major portion of the canal visitors." (NPS 1976)

GEOLOGY AND SOILS

Methodology and Assumptions

Potential impacts on geology and soil resources were assessed based on the extent of disturbance to geology and soils, including natural undisturbed geology and soils, the potential for soil erosion resulting from disturbance, and limitations associated with the geology and soils. Disturbance to soil occurs when topsoil or native soils are removed from a portion of land for purposes of construction.

Primary steps for assessing impacts on geology and soils include identifying potential changes in soils, potential changes to soil productivity, and potential changes to soil erosion rates. The alternatives were evaluated based on their potential to impact geology and soil resources.

Project Area

The geographic project area for geology and soil resources includes the areas within the construction site for the project.

Impact Thresholds

The following thresholds were used to determine the magnitude of impacts on geology and soils:

Negligible – Soils would be affected below or at the lower levels of detection. Any impacts on soils would be slight. Geologic resources would be undisturbed.

Minor – Impacts on soils would be detectable and would slightly change soil characteristics in a relatively small area but the change would not appreciably alter the potential for erosion. Geologic resources would be somewhat altered and impacts would be detectable but localized. Mitigation would be needed to offset adverse impacts. Mitigation measures would be relatively simple to implement and would likely be successful.

Moderate – Impacts on soils would be readily apparent and would appreciably change soil characteristics over a relatively large area. The potential for erosion to remove small quantities of additional soil would increase or decrease. Impacts on geologic resources would be altered and perceptible over a wide area. Mitigation measures would be necessary to offset adverse impacts and would likely be successful.

Major – Impacts on soils would be readily apparent and substantially change the character of the soils over a large area in or outside of the park. There would be a strong likelihood that the potential for erosion to remove large quantities of additional soil would increase or decrease. Impacts on geologic resources would be readily apparent and result in a substantial change over a large area. Mitigation measures to offset adverse impacts would be necessary, extensive, and their success would not be guaranteed.

Duration – Short-term impacts occur during the construction phase of the alternative; long-term impacts occur during and beyond implementation of the alternative.

Alternative 1: No-action Alternative

Under the no-action alternative, no additional disturbance to soils or geologic resources would occur; however, soils and geologic resources at the project site were previously disturbed for construction and excavation of the Potomac WFP. Most of the project site is covered with a layer of overburden fill and

soil of residual origin and variable thickness. The overburden soils were altered during construction of the WFP and soils were removed during excavation for the WFP. Fill consisting of excavated rock and soil from the WFP excavation and the original overburden material was replaced in the excavations. The ground surface was raised up to 25 feet in the vicinity of the existing intake. This disturbance to the geology and soils has resulted in a long-term moderate adverse impact at the project site under alternative 1.

Cumulative Impacts: Other past, present, and future planned actions within and around the project area (MM 17.5) have the potential to impact geology and soils. Past planning efforts, such as the park's General Plan, established goals for the preservation of the park's natural setting including a goal that outdoor recreation should not intrude upon or impair the resources for which the park was established to protect. The Potomac River watershed restoration projects would also benefit geologic resources and soils at the park. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stormwater pond improvements, stream restoration and enhancement, stormwater retrofit, and low impact development. The Washington Aqueduct dam may be adversely impacting the sediments of the Potomac River in the vicinity of MM 17.5. Impounded rivers may accumulate excessive nutrients, sediments, and aquatic plants. Dams block the flow of sediment downstream, possibly leading to downstream erosion of sedimentary depositional areas, and increased sediment build-up in the upstream impoundment. The river that emerges downstream of a dam can be altered from the character of the river entering the impoundment above a dam.

The overall impacts of these past, current, and future actions on geology and soils in the vicinity of MM 17.5 would be a combination of beneficial and adverse effects. The beneficial effects of these cumulative actions on geology and soils are expected to negate some of the adverse impacts of the dam on river sediments. Therefore, the adverse impacts described above are not expected to contribute to the long-term moderate adverse impacts on geology and soils under alternative 1. Cumulative impacts on geologic resources and soils in the project area would be long-term, moderate, and adverse.

Conclusion: Soils and geologic resources were previously disturbed for construction and excavation of the Potomac WFP resulting in a long-term moderate adverse impact at the project site under alternative 1.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the long-term moderate adverse impacts on geology and soils under alternative 1.

Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative)

Construction Impacts: Since construction of the new intake tunnels would involve excavating a tunnel beneath the Potomac River to connect the new intake to the existing raw water conduits, impacts on bedrock geology are expected. Constructing the tunnels would involve excavation of bedrock material from the level of the tunnel, using traditional drill and blast techniques. The tunnels would be constructed such that the top of the tunnel would be approximately 20-feet below the streambed based on geologic conditions. The tunnels have a 10-foot diameter, thus the bottom of the tunnels would be approximately 30-feet below the streambed. Approximately 250,000 cubic yards of bedrock would be removed for tunnel construction. The material removed from the tunnels would be disposed offsite at an approved facility. Impacts on geology would also occur from excavation of the intake shaft and junction vault. The excavated shafts would encounter bedrock and varying depths of soil. After construction, the 80-foot-diameter shaft excavations would be backfilled, using excavated material if suitable or off-site backfill, up to and around the junction vaults. Bedrock removal for both the tunnels and shafts would be

permanent under this alternative. However the excavations would be carried out in such a way as to maintain stability of the surrounding geology. Impacts on geologic resources would be long-term and adverse due to the permanent removal of bedrock at the site; the impacts would be moderate since the excavation of bedrock would be perceptible over a wide area.

The installation and removal of temporary cofferdams for the construction of the new intake, intake shaft, and boat ramp and the construction of the embankments in the channel of the Potomac River and C&O Canal would disturb riverbed material (sediments) potentially resulting in the release of fine sediment into the river and canal. Rock would be placed in the river to construct the cofferdams and road embankments. Approximately 4.0 acres of canal and riverbed would be disturbed for the construction of the cofferdams and embankments (table 22). One embankment is needed within the C&O Canal for the construction access road to cross the canal. Once the project is complete, the cofferdams and embankment would be removed and the areas would naturally return to conditions similar to those before construction. Short-term minor adverse impacts on canal and riverbed material (sediments) are expected from the cofferdams and embankments since they would only be placed on the surface of the canal bed and riverbed resulting in minimal disturbance to the sediments.

The boat ramp and submerged intake would be permanent structures affecting sediments at the site. The lower end of the boat ramp would likely rest on riverbed material approximately 2- or 3-feet below the normal water level. Some removal of riverbed and riverbank material to a depth of approximately 2- to 3-feet below the normal water level would be required in order to extend the boat ramp into the river. The submerged intake structure (0.14 acre) and boat ramp (0.030 acre – in-water portion) would represent a small loss of riverbed and riverbank material. Construction of these features would be done within temporary cofferdams to minimize impacts on Potomac River turbidity levels; impacts from these cofferdams are included in the 4.0 acres discussed under sediment impacts. Long-term minor adverse impacts on riverbed (sediments) and bank material would occur from construction of the boat ramp and the submerged intake since sediments and bank materials would be permanently removed from the river; however, this change would occur in a relatively small area.

The site investigation previously performed for the project indicates that up to an approximately 45-foot-thick layer of overburden consisting of residual soil and fill material would be encountered on the north side of the river. Upland construction activities, including the construction of the boat ramp access road, parking area, junction vault, and construction access road, are expected to impact soils at the site. Construction of these project components and associated construction laydown and storage (also known as staging) areas would possibly require that 4.7 acres of vegetation be cleared and that soils subsequently be graded resulting in soil disturbance and compaction (table 22). Most of the soils within the construction area limit (limit of disturbance) have been disturbed from past construction activities relating to the existing intake circa 1980; however, the parking area would be constructed over soils that were not previously disturbed during these construction activities. At the completion of construction, the construction access road would be removed and the site would be restored to preexisting conditions. Restoration at the site includes actions such as tilling and replacing topsoil that was removed from the original ground to prepare the soil for revegetation with native species that resemble the existing vegetation. This would happen throughout the site except where permanent, onshore structures (boat ramp access road, parking area, and junction vault) would be located.

Table 22. Construction Area Limits (Limits of Disturbance)

Project Components	Construction Area Limits (acres)		
	Alternative 2	Alternative 3	Alternative 4
Aquatic: Cofferdams, Embankments, Boat Ramp	4.0	5.4	4.5[a]
Terrestrial: Junction Vault, Boat Ramp Parking Area, Boat Ramp Road, Construction Access Road	4.7	3.7	4.4[b]
Total Construction Area Limits	8.7	9.1	8.9

Measurements in this table are approximate.
(a) Includes embankment/culvert for the temporary relocation of the towpath
(b) Includes the relocation of the temporary towpath and this alternative has an additional access area for maintenance of the vault.

Table 23. Construction Impacts - Permanent Structures

Project Components	Permanent Structures (acres)		
	Alternative 2	Alternative 3	Alternative 4
Submerged Intake Structure	0.14	0.14	0.14
Intake Tunnel/Conduits[(a)]	0.76 (tunneled)	0.36 (tunneled)	0.89 (tunneled)
		0.42 (trenched)	
		0.13 (concrete cap)	
Boat Ramp (impervious)	0.030 (aquatic)	0.030 (aquatic)	0.030 (aquatic)
	0.030 (terrestrial)	0.030 (terrestrial)	0.030 (terrestrial)
Boat Ramp Road (pervious)	0.15	0.15	0.11
Boat Ramp Parking Area (pervious)	0.090	0.090	0.090
Junction Vault/ Onshore Shaft (impervious)	0.040 (aboveground)	0.040 (aboveground)	0.10 (aboveground)[(b)]
	0.080 (belowground)	0.080 (belowground)	0.070 (underground)

Measurements in this table are approximate.
(a) Construction of the tunnel/conduits impacts both riverbed and soils/bedrock in alternative 3 due to trenching, while impacts are mostly to soils/bedrock in alternatives 2 and 4.
(b) This alternative has an additional access area for maintenance of the vault.

Table 24. Construction Impacts - Temporary Structures

Project Components	Temporary Structures (acres)		
	Alternative 2	Alternative 3	Alternative 4
Boat Ramp Cofferdam (acres)	0.09	0.09	0.09
Intake Cofferdam (acres)[(a)]	1.2	1.8	1.2
River and Canal Embankments (acres)	0.37	0.26	0.44[c]
Construction Access Road[(b)] (acres)	0.61	0.60	0.64[d]
Unnamed Island Embankment and Cofferdam	N/A	0.19	N/A

Measurements in this table are approximate.
(a) Construction of the intake cofferdam impacts both riverbed and vegetation near the parking area in alternative 3, while impacts are mostly to the riverbed in alternatives 2 and 4.
(b) Construction access road would be created using pervious materials.
(c) Includes embankment/culvert for the temporary relocation of the towpath.
(d) Includes the relocation of the temporary towpath.
N/A – Not applicable

To minimize the movement of soils and control runoff onsite, applicable Montgomery County, Maryland and federal guidelines and regulations, including the Maryland Stormwater Management Guidelines for State and Federal Projects (MDE 2010), would be followed. Details of how stormwater would be managed at the construction site would be included in the Erosion and Sediment Control Plan and the Stormwater Management Plan (see the "Purpose and Need" chapter for plan details) which would be prepared prior to construction and in conformance with Montgomery County and MDE requirements. MDE and Montgomery County review and approval of these plans would be required before construction could begin. Overall, short-term adverse impacts on soils would occur from construction activities since soils would be disturbed over a relatively large area (4.7 acres, table 22); however, most of the project area would be restored and revegetated to stabilize soils in the long term.

The area of permanent structures located on land at the site totals 0.31 acre (table 23). The boat ramp access road and parking area (0.24 acre, table 23) would be constructed of pervious paving materials (see the "Water Resources" section below for more information on paving materials) that would allow rainwater to pass through the material into the soil below and then back to the ground water supply, thereby stabilizing the soils at the site and minimizing impacts on soil functionality. Soils at the site would be permanently removed and replaced with concrete for construction of the junction vault and boat ramp (0.070 acre, table 23). Due to the relatively small area of soils permanently affected, minor adverse impacts would occur in the long-term.

Operational Impacts: Long-term maintenance of the offshore intake could include launching of a small barge to collect debris and deposits around the intake. A permanent access road, boat ramp, and parking area accessible by a barge-hauling truck and trailer would be required; impacts from installation of these features are discussed under "Construction Impacts." Over the long-term, some loss of soil to erosion and stormwater runoff could occur from use of these features. Stormwater control would be addressed in the Erosion and Sediment Control Plan and the Stormwater Management Plan to minimize stormwater runoff at the site.

Computational Fluid Dynamics (CFD) modeling was performed on a limited scale to investigate the sizing, configuration, and hydraulic characteristics of the conceptual intake system alternatives evaluated for this project (Black and Veatch 2013). Results of the preliminary model indicated that the submerged intake structure, regardless of the alternative, would increase local flow velocities upstream of the structure and vortices (whirling masses of water with suction force, such as a whirlpool) may form downstream, potentially leading to scour of the structure and the surrounding riverbed. Between the intake and Unnamed Island downstream of the structure the velocity would be slower and there is the potential for sedimentation. The low elevation of the submerged intake means that surface dimpling in the river may also occur at higher withdrawal rates (Black and Veatch 2013). However, these issues would be mitigated by "reshaping" or sculpting the river bottom where the intake is located and lowering the intake accordingly, if necessary. This would be done during the excavation of the intake shaft and would occur within the construction area limits. Additional CFD modeling is recommended to further optimize the design and layout of the intakes.

The onshore shaft is required for construction and maintenance regardless of the alternative. This shaft may be subject to settlement of sand and sediment, and therefore would need to be cleaned out periodically. This procedure is currently happening with the existing onshore intake. Any sediment from the existing onshore intake is carried forward and deposited in wetwells, where it is removed by crane twice a year. It is anticipated that the new intake and piping system would also transport sand and sediment forward to the wetwells for removal in the same fashion. Due to the expected improved quality of raw water from the proposed river intake, and higher intake velocities through the system, sedimentation quantities are expected to be less than the existing conditions. This would result in a long-

term minor adverse impact on the sediments of the Potomac River; however, the impacts would be localized to the project site.

Lock 13 Wetland Mitigation Site: There would be negligible impacts on soils and the geologic resources at the Lock 13 wetland mitigation site. No new wetlands are proposed to be created, the proposed wetland mitigation is considered to be enhancement. Enhancement activities include removing invasive species and planting native species. There would be no grading at the site and minimal soil disturbance.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 2 would be identical to those under alternative 1. The effects of these actions described above are not expected to contribute to the long-term moderate adverse impacts on geology, the short- and long-term minor adverse impacts on sediments, and short- to long-term minor to moderate adverse impacts on soils under alternative 2. Therefore, the cumulative impacts on geologic resources in the area of analysis would be long-term moderate adverse impacts on geology, the short- and long-term minor adverse impacts on sediments, and short- to long-term minor to moderate adverse impacts on soils.

Conclusion: The geologic resources, soils, and sediments at the site would be affected during construction of the project. Construction of the new intake tunnels would involve excavating a tunnel beneath the Potomac River to connect the new intake to the existing raw water conduits, thus affecting bedrock geology. Bedrock removal would be permanent; however, the excavations would be carried out in such a way as to maintain stability of the surrounding geology. The installation and removal of temporary cofferdams for the construction of the new intake, intake shaft, and boat ramp and the construction of the embankments in the C&O Canal and channel of the Potomac River would disturb canal and riverbed material (sediments) potentially resulting in the release of fine sediment into the canal and river. Upland construction activities including the construction of the boat ramp access road, parking area, junction vault, construction access road, and associated staging areas would impact soils at the site. Vegetation would be cleared and soils subsequently graded resulting in soil disturbance and compaction. Mitigation for these impacts would include site restoration. Revegetation with native species to resemble the existing vegetation would occur following construction. Most permanent features would be constructed of paving materials that would allow rainwater to pass through the material into the soil below and then back to the ground water supply, thereby stabilizing the soils at the site and minimizing impacts on soil functionality. Therefore, construction activities would result in long-term moderate adverse impacts on geologic resources; short-term minor adverse impacts on canal and riverbed sediments; and short-term moderate adverse impacts on soils from construction activities associated with alternative 2. Impacts on soils due to the permanent onshore structures would be minor and adverse in the long term due to the small area affected and due to the use of BMPs, such as stormwater control practices; impacts on sediments from the permanent boat ramp would also be long-term minor and adverse due to the small area affected. The submerged intake would result in long-term minor adverse impacts on the sediments of the Potomac River, but these impacts would be localized to the project site.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the long-term moderate adverse impacts on geology, the short- and long-term minor adverse impacts on sediments, and short- to long-term minor to moderate adverse impacts on soils under alternative 2.

Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake

Construction Impacts: This alternative involves a combination of trenching to construct the new intake, intake shaft, and conduit tunnel to the junction vault/onshore shaft and then tunneling to construct the conduit tunnel from the junction vault to the existing raw water conduits. The trenched conduits would be

constructed by traditional methods involving excavation of overburden and rock along the conduit alignment, placement of pipe, and backfilling in the excavated area. A significant amount of the trench would be excavated in rock and would potentially require blasting or other means to loosen the rock. Trenching would occur both onshore and offshore. Trenching onshore would involve relatively deep excavations of overburden to reach top of competent rock. Onshore ground elevations are generally on the order of 20- to 30-feet above rock. Much of the trenching would require shoring because of the depth and the restricted area available to lay back the overburden. Offshore trenching would be carried out within a cofferdam. There is very little overburden offshore and most offshore trenching would be in rock, thereby requiring drilling and blasting. The trenching component of this alternative would result in the removal of a smaller amount of bedrock (106,000 cubic yards) than alternative 2 (250,000 cubic yards) due to the trenching component. The trench would be 60-feet wide and 17-feet deep from the base of the trench to the river bottom. Within the trench the intake shaft is estimated to be slightly shallower than alternative 2 in partially excavated rock. The rock removed from the trench would not be replaced in the trench but may be processed and used for backfilling as gravel or removed and disposed offsite at an acceptable facility. The trenches created would be filled with permeable bedding material, such as small gravel. The tunnel portion proposed under this alternative would have similar impacts on geology as alternative 2. The excavated onshore shaft would encounter bedrock and varying depths of soil. Excavation of the shaft would not be restored because it would serve as a permanent access shaft for maintenance during operation. Bedrock removal would be permanent under this alternative; however, the excavations would be carried out in such a way as to maintain stability of the surrounding geology. Impacts on geologic resources would be long-term moderate and adverse due to the permanent removal of bedrock over a wide area at the project site.

More riverbed material (sediments) would be disturbed under this alternative since open-trench construction would require a larger, more extensive cofferdam in the river and across Unnamed Island to install the new intake conduits. Approximately 5.4 acres of canal and riverbed would be disturbed for the construction of the cofferdams and embankments whereas 4.0 acres would be disturbed for alternative 2 (table 24). Impacts on sediments from the embankment within the C&O Canal are similar to alternative 2. Short-term minor adverse impacts on canal and riverbed material (sediments) are expected from the cofferdams and embankments since they would only be placed on the surface of the canal bed and riverbed resulting in minimal disturbance to the sediments. Once the project is complete the cofferdams and embankments would be removed and the canal and riverbed would be returned to existing conditions.

Impacts from the boat ramp and new intake structure on riverbed material would be the same as alternative 2; however, more impacts on the riverbed would occur under this alternative due to the open-trench construction of the intake tunnel and conduits. Where the sections of new conduits are placed in the channel and river, a concrete cap or cover would be installed above the conduits for pipe protection. The elevation of the top of the concrete cover would match the elevation of the existing channel or river bottom. A total of 0.42 acre of riverbed would be affected permanently due to trenching for construction of the intake tunnel/conduits (table 23). Even though the boat ramp (in-water portion), intake structure, tunnel/conduits, and concrete caps that would cover the conduits in the river are permanent structures, they are relatively small (0.030, 0.14, 0.42, 0.13 acre, respectively, table 23). Long-term minor adverse impacts on riverbed (sediments) and bank material would occur from construction of the boat ramp, tunnel/conduits, and intake since sediments, riverbed, and bank materials would be permanently removed from the river; however, these changes would occur in relatively small areas.

More soils would be disturbed under alternative 3 than alternative 2 due to the construction of the trench and the additional cofferdam/embankment needed to cross Unnamed Island. Compaction of soils is expected from the placement of rock onto the soils for the construction of the cofferdams. An additional 0.19 acre of soil would be removed under this alternative for the construction of the Unnamed Island cofferdam/embankment (table 24). The remaining upland construction activities including the

construction of the boat ramp access road and parking area, junction vault/onshore shaft, and construction access road would have similar impacts on soil as alternative 2. Construction of these project components would possibly require that 3.7 acres of vegetation be cleared and that soils subsequently be graded resulting in soil disturbance and compaction (table 22). As mentioned previously, most of the soils within the construction area limits of the construction access road and junction vault and some of the boat ramp access road have been disturbed from past construction activities. At the completion of construction the construction access road would be removed and the site would be restored to preexisting conditions. Restoration at the site includes actions such as tilling and replacing topsoil that was removed from the original ground to prepare the soil for revegetation. The area for the permanent onshore boat ramp parking area and access road totals 0.24 acre (table 23). Soils at the site would be permanently removed and replaced with concrete for construction of the boat ramp and junction vault (0.070 acre, table 23). The boat ramp access road and parking area would be constructed of paving materials that would allow rainwater to pass through the material into the soil below, thereby stabilizing the soils at the site and minimizing impacts on soil functionality. Due to the relatively small area of soils permanently affected at the site and the use of pervious materials, minor adverse impacts would occur in the long term to soils.

As stated under alternative 2, applicable Montgomery County, Maryland and federal guidelines and regulations would be followed to minimize the movement of soils and control runoff onsite. Details of how stormwater would be managed at the construction site would be included in the Erosion and Sediment Control Plan and the Stormwater Management Plan which would be prepared prior to construction and in conformance with Montgomery County and MDE requirements. MDE and Montgomery County review and approval of these plans would be required before construction could begin. Overall, short-term moderate adverse impacts on soils would occur from construction activities since soils would be disturbed over a relatively large area (3.7 acres, table 22); however, most of the project area would be restored and revegetated to stabilize soils in the long term.

Operational Impacts: As discussed under alternative 2 impacts on sediments would occur due to the transport of sand and sediment from the new intake in the river to the wetwells. However, sedimentation quantities are expected to be equal to or less than existing conditions. This would result in a long-term impact on the sediments of the Potomac River.

The impacts from the permanent features that would permanently remove soils were discussed above under construction impacts. Some loss of soil to erosion and stormwater runoff could occur in the long term although stormwater control would be addressed in the Erosion and Sediment Control Plan and the Stormwater Management Plan to minimize stormwater runoff at the site.

As mentioned previously under alternative 2, the CFD modeling indicted that operation of the submerged intake structure, regardless of the alternative, would potentially create vortices downstream from the structure, potentially leading to scour of the structure and the surrounding riverbed, and create surface dimpling in the river at higher withdrawal rates (Black and Veatch 2013). These issues would be mitigated by “reshaping” or sculpting the river bottom where the intake is located and lowering the intake accordingly, if necessary. This would be done during the excavation of the intake shaft and would occur within the construction area limits.

Overall, operation of the submerged intake would result in long-term minor adverse impacts on the sediments of the Potomac River but would be localized to the project site. The CFD modeling found that alternative 3 provides the best performance with regards to minimizing sediment deposition within the system; however, alternatives 2 and 4 perform similarly (Black and Veatch 2013).

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 3 would be identical to those under alternative 1. The effects of

these actions described above are not expected to contribute to the long-term moderate adverse impacts on geology, the short- and long-term minor adverse impacts on sediments, and short- to long-term minor to moderate adverse impacts on soils under alternative 3. Therefore, the cumulative impacts on geologic resources in the area of analysis would be long-term moderate adverse impacts on geology, the short- and long-term minor adverse impacts on sediments, and short- to long-term minor to moderate adverse impacts on soils.

Conclusion: Geologic resources, soils, and sediments at the site would be affected during construction of the project. Since this alternative involves a combination of trenching and tunneling to construct the conduit tunnel, greater impacts on these resources would occur. Bedrock removal would be permanent; however, the excavations would be carried out in such a way as to maintain stability of the surrounding geology. More riverbed material (sediments) would be disturbed under this alternative due to the need for a larger, more extensive cofferdam in the river. The installation and removal of the temporary cofferdams for the construction of the new intake, intake shaft, and boat ramp and the construction of the embankments in the C&O Canal and channel of the Potomac River would disturb canal and riverbed material (sediments) potentially resulting in the release of fine sediment into the river and canal. Upland construction activities including the construction of the boat ramp access road, parking area, junction vault, construction access road, and associated staging areas would impact soils at the site. Vegetation would be cleared and soils subsequently graded resulting in soil disturbance and compaction. Mitigation for these impacts would include site restoration. Revegetation with native species to resemble the existing vegetation would occur. Permanent features would be constructed of paving materials that would allow rainwater to pass through the material into the soil below and then back to the ground water supply, thereby stabilizing the soils at the site and minimizing impacts on soil functionality. Therefore, construction activities would result in long-term moderate adverse impacts on geologic resources; short-term minor adverse impacts on canal and riverbed sediments; and short-term moderate adverse impacts on soils from construction activities associated with alternative 3. Impacts on sediments and soils due to the permanent structures would be minor and adverse in the long term due to the small area affected and due to the use of BMPs, such as stormwater control practices. The submerged intake would result in long-term minor adverse impacts on the sediments of the Potomac River but these impacts would be localized to the project site.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the long-term moderate adverse impacts on geology, the short- and long-term minor adverse impacts on sediments, and short- to long-term minor to moderate adverse impacts on soils under alternative 3.

Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake

Construction Impacts: This alternative would have similar impacts on geologic resources as alternative 2 since the method of constructing the intake tunnels and many of the design features are similar to what is described under alternative 2 except for the horizontal alignment of the tunnels/conduits and the location of the tunneling shaft/junction vault. Approximately 359,000 cubic yards of bedrock would be removed for tunnel construction, which is more than for alternative 2 (250,000 cubic yards) and alternative 3 (106,000 cubic yards). However, the tunnels would be located at an adequate depth to maintain stability of the rock and structures above the tunnels. Similar to alternatives 2 and 3, impacts on geology would also occur from excavation of the intake shaft and junction vault/onshore shaft. The excavated shafts would encounter bedrock and varying depths of soil. Shaft excavations would not be restored because they would serve as permanent access shafts for water intake (intake shaft) and maintenance during operation (junction vault/onshore shaft). Bedrock removal for both the tunnels and shafts would be permanent under this alternative. Underground excavation for the tunnels would not affect soils, as

tunneling would be performed beneath the overburden layer within bedrock material. Impacts on soils from the junction vault are discussed below in the impact analysis of soils. Impacts on geologic resources would be long-term moderate and adverse due to the permanent removal of bedrock at the site over a wide area.

Similar to alternatives 2 and 3, the installation and removal of temporary cofferdams for the construction of the new intake, intake shaft, and boat ramp and the construction of the embankments in the C&O Canal and channel of the Potomac River would disturb canal and riverbed material (sediments) potentially resulting in the release of fine sediment into the canal and river. This alternative has an additional embankment in the C&O Canal for the temporary relocation of the towpath. Under this alternative, approximately 4.5 acres (table 24) of canal and riverbed would be disturbed for the construction of the cofferdams and embankments. Short-term minor adverse impacts on canal and riverbed materials (sediments) are expected from the cofferdams and embankments since they would only be placed on the surface of the canal bed and riverbed resulting in minimal disturbance to the sediments. Once the project is complete the cofferdams and embankments would be removed and the canal bed and riverbed would be returned to existing conditions.

Impacts from the boat ramp and intake structure on riverbed and river bank material would be similar to alternative 2. Some removal of riverbed and bank material would be required in order to extend the boat ramp (0.030 acre – in-water portion) into the river and construct the submerged intake structure (0.14 acre) (table 25). Impacts on riverbed (sediments) and bank material would occur from construction of these features since sediments and bank materials would be permanently removed from the river; however, this impact would be long-term minor and adverse as it would occur in a relatively small area.

Similar to alternatives 2 and 3, the construction of the boat ramp access road, parking area, junction vault/onshore shaft, and construction access road are expected to impact soils at the site. Construction of these project components would possibly require that 4.4 acres of vegetation to be cleared and soils subsequently being graded resulting in soil disturbance and compaction (table 24). As mentioned previously, most of the soils within the construction area limits of the construction access road and junction vault and some of the boat ramp access road have been disturbed from past construction activities. At the completion of construction, the construction access road would be removed and the site would be restored to preexisting conditions. Restoration at the site would include actions such as tilling and replacing topsoil that was removed from the original ground to prepare the soil for revegetation. The area for the permanent onshore structures including boat ramp (on-land portion), boat ramp parking area, and access road totals 0.23 acre (table 23). Soils at the site would be permanently removed and replaced with concrete for construction of the boat ramp (0.030 acre, in-water portion) and junction vault (0.17 acre, table 23). The boat ramp access road and parking area would be constructed of paving materials that would allow rainwater to pass through the material into the soil below, thereby stabilizing the soils at the site and minimizing impacts on soil functionality. Due to the relatively small area of soils permanently affected at the site, minor adverse impacts would occur in the long term to soils.

As stated under alternatives 2 and 3, applicable Montgomery County, Maryland and federal guidelines and regulations would be followed to minimize the movement of soils and control runoff onsite. Details of how stormwater would be managed at the construction site would be included in the Erosion and Sediment Control Plan and the Stormwater Management Plan which would be prepared prior to construction and in conformance with Montgomery County and MDE requirements. MDE and Montgomery County review and approval of these plans would be required before construction could begin. Overall, short-term moderate adverse impacts on soils would occur from construction activities since soils would be disturbed over a relatively large area (4.4 acres, table 22); however, most of the project area would be restored and revegetated to stabilize soils in the long term.

Operational Impacts: As discussed previously, impacts on sediments would occur due to the transport of sand and sediment from the intake in the river to the wetwells. However, sedimentation quantities are expected to be equal to or less than existing conditions. This would result in a long-term impact on the sediments of the Potomac River.

Permanent impacts were discussed above under construction impacts. Some loss of soil to erosion and stormwater runoff could occur in the long term although stormwater control would be addressed in the Erosion and Sediment Control Plan and the Stormwater Management Plan to minimize stormwater runoff at the site.

As mentioned previously under alternative 2, the CFD modeling indicted that operation of the submerged intake structure, regardless of the alternative, would potentially create vortices downstream from the structure, potentially leading to scour of the structure and the surrounding riverbed, and create surface dimpling in the river at higher withdrawal rates (Black and Veatch 2013). These issues would be mitigated by "reshaping" or sculpting the river bottom where the intake is located and lowering the intake accordingly, if necessary. This would be done during the excavation of the intake shaft and would occur within the construction area limits.

Similar to the other alternatives, operation of the new intake would result in long-term minor adverse impacts on the sediments of the Potomac River but would be localized to the project site.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 4 would be identical to those under alternative 1. The effects of these actions described above are not expected to contribute to the long-term minor adverse impacts on geology, the short- and long-term minor adverse impacts on sediments, and short- to long-term minor to moderate adverse impacts on soils under alternative 4. Therefore, the cumulative impacts on geologic resources in the area of analysis would be long-term minor adverse impacts on geology, the short- and long-term minor adverse impacts on sediments, and short- to long-term minor to moderate adverse impacts on soils.

Conclusion: Alternative 4 would have similar impacts to alternative 2. The geologic resources, soils, and sediments at the site would be affected during construction of the project. Construction of the new intake tunnels would involve excavating a tunnel beneath the Potomac River to connect the new intake to the existing raw water conduits, thus impacting bedrock geology. Bedrock removal would be permanent; however, the excavations would be carried out in such a way as to maintain stability of the surrounding geology. The installation and removal of temporary cofferdams for the construction of the new intake, intake shaft, and boat ramp and the construction of the embankments in the C&O Canal and channel of the Potomac River would disturb canal and riverbed material (sediments) potentially resulting in the release of fine sediment into the canal and river. Upland construction activities including the construction of the boat ramp access road, parking area, junction vault, construction access road, and associated staging areas would impact soils at the site. Vegetation would be cleared and soils subsequently graded resulting in soil disturbance and compaction. Mitigation for these impacts would include site restoration. Revegetation with native species to resemble the existing vegetation would occur. Permanent features would be constructed of paving materials that would allow rainwater to pass through the material into the soil below and then back to the ground water supply, thereby stabilizing the soils at the site and minimizing impacts on soil functionality. Therefore, construction activities would result in long-term moderate adverse impacts on geologic resources; short-term minor adverse impacts on canal and riverbed sediments; and short-term moderate adverse impacts on soils from construction activities associated with alternative 4. Impacts on soils and sediments due to permanent structures would be minor and adverse in the long term due to the small area affected and due to the use of BMPs, such as stormwater control

practices. However, the submerged intake would result in long-term minor adverse impacts on the sediments of the Potomac River but these impacts would be localized to the project site.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the long-term moderate adverse impacts on geology, the short- and long-term minor adverse impacts on sediments, and short- to long-term minor to moderate adverse impacts on soils under alternative 4.

WATER RESOURCES

Methodology and Assumptions

Potential impacts on water resources are assessed based on the extent of disturbance to water quality. Water quality impacts were determined based on the ability of surface water to sustain wildlife. Other considerations in assessing the magnitude of water quality impacts are the impacts on resources that are dependent on a certain quality or condition of water. In general and in this document, turbidity is caused by suspended matter or impurities, including clay and silt that interfere with the clarity of the water; therefore, turbidity can be correlated with sediment transport and can affect water quality. Generally, if turbidity is decreased through reduced sediment transport, water clarity (and thus water quality) can be improved.

The impact analysis concentrates on how the alternatives would affect surface water quality and how stormwater would be managed.

Project Area

The geographic project area for water resources includes areas of the Potomac River and C&O Canal within the construction area limit (limit of disturbance) for the project and adjacent downstream areas within the Potomac River that could be affected by construction and operation of the project.

Impact Thresholds

The following thresholds were used to determine the magnitude of impacts on water quality:

> *Negligible*—Changes in water quality would not be detectable and would not have an appreciable effect. There would be no observable or measurable impacts on aquatic species or their habitats.
>
> *Minor*—Changes in water quality would be detectable but would not be large enough to cause substantial local changes. There would be an observable or measurable impact on aquatic species or their habitats but the impact would be slight and considered short-term.
>
> *Moderate*—Changes in water quality would be readily apparent and would result in substantial, noticeable effects on water quality on a local scale. An action would have a clearly detectable effect on aquatic organisms. Mitigation measures would be necessary to offset adverse impacts and would likely be successful.

Major—Changes in water quality would be detectable beyond the immediate project area and would be readily measurable downstream of the project area. Aquatic plant and animal species would disappear permanently, with species changes occurring on a regional scale. The action would result in a detectable change in aquatic plant and animal communities throughout the region. Mitigation measures to offset adverse impacts would be necessary, extensive, and their success would not be guaranteed.

Duration – Short-term impacts occur during the construction phase of the alternative; long-term impacts occur during and beyond implementation of the alternative.

Alternative 1: No-action Alternative

Under the no-action alternative there would be no additional changes to water quality or stormwater because existing conditions would remain unchanged under this alternative; however, the water quality of the Potomac River in the vicinity of the existing WSSC intake is affected by conditions throughout the Potomac River Basin including runoff from Watts Branch which impacts raw water quality at the existing intake location, particularly due to sediment concentrations. Therefore, long-term minor adverse impacts on water resources have resulted from current conditions.

Cumulative Impacts: Other past, present, and future planned actions within and around the project area (MM 17.5) have the potential to effect water resources (Potomac River). Past planning efforts, such as the park's General Plan established goals for the preservation of the park's natural setting including that outdoor recreation should not intrude upon or impair the resources for which the park was established to protect. The Potomac River watershed restoration projects also benefit water resources. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stormwater pond improvements, stream restoration and enhancement, stormwater retrofit, and low impact development which indirectly benefits the water resources of the Potomac River. Aspects of these projects include: stabilizing stream banks; improving fish passage; improving aquatic habitat conditions; constructing wetlands; and using features such as curb extensions, bioswales, tree box filters, and modified stormdrain inlets. The Washington Aqueduct dam may be adversely impacting the water resources of the Potomac River in the vicinity of MM 17.5. Dams alter flow patterns and over time affect stream channel configuration, fisheries habitat, and many other physical and biological processes including water quality.

The overall impacts of these past, current, and future actions on water resources in the vicinity of MM 17.5 would be a combination of beneficial and adverse effects. The beneficial effects of these cumulative actions on water resources are expected to negate some of the adverse impacts of the dam. Therefore, the adverse impacts described above are not expected to contribute to the long-term minor adverse impacts on water resources under alternative 1. Cumulative impacts on water resources in the area of analysis would be long-term minor adverse impacts due to the current condition of the water quality of the Potomac River.

Conclusion: The water quality of the Potomac River in the vicinity of the existing WSSC intake is affected by conditions throughout the Potomac River Basin including runoff from Watts Branch resulting in long-term minor adverse impacts on water resources under alternative 1.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the long-term minor adverse impacts on water resources under alternative 1.

Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative)

Construction Impacts: Under this alternative, construction of the new intake tunnels would involve constructing a tunnel under the Potomac River to connect the new intake to the existing raw water conduits. Since the tunnel would be excavated beneath the overburden layer within bedrock material below the Potomac River, no impacts on the water quality of the river are expected from the tunneling portion of the construction. However, other construction components of the project are expected to affect water quality of the river and are discussed below.

The installation and removal of temporary cofferdams for the construction of the new intake, intake shaft, and boat ramp would potentially result in the release of fine sediment into the river. The source of the sediment would be primarily the material placed to construct the cofferdam and some riverbed material disturbed during cofferdam placement. This sediment would temporarily increase turbidity locally. This impact is also expected from the construction of the embankments and placement of the culvert pipes in the channel of the Potomac River. Rock would also be placed in the channel to construct the temporary road embankments needed for the construction road that would cross the Potomac River channel. Within the embankments, culverts would be installed to maintain flow in the river past the construction areas. Approximately 4.0 acres (table 24) of canal and riverbed would be disturbed for the construction of the cofferdams and embankments including one embankment within the C&O Canal for the construction access road to cross the canal (table 22). A culvert would be installed within the embankment to maintain flow in the canal. However, this impact would be temporary and localized. Overall, there would be a short-term moderate adverse impact on the water quality and water resources of the river and canal from the installation and removal of cofferdams and embankments.

Upland construction activities could require the clearing of up to 4.7 acres for construction of temporary and permanent features and for use as construction staging areas (table 22). Construction of the boat ramp, parking area, boat ramp access road, and junction vault are expected to impact the water quality of the Potomac River. A total of 0.15 acre (boat ramp - on-land portion and junction vault) of impervious materials and 0.24 acre (parking area, boat ramp - on-land portion, and boat ramp access road) of pervious materials would replace the existing vegetation permanently (table 23). Pervious materials are porous-permeable paving that allows rainwater to pass through the cross section and back to the ground water supply. This type of paving mimics the natural water cycle reducing stormwater runoff volume and rate. In contrast, normal pavement is an impervious surface that sheds rainfall and associated surface pollutants forcing the water to run off paved surfaces directly into nearby storm drains and then into streams and rivers. Potential sediment runoff from these construction activities could increase turbidity in the river, but this increase would be localized and temporary. Similar impacts on water quality are expected from the construction of the construction access road, which would encompass approximately 0.61 acre (table 24) and would be constructed of pervious materials. The area surrounding the construction access road and areas to the east of the road would probably be impervious since these areas would be used for construction staging, as staging areas could become temporarily impervious due to compaction from heavy construction machinery. Once the project is complete and the construction access road and staging areas are no longer needed, restoration actions such as tilling and replacing topsoil that was removed from the original ground would be performed to prepare the soil for revegetation with native species to resemble the existing vegetation. Overall, there would be a short-term minor adverse impact on the water quality at the site from the upland construction activities.

Applicable Montgomery County, Maryland and federal guidelines and regulations, including the Maryland Stormwater Management Guidelines for State and Federal Projects (MDE 2010), would be followed to control runoff onsite and to minimize impacts on the watershed from excess stormwater. The MDE regulates impacts of construction activities to minimize the increase of turbidity values. Maryland

regulations provide maximum levels of turbidity during construction. To manage stormwater at the construction site, an Erosion and Sediment Control Plan and a Stormwater Management Plan would be prepared in conformance with Montgomery County and MDE requirements prior to construction (see the "Purpose and Need" chapter for plan details). These plans would provide measures to control runoff during storms and prevent impacts during construction including provisions for minimizing impacts on turbidity and for monitoring turbidity in the river to ensure compliance with State of Maryland requirements. MDE and Montgomery County review and approval of these plans would be required before construction could begin. In addition, BMPs for stormwater control would be used during construction and would be included in the plans. BMPs are management practices such as treatment requirements, operating procedures, practices to control site runoff, spillage or leaks, waste disposal, or drainage from material storage that prevent or reduce the pollution of waters. For this project, BMPs would include practices such as using clean rock for the construction of the cofferdams and embankments to minimize impacts on turbidity; using pervious pavement to allow percolation or infiltration of stormwater through the surface into the soil below where the water is naturally filtered and pollutants are removed; using temporary stormwater features such as silt fences, interceptor swales, sediment traps/ponds, stockpile covers, grate filters, or other BMPs to manage stormwater runoff during construction; replanting trees and groundcover vegetation as soon as feasible in areas that are necessarily disturbed by earthwork activities; and providing temporary erosion-control blankets or permanent rock armoring on steep terrain where vegetation is slow to get established. To the greatest extent possible, forested areas would be preserved and destruction of healthy mature trees on the site would be avoided when possible. A Forest Conservation Plan would be prepared for the project, which would include a planting plan for revegetation and practices to minimize the loss of forest resources during land development. Specific BMPs for the project would be determined later during the detailed design phase and would be included in the Erosion and Sediment Control Plan and Stormwater Management Plan.

Operational Impacts: The permanent structures discussed under construction activities (boat ramp, parking area, boat ramp access road, and junction vault) have the potential to impact water quality in the long term due to an increase in stormwater runoff. Impacts on water quality from the permanent onshore structures at the site are expected to be negligible in the long term due to the small area (0.15 acre) of new impervious surfaces (boat ramp and junction vault) created at the site and due to the use of stormwater control BMPs (table 23). Other permanent features including the new intake, intake shaft, and intake conduits are not expected to impact water quality in the long term since these features are either located beneath the overburden layer within bedrock material below the Potomac River or below grade inland, and the intake would only be collecting raw water from the river.

As discussed previously in the "Geology and Soils" section, results of the preliminary CFD modeling indicted that the submerged intake structure, regardless of the alternative, would increase local flow velocities upstream of the structure and vortices may form downstream. The low elevation of the submerged intake means that surface dimpling in the river may also occur at higher withdrawal rates (Black and Veatch 2013). These issues would be mitigated by "reshaping" the river bottom where the intake is located and lowering the intake accordingly, which would be done during the excavation of the intake shaft and would occur within the construction area limits. The impacts on water quality from operating the submerged intake would be long-term minor and adverse and would only occur within the limited area of the project site.

Lock 13 Wetland Mitigation Site: There are no water resources at the mitigation site; therefore there would be no impacts on water resources from the enhancement activities.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 2 would be identical to those under alternative 1. The effects of these actions described above are not expected to contribute to the short-term minor to moderate adverse

impacts from construction and negligible to long-term minor adverse impacts from operation on water resources under alternative 2. Therefore, the cumulative impacts on water resources in the area of analysis would be short-term minor to moderate adverse impacts from construction and negligible to long-term minor adverse impacts from operation.

Conclusion: The water resources including the water quality of the Potomac River and C&O Canal would be affected during construction of the project. It is anticipated that a moderate disturbance of river bottom sediment from the construction and removal of the cofferdams and embankments and potential sediment runoff from the upland construction areas would temporarily increase turbidity locally. However, applicable BMPs would be used and Maryland and Montgomery County regulations for sediment and erosion control would be followed during construction to ensure proper drainage onsite and to minimize impacts on stormwater. BMPs would be used to minimize disturbance within the river as well as onshore. Therefore, short-term moderate adverse impacts on the water resources of the Potomac River and C&O Canal would occur under this alternative from construction and removal of cofferdams and embankments. Impacts on water quality from the construction of onshore structures at the site are expected to be short-term minor and adverse; however, in the long term, impacts from the permanent onshore structures would be negligible due to the small area of new impervious surfaces created at the site and the use of stormwater control BMPs. The operation of the submerged intake would result in long-term minor and adverse impacts on the flow velocity of the Potomac River, but these impacts would be localized to the project site.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the short-term minor to moderate adverse impacts from construction and negligible to long-term minor adverse impacts from operation on water resources under alternative 2.

Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake

Construction Impacts: This alternative would have similar impacts on water quality as alternative 2 even though the method of constructing the three intake tunnels is different. Under this alternative, construction of the new intake tunnels would involve using both open-trench and tunneling construction. The open-trench would be constructed within the confines of the cofferdam and the tunneling would be below grade on land. No impacts on the water quality of the Potomac River are expected from the tunneling portion of the construction since the excavation would be beneath the overburden layer within bedrock material below the Potomac River. However, other construction components of the project are expected to affect the water quality of the river and are discussed below.

More riverbed and land would be disturbed under alternative 3 than alternative 2 due to the trenching method of construction, which would require a larger cofferdam to provide a dry work area for the trench to construct the horizontal alignment of the new conduits. A total of 5.4 acres of canal and riverbed would be disturbed in the canal and Potomac River for the construction of the cofferdams and embankments under this alternative, whereas alternative 2 would result in 4.0 acres of riverbed disturbance (table 24). Construction and removal of these structures would potentially result in the release of fine sediment into the canal and river, which would temporarily increase turbidity locally. Overall, there would be a short-term moderate adverse impact on the water quality and water resources of the river and canal from the installation and removal of cofferdams and embankments.

Impacts on the water quality of the Potomac River from the upland construction activities would be similar to alternative 2. Construction of the permanent features (boat ramp - on-land portion, boat ramp access road, parking area, and junction vault) and the temporary construction access road would require up to 3.7 acres of vegetation be cleared from the site (table 22). As with alternative 2, a total of 0.15 acre

(boat ramp and junction vault) of impervious and 0.24 acre (parking area and boat ramp access road) of pervious materials would replace the existing vegetation permanently (table 23). The construction access road (0.60 acre, table 24) would be constructed of pervious materials. Construction staging areas could become temporarily impervious due to compaction from storage of heavy construction materials and use of construction machinery. Potential sediment runoff from these construction activities could increase turbidity in the river, but this effect would be localized and temporary. Once the project is complete and the construction access road and staging areas are no longer needed, restoration actions such as tilling and replacing topsoil that was removed from the original ground would occur to prepare the soil for revegetation with native species to resemble the existing vegetation. Overall, there would be a short-term minor adverse impact on the water quality of the river from the upland construction activities.

As mentioned previously under alternative 2, applicable state, county, and federal guidelines and regulations would be followed to control runoff onsite and to minimize impacts on the watershed from excess stormwater. Several plans would be prepared including an Erosion and Sediment Control Plan, Stormwater Management Plan, and Forest Conservation Plan that would include BMPs for stormwater control and practices to minimize the loss of forest resources. Other BMPs would be the same as those listed in alternative 2. MDE and Montgomery County review and approval of these plans would be required before construction could begin.

Operational Impacts: The operational impacts of the project on water quality would be the same as alternative 2 since the permanent onshore structures at the site (boat ramp, parking area, boat ramp access road, and junction vault) have the same design and footprint. Due to these permanent features at the site stormwater runoff is expected to increase which has the potential to increase turbidity in the Potomac River; however, long-term stormwater control BMPs would be developed during the detailed design phase of this project to minimize stormwater runoff at the site. Overall, impacts on water quality from the permanent onshore structures at the site are expected to be negligible in the long term due to the small area (0.15 acre, table 23) of new impervious surfaces created at the site and the use of stormwater control BMPs.

As mentioned previously under alternative 2, the CFD modeling indicted that the submerged intake structure, regardless of the alternative, would increase local flow velocities upstream of the structure and vortices may form downstream. Between the intake and Unnamed Island downstream of the structure the velocity would be slower and there is the potential for sedimentation. The low elevation of the intake means that surface dimpling in the river may also occur at higher withdrawal rates (Black and Veatch 2013). These issues would be mitigated during the excavation of the intake shaft and would occur within the construction area limits. The impacts on water quality from operating the submerged intake would be long-term minor and adverse and would only occur within the limited area of the project site.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 3 would be identical to those under alternative 1. The effects of these actions described above are not expected to contribute to the short-term minor to moderate adverse impacts from construction and negligible to long-term minor adverse impacts from operation on water resources under alternative 3. Therefore, the cumulative impacts on water resources in the area of analysis would be short-term minor to moderate adverse impacts from construction and negligible to long-term minor adverse impacts from operation.

Conclusion: This alternative would have similar impacts on water resources as alternative 2. The water resources including the water quality of the Potomac River and C&O Canal would be affected during construction of the project. It is anticipated that a moderate disturbance of canal and river bottom sediment from the construction and removal of the cofferdams and embankments, and potential sediment runoff from the upland construction areas would temporarily increase turbidity locally. However,

applicable BMPs would be used and Montgomery County and Maryland regulations for sediment and erosion control would be followed during construction to ensure proper drainage onsite and to minimize impacts on stormwater. BMPs would be used to minimize disturbance within the river as well as onshore. Aquatic plant and animal species would be lost from within the construction area limits of the cofferdams and embankments; however, over time, recruitment and reestablishment of these species would occur thus resulting in a temporary adverse impact on the water resources of the river and canal. Therefore, short-term moderate adverse impacts on the water resources of the Potomac River would occur under this alternative from construction and removal of cofferdams and embankments. Impacts on water quality from the construction of onshore structures at the site are expected to be short-term minor and adverse; however, in the long term, impacts from the permanent onshore structures would be negligible due to the small area of new impervious surfaces created at the site and the use of stormwater control BMPs. The operation of the submerged intake would result in long-term minor adverse impacts on the flow velocity of the Potomac River, but these impacts would be localized to the project site. Alternative 3 would impact a larger area of the river; however, the difference would not be great enough to change the impact intensities for construction activities.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the short-term minor to moderate adverse impacts from construction and negligible to long-term minor adverse impacts from operation on water resources under alternative 3.

Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake

Construction Impacts: This alternative would have similar impacts on water quality as alternative 2 since the method of constructing the three intake tunnels and many of the design features are similar to what is described under alternative 2. The difference is that the horizontal alignment of the tunnels/conduits and the location of the tunneling shaft/junction vault are different for this alternative. Since this alternative also involves tunneling under the Potomac River to connect the new intake to the existing raw water conduits, no impacts on the water quality of the river would be expected from tunnel construction.

Similar to alternatives 2 and 3, the installation and removal of temporary cofferdams for the construction of the new intake, intake shaft, and boat ramp would potentially result in the release of fine sediment into the river including the channel which would temporarily increase turbidity locally. This impact is also expected from the construction of the embankments and placement of the culvert pipes in the canal. This alternative has an additional embankment in the C&O Canal for the temporary relocation of the towpath. Approximately 4.5 acres of canal and riverbed would be disturbed for the construction of the cofferdams and embankments under this alternative (table 24). Overall, there would be a short-term moderate adverse impact on the water quality and water resources of the river and canal from the installation and removal of cofferdams and embankments.

Construction of the permanent features (boat ramp, parking area, boat ramp access road, and junction vault) and the temporary construction access road would possibly require that 4.4 acres of vegetation be cleared from the site (table 24). The parking area and boat ramp access road (0.20 acre) and construction access road (0.64 acre) would be constructed of pervious materials whereas the boat ramp (0.03 acre) and junction vault (0.17 acre) would be impervious (table 23). The remainder of the land surrounding these structures and the land to the east would most likely be impervious since it would be used for construction staging. Once the project is complete and the construction access road and staging areas are no longer needed, restoration actions such as tilling and replacing topsoil that was removed from the original ground would occur to prepare the soil for revegetation with native species to resemble the existing vegetation. Overall, there would be a short-term minor adverse impact on the water quality of the canal and river from the upland construction activities.

As mentioned previously under alternative 2, applicable state, county, and federal guidelines and regulations would be followed to control runoff onsite and to minimize impacts on the watershed from excess stormwater. Several plans would be prepared including an Erosion and Sediment Control Plan, Stormwater Management Plan, and Forest Conservation Plan that would include BMPs for stormwater control and practices to minimize the loss of forest resources. Other BMPs would be the same as listed in alternative 2. MDE and Montgomery County review and approval of these plans would be required before construction could begin.

Operational Impacts: The operational impacts of the project on water quality would be the same as alternatives 2 and 3 since the permanent structures at the site (boat ramp, parking area, boat ramp access road, and junction vault) have similar designs and footprints. Due to these permanent features at the site stormwater runoff is expected to increase which has the potential to increase turbidity in the Potomac River. New impervious surfaces created at the site would result from the construction of the boat ramp and junction vault totaling 0.20 acre (table 23). However, long-term stormwater control BMPs would be developed during the detailed design phase of this project to minimize stormwater runoff at the site, resulting in negligible impacts in the long term.

Similar to alternatives 2 and 3, the CFD modeling indicted that the submerged intake structure, regardless of the alternative, would increase local flow velocities upstream of the structure and vortices may form downstream. Between the intake and Unnamed Island downstream of the structure the velocity would be slower and there is the potential for sedimentation. The low elevation of the intake means that surface dimpling in the river may also occur at higher withdrawal rates (Black and Veatch 2013). These issues would be mitigated during the excavation of the intake shaft and would occur within the construction area limits. The impacts on water quality from operating the submerged intake would be long-term minor and adverse and would only occur within the limited area of the project site.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 4 would be identical to those under alternative 1. The effects of these actions described above are not expected to contribute to the short-term minor to moderate adverse impacts from construction and negligible to long-term minor adverse impacts from operation on water resources under alternative 4. Therefore, the cumulative impacts on water resources in the area of analysis would be short-term minor to moderate adverse impacts from construction and negligible to long-term minor adverse impacts from operation.

Conclusion: This alternative would have similar impacts on water resources as alternatives 2 and 3. The water resources including the water quality of the Potomac River and the C&O Canal would be affected during construction of the project. It is anticipated that a moderate disturbance of canal and river bottom sediment from the construction and removal of the cofferdams and embankments, and potential sediment runoff from the upland construction areas would temporarily increase turbidity locally. However, applicable BMPs would be used and Montgomery County and Maryland regulations for sediment and erosion control would be followed during construction to ensure proper drainage onsite and to minimize impacts on stormwater. BMPs would be used to minimize disturbance within the canal and river as well as onshore. Therefore, short-term moderate adverse impacts on the water resources of the canal and Potomac River would occur under this alternative from construction and removal of cofferdams and embankments. Impacts on water quality from the construction of onshore structures at the site are expected to be short-term minor and adverse; however, in the long term, impacts from the permanent onshore structures would be negligible due to the small area of new impervious surfaces created at the site and the use of stormwater control BMPs. The operation of the submerged intake would result in long-term minor adverse impacts on the flow velocity of the Potomac River, but these impacts would be localized to the project site.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to short-term minor to moderate adverse impacts from construction and negligible to long-term minor adverse impacts from operation on water resources under alternative 4.

WETLANDS

Methodology and Assumptions

The NPS has adopted a policy of "no net loss" of wetlands. Executive Order 11990, "Protection of Wetlands", states that federal agencies are to avoid to the extent possible long-term and short-term impacts associated with the destruction and modification of wetlands to avoid direct and indirect support of new construction in wetlands whenever practical alternatives exist. The USACE regulates development in wetland areas pursuant to Section 404 of the CWA (33 CFR, 320-330). NPS Director's Order 77-1: *Wetland Protection* (2002) and *Procedural Manual* (2012b) provide NPS policies and procedures for complying with Executive Order 11990, as follows: Actions proposed by NPS that have the potential to have adverse impacts on wetlands will be addressed in an EA. If the preferred alternative in an EA will result in adverse impacts on wetlands an SOF documenting compliance with Director's Order 77-1 (NPS 2002) and *Procedural Manual* 77-1 (NPS 2012b) will be completed. Actions that may be exempted from the SOF requirement are identified in the *Procedural Manual*.

A SOF has been prepared for this project and can be found in appendix E of this EA. The SOF addresses mitigation for impacts to NPS wetlands on NPS property including a proposed wetland mitigation plan for the preferred alternative and includes detailed information on the proposed wetland mitigation site and enhancement actions. A wetland mitigation site was identified on park property within the area of Lock 13. The Lock 13 wetland mitigation site is a 1.7 acre wetland between the Potomac River and C&O Canal, near the I-495 overpass. Further mitigation required for wetlands on State of Maryland and WSSC property would be determined during the permit application process in the future. The Habitat Restoration Plan (appendix D) includes a detailed plan for monitoring and managing nonnative invasive species.

Impact analysis and the conclusions for possible impacts on wetlands were based on review of existing literature and studies, information provided by park staff and other agencies, and on-site investigation. Where possible, locations of wetlands were overlain with the alternatives to determine impacts on wetlands. Impacts on SAV are analyzed in the "Aquatic and Terrestrial Vegetation" section.

Project Area

The geographic project area for wetlands includes the areas located within the construction area limit (limit of disturbance) for the project. There are three property owners within the construction area limits: NPS, WSSC, and the State of Maryland. Figure 9 shows the property boundaries in the construction area limits. Wetlands were delineated and would be mitigated appropriately per the regulations applicable to the respective landowner. NPS policy on wetlands applies to wetlands within NPS boundaries.

Impact Thresholds

The following thresholds were used to determine the magnitude of impacts on wetlands:

Negligible – A barely measurable or perceptible change in wetland size, integrity, or continuity could occur.

Minor – The impact would be easily measurable or perceptible. A small change in size, integrity, or continuity could occur due to effects such as construction related runoff. However, the overall viability of the resource would not be affected.

Moderate – The impact would be sufficient to cause an appreciable change in at least one wetland parameter – size, integrity, or continuity – and resource viability could be affected.

Major – The action would result in a substantial change in multiple parameters (size, integrity, and continuity) or a loss of large wetland areas. The impact would be substantial and highly noticeable.

Duration – Short-term impacts occur during the construction phase of the alternative; long-term impacts occur during and beyond implementation of the alternative.

Alternative 1: No-action Alternative

Under the no-action alternative, there would be no additional adverse effect to the riverine systems or wetland areas because the existing conditions would remain unchanged. The existing intake and associated structures would remain in place. However, the existing WFP intake structure has permanently impacted the Potomac River riverine system at the project site resulting in long-term minor adverse impacts on wetlands.

Cumulative Impacts: Other past, present, and future planned actions within and around the project area (MM 17.5) have the potential to impact riverine systems and wetland areas. Past planning efforts, such as the park's General Plan established goals for the preservation of the park's natural setting including that outdoor recreation should not intrude upon or impair the resources for which the park was established to protect. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stream restoration and enhancement and low impact development. Aspects of these projects include: stabilizing stream banks and enhancing riparian habitats; constructing wetlands; using features such as bioswales and tree box filters.

The overall effect of these past, current, and future actions on wetlands in the vicinity of MM 17.5 would be beneficial. Therefore, these beneficial actions would not contribute to the long-term minor adverse impacts from the existing intake under alternative 1. Cumulative impacts on riverine systems in the area of analysis would be long-term minor adverse impacts from the existing intake structure.

Conclusion: The existing intake structure has permanently impacted the Potomac River riverine system at the project site resulting in long-term minor adverse impacts on wetlands.

The beneficial impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the long-term minor adverse impacts on wetlands under alternative 1.

Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative)

Project components specific to alternative 2 would adversely affect wetlands and riverine systems. The construction of a portion of the construction access road would adversely impact wetlands. The installation of cofferdams, embankments, portions of the construction access road, boat ramp, and submerged intake structure would adversely impact riverine systems at the project site. Overall, the construction area limits for the project were designed to avoid and minimize impacts to natural resources including impacts to wetlands by constructing the project in the smallest footprint feasible. Total impacts associated with the proposed construction activity are listed in table 25. Figure 9 presents the riverine systems and wetlands delineated on NPS, WSSC, and State of Maryland lands within the construction area limits of the project. Figure 3 in the SOF (appendix E) presents the impacts to wetlands from alternative 2.

Table 25. Alternative 2 Riverine Systems and Wetland Impacts

System	Classification	Impact (acres)	Impact (square feet)
Wetland A (NPS Only)	PFO1B	0.020	871.2
Wetland A (WSSC Only)	PFO1B	0.057	2,482.9
Wetland A (Total)	PFO1B	0.077	3,354.1
Potomac River Riverine (NPS only)	R2UBH	0.032	1,393.9
Potomac River Riverine (State of Maryland only)	WUS	3.36	146,361.6
Potomac River Riverine (Total)	R2UBH/WUS	3.39	147,755.5
C&O Canal Riverine	R2UBHx	0.14	5,967.7
Total NPS Property Impacts		**0.19**	**8,232.8**
Total Project Area Impacts		**3.61**	**157,077.4**

Note:Measurements in this table are approximate. Area values in acres have been rounded for brevity; this may cause area values in square feet to appear not to be a direct conversion from the acre value.
Wetland Definitions:
PFO1B – Palustrine, forested, broad-leaved deciduous, saturated
R2UBH – Riverine, lower perennial, unconsolidated bottom, permanently flooded
R2UBHx – Riverine, lower perennial, unconsolidated bottom, permanently flooded, excavated
WUS = Waters of the United States

Construction Impacts – The installation and removal of temporary cofferdams associated with the intake, intake shaft, intake conduits, and boat ramp would impact the Potomac River riverine system as a result of dewatering a portion of the Potomac River and disturbance of riverbed material during cofferdam placement. The riverine systems would also be impacted by construction of the embankments and placement of culverts in the C&O Canal and channel of the Potomac River. Installation of the temporary cofferdams and embankments would require the placement of rock with a clay layer/liner and geotextile that would serve as the water barrier. The rock would impact SAV within the cofferdam and embankment, resulting in a direct loss of those plants. Indirect impacts on SAV would occur from the release of fine sediment into the river from construction activities. The embankments would support a temporary construction access road that would cross the Potomac River channel. Culverts would be installed to maintain flow in the river past the construction areas. The cofferdams and embankments would affect riverine wetlands and Waters of the U.S. In addition to impacts on existing SAV, a state endangered wetland plant (floating paspalum) and a state watch list wetland plant (halberd-leaved hibiscus) are located along the shoreline of Unnamed Island, which is characterized as part of the Potomac River riverine system**.** The entire shoreline of Unnamed Island and most of the shoreline west of

the existing intake would be impacted during construction. Vegetation would be removed along the Potomac River shoreline for temporary construction features and staging of construction materials. Construction impacts on the wetland plants floating paspalum and halberd-leaved hibiscus would be adverse and are discussed in more detail in the "Special-status Species" section. Overall, there would be short-term moderate adverse impacts on the riverine systems (Potomac River and C&O Canal) from the installation and removal of the cofferdams and embankments. Areas temporarily affected by alternative 2 would be restored to pre-existing conditions once the project is complete. Within the Potomac River and C&O Canal, SAV would be expected to recolonize in the area within a few years following removal of the temporary structures built during construction (cofferdam and embankment) since dense SAV exists within both riverine systems in adjacent areas that would not be disturbed by this project.

The construction of the construction access road both adjacent to and through wetland A would remove portions of or fragment the wetlands, resulting in changes to hydrology and impeding water movement, ground-level wildlife movement, and the seed distribution of wetland plants. The construction access road also reduces the ability of wetlands to perform functions such as groundwater discharge/recharge, sediment/toxicant retention, and nutrient removal due to temporary disturbance adjacent to the wetland. The construction access road would also cause the wetland's stormwater/nutrient assimilative capacity to be lost and construction vehicles along the road could introduce toxic substances (oil and grease). During construction activities, siltation/runoff into wetland areas could occur but would be contained with approved BMPs as discussed under mitigation. Impacts on wetlands from the construction access road would occur during the approximately 3.0 years that the road would be utilized at the site. The presence of the construction access road would have short-term minor and adverse impacts on wetlands during the construction phase of the project.

The construction access road would require vegetation clearing and grading in wetland A, resulting in a loss of trees at this forested wetland area. Wetland functions and values that would change as a result of tree loss include groundwater recharge/discharge, wildlife productivity and habitat, vegetation, water quality, and hydrology. Tree removal within forested wetland A would change functions and values by reducing the vegetation canopy over these wetlands, which would reduce the biomass and change the species composition of the wetland (Cutlip 1986). The reduction in biomass would potentially alter the vegetation and wildlife species that use that wetland. This shift in the vegetation type could lessen available resources for wildlife species that depend on the conditions currently found in the wetland. Therefore, measurable changes to the abundance and diversity of wetland vegetation would occur. Following construction, all cleared areas within the construction area limit, including the construction access road, would be re-graded and re-planted to resemble the existing vegetation. Wetland A would be re-planted with wetland plants and monitored for invasive species; however, the clearing would be considered a permanent impact, as northern forested wetlands may take 50 years to reach maturity (Kusler 2006) and trees within wetland A would not recover during the life of the project (15 years) to become a fully functioning forested wetland; therefore there would be long-term minor and adverse impacts on wetlands. Details for invasive species monitoring and management can be found in "Appendix D: Habitat Restoration Plan".

The Potomac River riverine system would be affected by installation of the boat ramp and the submerged intake. The boat ramp would extend into the Potomac River and permanently affect a small amount of riverine wetland. Similar to the discussion above, floating paspalum and halberd-leaved hibiscus were observed along the shoreline of the river in the area of the proposed boat ramp. It is unlikely that impacts on the mosquito fern, a "Maryland Established Plant," would occur due to the floating nature of this plant and the fact that it is possibly a nonnative cultivar that is well established and no longer tracked by MDNR. Permanent impacts to the Potomac River bottom, classified as Waters of the U.S. on State of Maryland property, would occur from the intake structure.

Overall, 3.392 acres of the Potomac River, 0.137 acre of the C&O Canal, and 0.077 acre of wetland A (PFO1B) would be affected by project components associated with alternative 2 for a total of 3.606 acres of wetland and river impacts. However, only 0.153 acre of the wetland and river impacts are permanent. The remaining impacted areas are associated with temporary construction features, and would be replanted following the completion of construction. Only 0.19 acre of the wetlands and river being impacted are on NPS property. Of the impacted wetlands on NPS property, 0.002 acre of riverine wetland would be permanently impacted by the portion of the boat ramp that crosses the Potomac River. The rest of the permanent impacts are associated with the intake structure (0.14 acre) and the portion of the boat ramp that extends into the Potomac River (0.011 acre of Waters of the U.S.) on State of Maryland Property. Wetland mitigation actions for impacts to wetlands on NPS property have been proposed as part of the SOF (appendix E). The proposed mitigation includes enhancement of an existing wetland (figure 1) within C&O Canal NHP in order to provide the same functional benefits of the 0.19 acre of wetlands that would be impacted at the WSSC Potomac WFP. The wetland mitigation site is approximately 1.7 acres in size. Approximately 0.75 acre of the available 1.7 acres would be enhanced, making the mitigation ratio nearly 4:1.

Mitigation measures would be employed during construction, when appropriate, to minimize impacts on riverine systems and wetland areas, including the use of silt curtains that would be placed in the Potomac River and C&O Canal to prevent impacts on the aquatic environment from silt and sediment that may be disturbed during construction. Guidelines for waterway construction, published by the MDE (*Maryland's Waterway Construction Guidelines*, MDE 2000) would also be followed. The limits of the area disturbed by project components associated with alternative 2 would be kept as minimal as possible.

Operational Impacts: The river bottom may be sculpted upstream of the intake to provide optimal flow conditions to the intake; however, the need for and extent of this sculpting has yet to be determined. This sculpting would have a permanent impact on the Potomac River riverine system, as the riverbed would be altered. However, following construction, SAV from adjacent areas would likely repopulate the disturbed areas.

CFD modeling was completed to determine the sizing, configuration, and hydraulic characteristics of the proposed intake system alternatives (Black and Veatch 2013). Results of the preliminary model indicted that the submerged intake structure, regardless of the alternative, would increase local flow velocities upstream of the structure and vortices (a whirling mass of water, especially one in which a force of suction operates, such as a whirlpool) may form downstream, potentially leading to scour of the structure and the surrounding riverbed. Between the intake and Unnamed Island downstream of the structure, the velocity would be slower and there is the potential for sedimentation.

Additionally, the CFD modeling has predicted that a small area of scour surrounding the intake structure is likely possible that would also affect existing SAV. One of the co-dominant species of SAV in the area proposed for the intake structure includes southern water nymph. This species is listed as a watch list species by MDNR. Watch list species are not officially listed as threatened or endangered by the State of Maryland, nor are they considered rare enough in Maryland to currently warrant reporting and tracking by the Maryland Natural Heritage Program database. They are however, considered uncommon species in Maryland and are often significant on a local level (MDNR 2010). During the 2013 SAV survey (EAEST 2013c), southern water nymph was one of the co-dominant species that occurred in high densities in the Potomac River both within and beyond the boundaries of the project area. This SAV species is therefore not unique in the vicinity of the project. It is expected that SAV species in the areas beyond the intake structure and area of scouring would not be affected in the long-term, but would repopulate areas with adjacent SAV rooted plant stock when project disturbance has ceased. Therefore, it is anticipated that the operation of the submerged intake structure would have negligible impacts on the Potomac River riverine system.

Lock 13 Wetland Mitigation Site: There would be beneficial impacts to wetlands at the Lock 13 wetland mitigation site. No new wetlands are proposed to be created, the proposed wetland mitigation is considered to be enhancement. Enhancement activities include removing the invasive reed canarygrass and planting native species before the reed canarygrass can re-establish itself. The wetland would be upgraded from an emergent wetland dominated by invasive species to a scrub-shrub/forested wetland composed of native species.

Cumulative Impacts: Other past, present, and future planned actions within and around the project area (MM 17.5) have the potential to impact riverine systems and wetland areas. Past planning efforts, such as the park's General Plan established goals for the preservation of the park's natural setting including that outdoor recreation should not intrude upon or impair the resources for which the park was established to protect. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stream restoration and enhancement and low impact development. Aspects of these projects include: stabilizing stream banks and enhancing riparian habitats; constructing wetlands; using features such as bioswales and tree box filters.

The overall effect of these past, current, and future actions on wetlands in the vicinity of MM 17.5 would be beneficial. Therefore, these beneficial actions would not contribute to the short- to long-term minor to moderate adverse impacts from construction and negligible impacts from operation on riverine systems and wetland areas under alternative 2. Cumulative impacts on riverine systems and wetland areas in the area of analysis would be short- to long-term minor to moderate adverse impacts from construction and negligible impacts from operation.

Conclusion: Riverine systems and wetlands would be affected during construction of alternative 2. It is anticipated that disturbance of the Potomac River and C&O Canal riverine systems from the construction and removal of the cofferdams and embankments would occur, resulting in short-term moderate adverse impacts. Short-term minor impacts would occur on wetlands in the project area from the presence of the construction access road, as it would cause a loss of functions and values of wetland A. Impacts on wetland A and the Potomac River riverine system would occur from installation of the boat ramp, intake, parking lot, and construction access road; these impacts would be long-term minor and adverse. During the construction activities for alternative 2, BMPs would be employed to minimize impacts on hydrology, water quality, and special-status species to comply with *PM #77-1: Wetland Protection.* Operation of the Potomac WFP would have negligible effects to the riverine systems.

The beneficial effect of past, current, and future actions on the riverine systems and wetlands in the vicinity of MM 17.5 would not contribute cumulatively to the short- to long-term minor to moderate adverse impacts from construction and negligible impacts from operation on these resources under alternative 2.

Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake

Alternative 3 would have similar impacts on wetlands and riverine systems as alternative 2 even though the method of constructing the three intake conduits is different. Under this alternative, construction of the new intake conduits would involve using both open-trench and tunneling construction. The open-trench would be constructed within the confines of the cofferdam and the tunneling would be below grade on land. Project components specific to alternative 3 that would adversely affect wetlands include the construction of the construction access road. Project components that would adversely affect riverine systems include the installation of cofferdams and embankments, and construction of the boat ramp, intake, and the intake tunnels. Total impacts associated with the proposed construction activity are listed

in table 26. Figure 9 presents the riverine systems and wetlands delineated on NPS, WSSC, and State of Maryland lands.

Table 26. Alternative 3 Riverine Systems and Wetland Impacts

System	Classification	Impact (acres)	Impact (square feet)
Wetland A (NPS Only)	PFO1B	0.020	871.2
Wetland A (WSSC Only)	PFO1B	0.057	2,482.9
Wetland A (Total)	PFO1B	0.077	3,354.1
Potomac River Riverine (NPS only)	R2UBH	0.030	1,306.8
Potomac River Riverine (State of Maryland only)	WUS	3.9	168,533.6
Potomac River (Total)	R2UBH/WUS	3.9	169,840.4
C&O Canal	R2UBHx	0.14	5,967.7
Total NPS Property Impacts		**0.19**	**8,145.7**
Total Project Area Impacts		**4.1**	**179,162.3**

Note: Measurements in this table are approximate. Area values in acres have been rounded for brevity; this may cause area values in square feet to appear not to be a direct conversion from the acre value.

Wetland Definitions:
PFO1B – Palustrine, forested, broad-leaved deciduous, saturated
R2UBH – Riverine, lower perennial, unconsolidated bottom, permanently flooded
R2UBHx – Riverine, lower perennial, unconsolidated bottom, permanently flooded, excavated
WUS = Waters of the United States

Construction Impacts –The installation and removal of temporary cofferdams associated with the intake, intake shaft, intake conduits, and boat ramp, as well as the embankments needed to support the construction access road, would impact the Potomac River and C&O Canal riverine systems. The effects of installation and removal of the cofferdams and embankments would be the same as described for alternative 2: a direct loss of SAV plants in the construction area limit and indirect impacts from the release of fine sediment into the river from construction activities. The construction area limit under alternative 3 would be larger than under alternative 2 to provide a dry work area for the trench to construct the horizontal alignment of the new intake tunnel and conduits. Impacts on the canal would be the same for alternatives 2 and 3. Under alternative 3, the flow of water from the main portion of the Potomac River into the channel would be blocked by the intake cofferdam; however, flow to the channel would be maintained by installation of an embankment and culvert across Unnamed Island. This change in the natural flow of the river could indirectly impact SAV in the channel.

Two special-status wetland plant species would be affected by alternative 3, the state endangered floating paspalum and the state watch list species, halberd-leaved hibiscus. These plants are located along the shoreline of Unnamed Island characterized as part of the Potomac River riverine system**.** The entire shoreline of Unnamed Island and most of the shoreline west of the existing intake would be impacted during construction. Vegetation would be removed along the Potomac River shoreline for temporary construction features and staging of construction materials. Construction impacts on the wetland plants floating paspalum and halberd-leaved hibiscus would be adverse and are discussed in more detail in the "Special-status Species" section.

Impacts on the Potomac River and C&O Canal riverine systems are expected to be short-term moderate and adverse from the installation and removal of the cofferdams and embankments. Areas temporarily affected by alternative 3 would be restored to pre-existing conditions once the project is complete. Within the Potomac River and C&O Canal, SAV would be expected to recolonize in the area within a few years

following removal of the temporary structures built during construction (cofferdams and embankments) since dense SAV exists within both riverine systems in adjacent areas that would not be disturbed by this project.

Impacts on riverine systems and wetlands under alternative 3 would be similar to alternative 2. Impacts would occur to wetland A from the clearing for the construction access road and the Potomac River would be affected by installation of the new intake, the boat ramp, and the intake tunnels.

The construction access road would impact wetland A. The road would be constructed through or adjacent to the wetland, which could change hydrology; impede water movement, ground-level wildlife movement, and the seed distribution of wetland plants; reduce the ability of wetlands to perform functions such as groundwater discharge/recharge, sediment/toxicant retention, and nutrient removal; cause loss of stormwater/nutrient assimilative capacity; and introduce toxic substances from construction vehicles along the road. Impacts on wetlands from the construction access road would occur during the approximately 3.0 years that the road would be installed and utilized at the site. The presence of the construction access road would have short-term minor and adverse impacts on wetlands during the construction phase of the project.

The impacts on wetland A would be the same as described for alternative 2. Wetland A would be affected by the construction access road. Vegetation clearing would remove part of wetland A. Even though the construction access road would be removed and the area restored, the loss of wooded wetland would be considered a permanent impact, as northern forested wetlands may take 50 years to reach maturity (Kusler 2006). The removal of trees would change functions and values of the wetland, resulting in measureable impacts to the wetland. Details for invasive species monitoring and management can be found in "Appendix D: Habitat Restoration Plan".

Under alternative 3, there would be an increase in impacts on the Potomac River riverine system. In addition to the new intake and the boat ramp, the river bottom would be affected by the installation of the intake conduit trench. The boat ramp would extend into the Potomac River and affect a small amount of riverine wetland. Similar to the discussion above, floating paspalum and halberd-leaved hibiscus were observed along the shoreline of the Potomac River in the area of the proposed boat ramp. The boat ramp represents loss of habitat for these two species in the project area. Removal of existing SAV and impacts to the Potomac River bottom would occur from the intake structure and the intake conduit trench.

Overall, 3.899 acres of the Potomac River, 0.14 acre of the C&O Canal, and 0.077 acre of wetland A (PFO1B) would be affected by project components associated with alternative 3 for a total of 4.113 acres of wetland and river impacts. However, only 0.15 acre of wetland and river impacts are permanent. The remaining impacted areas are associated with temporary construction features, and would be replanted following the completion of construction. Only 0.19 acre of the wetlands being impacted is on NPS property. Of the impacted wetlands on NPS property, 0.002 acre of riverine wetland would be permanently impacted by the portion of the boat ramp that crosses the Potomac River. The rest of the permanent impacts are associated with the intake structure (0.14 acre) and the portion of the boat ramp that extends into the Potomac River (0.011 acre of Waters of the U.S.) in the Potomac River on State of Maryland Property. The 0.19 acre of the impacted wetlands that are on NPS property would be mitigated according to NPS regulations.

Mitigation measures would be employed during construction, when appropriate, to minimize impacts on riverine systems and wetland areas, including the use of silt curtains that would be placed in the Potomac River and C&O Canal to prevent impacts on the aquatic environment from silt and sediment that may be disturbed during construction. Guidelines for waterway construction, published by the MDE (*Maryland's Waterway Construction Guidelines*, MDE 2000) would also be followed. The limits of the area disturbed

by project components associated with alternative 3 would be kept to as minimal an area as possible. Whenever feasible, construction activities, including heavy equipment use and stockpiling of materials, would be conducted outside of wetland areas.

Operational Impacts: As stated in alternative 2, CFD modeling was completed to determine the sizing, configuration, and hydraulic characteristics of the proposed intake system alternatives (Black and Veatch 2013). The intake is expected to cause an increase in local flow velocities upstream of the structure and vortices downstream, potentially leading to scour of the structure and the surrounding riverbed. Between the intake and Unnamed Island downstream of the structure the velocity would be slower and there is the potential for sedimentation.

Additionally, the CFD modeling has predicted that a small area of scour surrounding the intake structure is likely possible that would also affect existing SAV. One of the co-dominant species of SAV in the area proposed for the intake structure includes southern water nymph, a watch list species by MDNR.

Similar to alternative 2, there is a potential that the river bottom would need to be sculpted to obtain optimal flow to the intake. The sculpting would alter the river bottom in this area. It is expected that SAV species in the areas beyond the intake structure and areas of scouring sculpting would not be affected in the long-term, but would repopulate areas with adjacent SAV rooted plant stock when project disturbance has ceased. Therefore, it is anticipated that the operation of the submerged intake structure would have negligible impacts on the Potomac River riverine system.

Cumulative Impacts: Other past, present, and future planned actions within and around the project area (MM 17.5) have the potential to impact riverine systems and wetland areas. Past planning efforts, such as the park's General Plan established goals for the preservation of the park's natural setting including that outdoor recreation should not intrude upon or impair the resources for which the park was established to protect. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stream restoration and enhancement and low impact development. Aspects of these projects include: stabilizing stream banks and enhancing riparian habitats; constructing wetlands; using features such as bioswales and tree box filters.

The overall effect of these past, current, and future actions on wetlands in the vicinity of MM 17.5 would be beneficial. Therefore, these beneficial actions would not contribute to the short- to long-term minor to moderate adverse impacts from construction and negligible impacts from operation on riverine systems and wetland areas under alternative 3. Cumulative impacts on riverine systems and wetland areas in the area of analysis would be short- to long-term minor to moderate adverse impacts from construction and negligible impacts from operation.

Conclusion: Riverine systems and wetlands would be affected during construction of alternative 3. It is anticipated that disturbance of the Potomac River and C&O Canal riverine systems from the construction and removal of the cofferdams and embankments would occur, resulting in short-term moderate impacts. Short-term minor impacts would occur on wetlands in the project area from the presence of the construction access road, as it would cause a loss of functions and values of wetland A. Impacts on wetland A and the Potomac River riverine system would occur from installation of the construction access road, the boat ramp, parking area, intake structure, and intake conduit trench; these impacts would be long-term minor and adverse. During the construction activities for the preferred alternative, BMPs would be employed to minimize impacts on hydrology, water quality, and special-status species to comply with *PM #77-1: Wetland Protection.* Operation of the Potomac WFP would have negligible effects to the riverine systems.

The beneficial effect of past, current, and future actions on the riverine systems and wetlands in the vicinity of MM 17.5 would not contribute cumulatively to the short- to long-term minor to moderate adverse impacts from construction and negligible impacts from operation on these resources under alternative 3.

Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake

Construction Impacts: This alternative would have similar impacts on riverine systems and wetland areas as alternative 2 since the method of constructing the three intake tunnels and many of the design features are similar to what is described under alternative 2. The difference is that the horizontal alignment of the tunnels/conduits and the location of the junction vault would be different for this alternative. Project components specific to alternative 4 would adversely affect wetlands and include the construction of the construction access road. Project components would adversely affect riverine systems and include the installation of cofferdams, embankments, the boat ramp, and the intake structure. Total impacts associated with the proposed construction activity are listed in table 27. Figure 9 presents the riverine systems and wetlands delineated on NPS, WSSC, and State of Maryland lands.

Table 27. Alternative 4 Riverine Systems and Wetland Impacts

System	Classification	Impact (acres)	Impact (square feet)
Wetland A (NPS Only)	PFO1B	0.020	871.2
Wetland A (WSSC Only)	PFO1B	0.057	2,482.9
Wetland A (Total)	PFO1B	0.077	3,354.1
Potomac River Riverine (NPS only)	R2UBH	0.032	1,393.9
Potomac River Riverine (State of Maryland only)	WUS	3.3	143,051.0
Potomac River (Total)	R2UBH/WUS	3.3	144,445.0
C&O Canal	R2UBHx	0.38	16,596.4
Total NPS Property Impacts		**0.43**	**18,861.5**
Total Project Area Impacts		**3.77**	**164,395.4**

Note: Measurements in this table are approximate. Area values in acres have been rounded for brevity; this may cause area values in square feet to appear not to be a direct conversion from the acre value.

Wetland Definitions:
PFO1B – Palustrine, forested, broad-leaved deciduous, saturated
R2UBH – Riverine, lower perennial, unconsolidated bottom, permanently flooded
R2UBHx – Riverine, lower perennial, unconsolidated bottom, permanently flooded, excavated
WUS = Waters of the United States

The riverine systems of the Potomac River and the C&O Canal would be affected by the installation and removal of the cofferdams and embankments associated with the intake, intake conduits, junction vault, boat ramp, and construction access road. The placement of cofferdams and embankments would impact SAV in a direct loss of those plants. This alternative has an additional embankment in the C&O Canal for the temporary relocation of the towpath. Indirect impacts on SAV would occur from the release of fine sediment into the river from construction activities. Floating paspalum, a state endangered wetland plant, and halberd-leaved hibiscus, a state watch list wetland plant, inhabit the shorelines of the Unnamed Island and the area west of the existing intake. These areas would be impacted during construction, affecting the plants and their habitats. Construction impacts on the wetland plants floating paspalum and halberd-leaved hibiscus would be adverse and are discussed in more detail in the "Special-status Species" section. Overall, there would be short-term adverse impacts on the riverine systems (Potomac River and C&O Canal) from the installation and removal of the cofferdams and embankments. Areas temporarily affected

by alternative 4 would be restored to pre-existing conditions once the project is complete. Within the Potomac River and C&O Canal, SAV would be expected to recolonize in the area within a few years following removal of the temporary structures built during construction (cofferdam and embankment) since dense SAV exists within both riverine systems in adjacent areas that would not be disturbed by this project.

Temporary and permanent components of the project would affect the Potomac River riverine system and wetland A. Impacts are associated with the construction of the boat ramp, intake structure, and construction access road.

Short-term minor adverse impacts would be expected on wetland A from the presence of the construction access road. This road would remove portions of or fragment the wetlands, resulting in a loss of functions and values. Impacts on wetlands from the construction access road would occur during the approximately 3.0 years that the roads would be installed and utilized at the site, the longest of the three action alternatives.

The construction access road would have a direct impact on wetland A, a forested wetland. The removal of vegetation, including mature trees, would create a change in the following functions and values: groundwater recharge/discharge; wildlife productivity and habitat; and vegetation, water quality, and hydrology. The vegetation removal could also reduce the biomass and change the species composition of the wetland (Cutlip 1986). Measurable changes to the abundance and diversity of wetland A vegetation would occur. The vegetation removal from Wetland A would be considered a permanent impact. Although all cleared areas within the construction area limit would be re-graded and re-planted to resemble the existing vegetation, the trees within wetland A would not recover during the life of the project (15 years) to become a fully functioning forested wetland. Details for invasive species monitoring and management can be found in "Appendix D: Habitat Restoration Plan".

The Potomac River riverine system would be affected by installation of the boat ramp and the submerged intake structure. The boat ramp would extend into the Potomac River and affect approximately a small amount of riverine wetland. Similar to the discussion above, floating paspalum and halberd-leaved hibiscus were observed along the shoreline of the Potomac River in the area of the proposed boat ramp**.** Impacts to the Potomac River bottom and removal of existing SAV would occur from the intake structure.

Overall, 3.3 acres of the Potomac River, 0.38 acre of the C&O Canal, and 0.077 acre of wetland A (PFO1B) would be affected by project components associated with alternative 3 for a total of 3.774 acres of wetland and river impacts. However, only 0.15 acre of wetland and river impacts is permanent. The remaining impacted areas are associated with temporary construction features, and would be replanted following the completion of construction. Only 0.43 acre of the wetlands being impacted is on NPS property. Of the impacted wetlands on NPS property, 0.002 acre of riverine wetland would be permanently impacted by the portion of the boat ramp that crosses the Potomac River. The rest of the permanent impacts are associated with the intake structure (0.14 acre) and the portion of the boat ramp that extends into the Potomac River (0.011 acre of Waters of the U.S.) in the Potomac River on State of Maryland Property. The 0.43 acre of the impacted wetlands that are on NPS property would be mitigated according to NPS regulations.

Mitigation measures would be employed during construction, when appropriate, to minimize impacts on riverine systems and wetland areas, including the use of silt curtains that would be placed in the Potomac River and C&O Canal to prevent impacts on the aquatic environment from silt and sediment that may be disturbed during construction. Guidelines for waterway construction, published by the MDE (*Maryland's Waterway Construction Guidelines*, MDE 2000) would also be followed. The limits of the area disturbed by project components associated with alternative 4 would be keep to as minimal an area as possible.

Whenever feasible, construction activities, including heavy equipment use and stockpiling of materials, would be conducted outside of wetland areas.

Operational Impacts: Under alternative 4, operation would be the same as described for alternatives 2 and 3. The new intake may cause an increase in local flow velocities upstream of the structure and vortices downstream, potentially leading to scour of the structure and the surrounding riverbed, as well as reduced velocity and the potential for sedimentation between the intake and Unnamed Island downstream of the structure.

Additionally, the CFD modeling has predicted that a small area of scour surrounding the intake structure is likely possible that would also affect existing SAV. One of the co-dominant species of SAV in the area proposed for the intake structure includes southern water nymph, a watch list species by MDNR.

As stated for alternative 2, there is a potential that the river bottom would need to be sculpted to obtain optimal flow to the intake. The sculpting would alter the river bottom in this area. It is expected that SAV species in the areas beyond the intake structure and area of scouring would not be affected in the long-term, but would repopulate areas with adjacent SAV rooted plant stock when project disturbance has ceased. Therefore, it is anticipated that the operation of the submerged intake structure would have negligible impacts on the Potomac River riverine system.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 4 would be identical to those under alternative 2. The effects of these actions described above are not expected to contribute to the short- to long-term minor to moderate adverse impacts from construction and negligible impacts from operation on riverine systems and wetlands under alternative 4. Therefore, the cumulative impacts on riverine systems and wetlands in the area of analysis would be short- to long-term minor to moderate and adverse from construction and negligible from operation.

Conclusion: Riverine systems and wetlands would be affected during construction of alternative 4. It is anticipated that disturbance of the Potomac River and C&O Canal riverine systems from the construction and removal of the cofferdams and embankments would occur, resulting in short-term moderate adverse impacts. Short-term minor impacts would occur on wetlands in the project area from the presence of the construction access road, as it would cause a loss of functions and values of wetland A. Impacts on wetland A and the Potomac River riverine system would occur from installation of the construction access road, boat ramp, parking area, and intake structure; these impacts would be long-term minor and adverse. During the construction activities for alternative 4, BMPs would be employed to minimize impacts on hydrology, water quality, and special-status species to comply with *PM #77-1: Wetland Protection.* Operation of the Potomac WFP would have negligible effects to the riverine systems.

The beneficial effect of past, current, and future actions on the riverine systems and wetland areas in the vicinity of MM 17.5 would not contribute cumulatively to the short- to long-term minor to moderate adverse impacts from construction and negligible impacts from operation on these resources under alternative 4.

FLOODPLAINS

Methodology and Assumptions

In accordance with Director's Order 77-2: *Floodplain Management*, NPS policy is to preserve floodplain values and avoid impacts associated with modification of the floodplain. The location of the 100-year floodplain in the project area was analyzed using FEMA flood insurance rate mapping. To determine impacts, the scope of the proposed actions within the floodplain was considered and the area of proposed ground disturbance in the floodplain was determined. Predictions of short-term and long-term impacts were based on an assessment of floodplain functions and values, professional judgment, and similar projects. A SOF has been prepared for this project and can be found in appendix E. The SOF contains a summary of the impact analysis presented below for floodplains. Mitigation measures for floodplains described in the SOF are also incorporated in the impact analysis below.

Project Area

The geographic project area for the 100-year floodplain includes the areas within the construction area limit (limit of disturbance) for the project. The entire project site, except for a small (0.07 acre) portion of the northwest corner of the construction access road, is within the 100-year floodplain. Under alternative 4, an additional 0.29 acre extends outside of the floodplain of the east side of the site along the towpath. Figure 4 in the SOF (appendix E) depicts the 100-year flood zone at the project site.

Impact Thresholds

The following thresholds were used to determine the magnitude of impacts on floodplains:

Negligible – There would be no measurable change in the values and functions of the floodplain or its ability to convey floodwaters. The project would not contribute to flooding.

Minor – Changes in the values and functions of a floodplain or its ability to convey floodwaters would be detectable and local, although the changes may not be measurable. Project would not contribute to flooding. No mitigation would be needed.

Moderate – Changes in the values and functions of a floodplain or its ability to convey floodwaters would be measurable and local. Project could contribute to flooding. Mitigation measures would be necessary to offset adverse impacts and would likely be successful.

Major – Changes in the values and functions of a floodplain or its ability to convey floodwaters would be measurable and widespread. Project would contribute to flooding. Mitigation measures to offset adverse impacts would be needed, extensive, and their success would not be guaranteed.

Duration – Short-term impacts occur during the construction phase of the alternative; long-term impacts occur during and beyond implementation of the alternative.

Alternative 1: No-action Alternative

Under the no-action alternative there would be no additional adverse effect to the 100-year floodplain because existing conditions would remain unchanged. However, the existing WFP intake is a permanent structure in the 100-year floodplain resulting in a long-term minor adverse impact.

Cumulative Impacts: Other past, present, and future planned actions within and around the project area (MM 17.5) have the potential to impact floodplains. Past planning efforts, such as the park's General Plan

established goals for the preservation of the park's natural setting including that outdoor recreation should not intrude upon or impair the resources for which the park was established to protect. The Potomac River watershed restoration projects also benefit the 100-year floodplain. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stream restoration and enhancement and low impact development, which indirectly benefit the 100-year floodplain. Aspects of these projects include: stabilizing stream banks and enhancing riparian habitats; constructing wetlands; using features such as bioswales and tree box filters.

The overall effect of these past, current, and future actions on the 100-year floodplain in the vicinity of MM 17.5 would be beneficial. Therefore, these beneficial actions would not contribute to the long-term minor adverse impacts on the 100-year floodplain under alternative 1. Cumulative impacts on the 100-year floodplain in the area of analysis would be long-term minor and adverse.

Conclusion: The existing intake at the project site is a permanent structure in the 100-year floodplain resulting in a long-term minor adverse impact under alternative 1.

The beneficial impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the long-term minor adverse impacts on floodplains under alternative 1.

Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative)

Under this alternative, construction of the new intake and intake conduits would involve constructing a tunnel under the Potomac River to connect the new intake to the existing raw water conduits. Temporary impacts would occur from the installation and removal of cofferdams and embankments and vegetation clearing for construction activities. Permanent impacts would result from construction of permanent features within the floodplain (submerged intake structure, boat ramp, parking area, boat ramp access road, and junction vault). Overall, the construction area limits for the project were designed to avoid and minimize impacts to natural resources including impacts to floodplains by constructing the project in the smallest footprint feasible.

Construction Impacts: Approximately 1.7 acres within the floodplain would be affected by temporary in-water project components (table 28). The installation and removal of temporary cofferdams for the construction of the new intake, intake shaft, river embankments, and boat ramp would potentially result in changes to the hydrological regime of the river as it may alter the natural flow regimes. The temporary cofferdams may alter the capacity of the channel to convey water and increase the height of surface water. Upstream flooding may increase due to narrowing the width of the channel and increasing the channel's resistance to flow, resulting in a higher stage as it flows past the obstruction. This impact is also expected from the construction of the embankments and placement of the culvert pipes into the channel of the Potomac River. The embankment needed within the C&O Canal for the construction access road to cross the canal is located within the 100-year floodplain. Within the embankments, culverts would be installed to maintain flow in the river past the construction areas. Overall, there would be short-term minor adverse impacts on the 100-year floodplain from the installation and removal of the cofferdams and embankments. The in-water construction phase of the proposed project is expected to take approximately 2 years.

Table 28. Alternative 2 Floodplain Impacts

Project Components	Temporary Impacts (acres)	Permanent Impacts (acres)
Cofferdams and Embankments	1.7	---
Terrestrial Vegetation Clearing	4.7	---
Construction Access Road	0.61[(a)]	---
Boat Ramp	---	0.030
Junction Vault	---	0.12
Intake Structure	---	0.14
Parking Area and Boat Ramp Access Road	---	0.24

Note: Measurements in this table are approximate
(a) Approximately 0.07 acre of the construction access road is located outside of the 100-year floodplain.

Upland construction activities are also expected to have adverse impacts on the 100-year floodplain as a result of vegetation clearing and access road construction from temporary project components. Appropriate stormwater management techniques, including approved BMPs, would be required to avoid indirect impacts to floodplains during construction of the access road. Short-term impacts would occur from the use of heavy construction equipment and other materials within the floodplain. Construction of project components would possibly require a maximum of 4.7 acres of vegetation to be cleared from the construction area limit within the floodplain resulting in a loss of trees (table 28). All cleared areas within the construction area limit would be re-graded and re-planted to resemble the existing vegetation after construction is complete; however, because northern forests may take 50 years to reach maturity (Kusler 2006), trees within the floodplain would not recover during the duration of this EA to become a fully functioning floodplain, and a long-term impact would result. Floodplain functions and values would change as a result of tree loss including the ability to convey floodwaters, but this would be a localized event within the project area. In summary, the upland construction activities would result in short- and long-term minor adverse impacts on the 100-year floodplain. Even though the upland construction phase of the proposed project is expected to last approximately 4 years, long-term impacts to the floodplain would result from the removal of forest trees.

A total of 0.53 acre within the floodplain would be adversely affected by permanent project components (table 28). Permanent structures including the boat ramp, parking area, boat ramp access road, and junction vault have the potential to impact the 100-year floodplain in the long-term since the proposed location of these structures is currently vegetated and would require conversion to either pervious or impervious cover. The parking area and associated access road would be located within the floodplain (0.24 acre, table 28) but constructed of pervious paving to allow percolation or infiltration of rainwater and stormwater. The pervious materials are designed to be porous-permeable paving that allows rainwater to pass through the cross section and back to the groundwater supply. New impervious areas within the floodplain are associated with the boat ramp (0.030 acre, table 28) and junction vault (0.12 acre, table 28). These facilities are water-dependent structures and were placed in the floodplain because no other viable alternative was available. As a result of these permanent structures, these previously vegetated areas would have less capacity to store rainfall; the replacement of those areas with impervious surfaces may result in a reduction of water storage, a reduction of infiltration of water into the ground, and the acceleration of runoff to ditches and streams. Other permanent features located within the floodplain include the intake and associated intake conduits. These impacts are to the riverbed and are not expected to alter the capacity of the channel to convey water, or increase the height of the water surface and the chance of flooding. In addition, even though the intake conduits would be located within the floodplain,

they would be placed underground within the bedrock and would not affect hydrologic patterns at the surface.

Operational Impacts: Under alternative 2, the use of the Potomac WFP would remain the same; however, the operation of a submerged channel intake would require structures to be placed within the 100-year floodplain, as described above. The addition of new structures within the floodplain would create long-term adverse impacts on flooding characteristics such as conveyance of flood flows and flooding potential. There is a potential that the river bottom would need to be sculpted to obtain optimal flow to the intake. The sculpting would alter the river bottom in this area. The removal of bedrock, soils, and vegetation would result in adverse impacts on floodplain values. The long-term impacts would be site specific and would only affect a small portion of the floodplain. The design of the structures within the floodplain would incorporate methods for minimizing flood damage, as described in the National Flood Insurance Program "Floodplain Management Criteria for Flood-Prone Areas" (CFR 44 60.3) and in accordance with state and/or county requirements for flood-prone areas. Overall, operation of the permanent structures would result in long-term minor adverse impacts on the 100-year floodplain.

Lock 13 Wetland Mitigation Site: There would be negligible impacts on floodplains at the Lock 13 wetland mitigation site. No new wetlands are proposed to be created, the proposed wetland mitigation is considered to be enhancement. Enhancement activities include removing invasive species and planting native species. There would be no grading at the site and minimal soil disturbance.

Cumulative Impacts: Other past, present, and future planned actions within and around the project area (MM 17.5) have the potential to impact floodplains. Past planning efforts, such as the park's General Plan established goals for the preservation of the park's natural setting including that outdoor recreation should not intrude upon or impair the resources for which the park was established to protect. The Potomac River watershed restoration projects also benefit the 100-year floodplain. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stream restoration and enhancement and low impact development, which indirectly benefit the 100-year floodplain. Aspects of these projects include: stabilizing stream banks and enhancing riparian habitats; constructing wetlands; using features such as bioswales and tree box filters.

The overall effect of these past, current, and future actions on the 100-year floodplain in the vicinity of MM 17.5 would be beneficial. Therefore, these beneficial actions would not contribute to the short- to long-term minor adverse impacts on the 100-year floodplain under alternative 2. Cumulative impacts on the 100-year floodplain in the area of analysis would be short- to long-term minor and adverse.

Conclusion: Under alternative 2, the 100-year floodplain would be affected during construction of the project. It is anticipated that short-term minor adverse impacts would result from construction and removal of the cofferdams and embankments. Long-term minor adverse impacts on the 100-year floodplain are anticipated from the clearing of forest trees and for the operation of the permanent structures.

The beneficial effect of past, current, and future actions on the 100-year floodplain in the vicinity of MM 17.5 would not contribute cumulatively to the short- to long-term minor adverse impacts on the 100-year floodplain under alternative 2.

Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake

Alternative 3 would have similar impacts on the 100-year floodplain as alternative 2, even though the method of constructing the three intake tunnels is different. Under alternative 3 the intake conduits between the intake shaft and the onshore shaft would be installed in a trench and the intake conduits

between the onshore shaft and the connection to the existing conduits would be installed in a tunnel followed by open cut at the existing conduits. The open trench would be constructed within the confines of the cofferdam and the tunneling would be below grade on land.

Table 29. Alternative 3 Floodplain Impacts

Project Components	Temporary Impacts (acres)	Permanent Impacts (acres)
Cofferdams and Embankments	2.2	---
Terrestrial Vegetation Clearing	3.5	---
Construction Access Road	0.60[(a)]	---
Boat Ramp	---	0.060
Junction Vault	---	0.12
Intake Structure and Intake Conduits	---	0.78
Parking Area and Boat Ramp Access Road	---	0.24

Note: Measurements in this table are approximate
(a) Approximately 0.07 acre of the construction access road is located outside of the 100-year floodplain.

Construction Impacts: The installation and removal of temporary cofferdams for the construction of the new intake, intake shaft, intake conduits, river embankments, and boat ramp would potentially result in changes to the hydrological regime of the river as it may alter the natural flow regimes with a total of 2.2 acres that would be affected (table 29). In the Potomac River, the temporary cofferdam may alter the capacity of the channel to convey water and increase the height of surface water and cause upstream flooding, resulting in a higher stage as it flows past the obstruction. Overall, there would be short-term minor adverse impacts on the 100-year floodplain from the installation and removal of the cofferdams and embankments. The in-water construction phase of the proposed project is expected to take approximately 1.8 years.

Vegetation clearing and upland construction activities are also expected to have adverse impacts on the 100-year floodplain. Appropriate stormwater management techniques, including approved BMPs, would be required to avoid indirect impacts to floodplains during construction of the access road. Short-term impacts would occur from the use of heavy construction equipment and other materials within the floodplain. Construction of project components would possibly require a maximum of 3.5 acres of vegetation to be cleared from the construction area limit within the floodplain resulting in a loss of trees (table 29). All cleared areas within the construction area limit would be re-graded and re-planted to resemble the existing vegetation after construction is complete; however, because northern forests may take 50 years to reach maturity (Kusler 2006), trees within the floodplain would not recover during the duration of this EA to become a fully functioning floodplain, and a long-term impact would result. Floodplain functions and values would change as a result of tree loss including the ability to convey floodwaters, but this would be a localized event within the project area. In summary, the upland construction activities would result in short- and long-term minor adverse impacts on the 100-year floodplain. Even though the upland construction phase of the proposed project is expected to last approximately 4 years, long-term impacts to the floodplain would result from the removal of forest trees.

A total of 1.4 acres within the floodplain would be adversely affected by permanent project components (table 29). Permanent structures including the boat ramp, parking area, boat ramp access road, and junction vault have the potential to impact the 100-year floodplain in the long-term since the proposed location of these structures is currently vegetated and would require conversion to either pervious or impervious cover. The parking area and associated access road (0.24 acre, table 29) would be constructed

of pervious materials, allowing rainwater to pass through the cross section and back to the groundwater supply. The boat ramp (0.060 acre, table 29) and junction vault (0.12 acre, table 29) would be constructed with impervious materials, resulting in a reduction of water storage, a reduction of infiltration of water into the ground, and the acceleration of runoff to ditches and streams. These facilities are water-dependent structures and were placed in the floodplain because no other viable alternative was available. Other permanent features located within the floodplain include the intake and intake conduits (0.98 acre, table 29). These impacts are to the riverbed and are not expected to alter the capacity of the channel to convey water, or increase the height of the water surface and the chance of flooding.

Operational Impacts: As stated for alternative 2, the use of the Potomac WFP would remain the same; however, the operation of a submerged channel intake would require structures to be placed within the 100-year floodplain, as described above. The addition of new structures within the floodplain would create long-term adverse impacts on flooding characteristics such as conveyance of flood flows and flooding potential. There is a potential that the river bottom would need to be sculpted to obtain optimal flow to the intake, which would alter the river bottom in this area. The removal of bedrock, soils, and vegetation would result in adverse impacts on floodplain values. The impacts would be site specific and would only affect a small portion of the floodplain. The design of the structures within the floodplain would incorporate methods for minimizing flood damage, as described in the National Flood Insurance Program "Floodplain Management Criteria for Flood-Prone Areas" (CFR 44 60.3) and in accordance with state and/or county requirements for flood-prone areas. Overall, operation of the permanent structures would result in long-term minor adverse impacts on the 100-year floodplain.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 3 would be identical to those under alternative 2. The effects of these actions described above are not expected to contribute to the short- to long-term minor and adverse impacts on the 100-year floodplain under alternative 3. Therefore, the cumulative impacts on the 100-year floodplain in the area of analysis would be short- to long-term minor and adverse.

Conclusion: Under alternative 3, the 100-year floodplain would be affected during construction of the project. It is anticipated that short-term minor adverse impacts would result from the construction and removal of the cofferdams and embankments, and from construction of the temporary structures. Long-term minor adverse impacts on the 100-year floodplain are anticipated from the clearing of forest trees and for the operation of the permanent structures.

The beneficial effect of past, current, and future actions on the 100-year floodplain in the vicinity of MM 17.5 would not contribute cumulatively to the short- to long-term minor adverse impacts on the 100-year floodplain under alternative 3.

Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake

Alternative 4 would have similar impacts on the 100-year floodplain as alternative 2 since the method of constructing the three intake tunnels and many of the design features are similar. The difference between alternatives is that the horizontal alignment of the tunnels/conduits and the location of the tunneling shaft/junction vault are different for alternative 4. Under this alternative, construction of the new intake conduits would involve constructing a tunnel under the Potomac River to connect the new intake to the existing raw water conduits.

Table 30. Alternative 4 Floodplain Impacts

Project Components	Temporary Impacts (acres)	Permanent Impacts (acres)
Cofferdams and Embankments	2.0	---
Terrestrial Vegetation Clearing	4.4	---
Construction Access Road	0.64[(a)]	---
Boat Ramp	---	0.060
Junction Vault	---	0.17
Intake Structure	---	0.14
Parking Area and Boat Ramp Access Road	---	0.20

Note: Measurements in this table are approximate
(a) Approximately 0.07 acre of the construction access road is located outside of the 100-year floodplain.

Construction Impacts: A total of 1.8 acres within the floodplain would be affected by temporary project components (table 30). The installation and removal of temporary cofferdams for the construction of the new intake, intake shaft, intake conduits, river embankments, and boat ramp would potentially result in changes to the hydrological regime of the river as it may alter the natural flow regimes, as described for alternative 2. Overall, there would be short-term minor adverse impacts on the 100-year floodplain from the installation and removal of the cofferdams and embankments. The in-water construction phase of the proposed project is expected to take approximately 2.0 years.

Upland construction activities are also expected to have adverse impacts on the 100-year floodplain as a result of vegetation clearing and construction activities. Appropriate stormwater management techniques, including approved BMPs, would be required to avoid indirect impacts to floodplains during construction of the access road. Construction of project components would possibly require a maximum of 4.4 acres of vegetation to be cleared from construction area limit within the floodplain resulting in a loss of trees (table 30). All cleared areas within the construction area limit would be re-graded and re-planted to resemble the existing vegetation after construction is complete; however, because northern forests may take 50 years to reach maturity (Kusler 2006), trees within the floodplain would not recover during the duration of this EA to become a fully functioning floodplain, and a long-term impact would result. Floodplain functions and values would change as a result of tree loss including the ability to convey floodwaters, but this would be a localized event within the project area. In summary, the upland construction activities would result in short-term minor adverse impacts on the 100-year floodplain. Even though the upland construction phase of the proposed project is expected to last approximately 4 years, long-term impacts to the floodplain would result from the removal of forest trees.

A total of 0.57 acre within the floodplain would be adversely affected by permanent project components (table 30). Permanent structures including the boat ramp, parking area, boat ramp access road, and junction vault have the potential to impact the 100-year floodplain in the long-term since the proposed location of these structures is currently vegetated and would require conversion to either pervious or impervious cover. The parking area and associated access road would be located within the floodplain (0.20 acre, table 30) but constructed of pervious paving to allow percolation or infiltration of rainwater and stormwater. New impervious areas within the floodplain are associated with the boat ramp (0.060 acre, table 30) and junction vault (0.17 acre, table 30). These facilities are water-dependent structures and were placed in the floodplain because no other viable alternative was available. As a result of these permanent structures, these previously vegetated areas would have less capacity to store rainfall; the replacement of those areas with impervious surfaces may result in a reduction of water storage, a reduction of infiltration of water into the ground, and the acceleration of runoff to ditches and streams.

Other permanent features located within the floodplain include the intake and associated intake conduits. These impacts are to the riverbed and are not expected to alter the capacity of the channel to convey water, or increase the height of the water surface and the chance of flooding. In addition, even though the intake conduits would be located within the floodplain, they would be placed underground within the bedrock and would not affect hydrologic patterns at the surface.

Operational Impacts: Under alternative 4, the use of the Potomac WFP would remain the same; however, the operation of a submerged channel intake would require structures to be placed within the 100-year floodplain, as described above. The addition of new structures within the floodplain would create long-term adverse impacts on flooding characteristics such as conveyance of flood flows and flooding potential. There is a potential that the river bottom would need to be sculpted to obtain optimal flow to the intake, which would alter the river bottom in this area. The removal of bedrock, soils, and vegetation would result in long-term minor adverse impacts on floodplain values. The long-term impacts would be site specific and would only affect a small portion of the floodplain. The design of the structures within the floodplain would incorporate methods for minimizing flood damage, as described in the National Flood Insurance Program "Floodplain Management Criteria for Flood-Prone Areas" (CFR 44 60.3) and in accordance with state and/or county requirements for flood-prone areas. Overall, operation of the permanent structures would result in long-term adverse impacts on the 100-year floodplain.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 4 would be identical to those under alternative 2. The effects of these actions described above are not expected to contribute to the short- to long-term minor and adverse impacts on the 100-year floodplain under alternative 4. Therefore, the cumulative impacts on the 100-year floodplain in the area of analysis would be short- to long-term minor and adverse.

Conclusion: Under alternative 4, the 100-year floodplain would be affected during construction of the project. It is anticipated that short-term minor adverse impacts would result from the construction and removal of the cofferdams and embankments, and from construction of the temporary structures. Long-term minor adverse impacts on the 100-year floodplain are anticipated from the clearing of forest trees and for the operation of the permanent structures.

The beneficial effect of past, current, and future actions on the 100-year floodplain in the vicinity of MM 17.5 would not contribute cumulatively to the short- to long-term minor adverse impacts on the 100-year floodplain under alternative 4.

AQUATIC AND TERRESTRIAL VEGETATION

Methodology and Assumptions

In order to evaluate impacts on vegetation, vegetative species composition within the project area was considered. Types of trees, shrubs, and herbaceous plants potentially affected by the proposed project were determined. Intensity levels of potential impacts were determined based on the anticipated extent of vegetation removal needed for project construction. Impacts on sensitive vegetation species are analyzed in the "Special-status Species" section of this document.

Project Area

The geographic project area for vegetation includes the aquatic and terrestrial areas located within the construction area limit (limit of disturbance) for the project.

Impact Thresholds

The following thresholds were used to determine the magnitude of impacts on vegetation:

Negligible –Some individual native plants could be affected as a result of the alternative, but there would be no effect on native species populations.

Minor – The alternative could affect the abundance or distribution of some individual native plants in a localized area, but would not affect the viability of local populations or overall community size, structure, or composition. Mitigation would be needed to offset adverse impacts and would be relatively simple to implement and would likely be successful.

Moderate – The alternative would affect the abundance or distribution of local populations and localized changes to community size, structure, or composition and ecological processes would occur. Mitigation to offset adverse impacts could be extensive and would likely be successful.

Major – The alternative would have a considerable effect on the abundance or distribution of local or regional native plant populations and community size, structure, or composition would be highly altered over a relatively large area. Mitigation measures to offset the adverse impacts would be required and extensive and success of the mitigation measures would not be guaranteed.

Duration – Short-term impacts occur during the construction phase of the alternative; long-term impacts occur during and beyond implementation of the alternative.

Alternative 1: No-action Alternative

Under alternative 1, there would be no additional effects to vegetation as conditions would remain unchanged. No construction activities would occur and the existing facility would continue to operate as it does under current conditions. Impacts from the existing WFP intake and associated structures to aquatic and terrestrial vegetation are expected to be negligible. These resources would continue to function naturally.

Cumulative Impacts: The no-action alternative would have a negligible effect on vegetation at the project site, so this alternative would not contribute to the cumulative impacts on vegetation from the compiled list of projects and actions included in the "Cumulative Impacts Analysis Method" section.

Conclusion: The no-action alternative would have a negligible effect on aquatic and terrestrial vegetation at the project site due the existing intake structure. Since this alternative proposed a negligible change to the project area, there would be no cumulative effects associated with the no-action alternative.

Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative)

Construction Impacts: Alternative 2 would affect both aquatic and terrestrial vegetation at the project site. Within the construction limit area, approximately 4.7 acres (table 22) of terrestrial vegetation and 4.0 acres (table 24) of aquatic vegetation within the 8.7 acres (table 22) of the construction area limits could be affected during construction. Overall, the construction area limits for the project were designed to avoid and minimize impacts to natural resources including impacts by constructing the project in the smallest footprint feasible.

As stated in the "Affected Environment" chapter, a summer 2013 SAV survey indicated that SAV is very sparse in early summer, but much denser in late summer with an areal coverage of up to 70%. The densest area surveyed within the construction area limit was the location of the submerged intake. One of the

codominant species of SAV was southern water nymph, which is listed as a watch list species by MDNR. Impacts on this species are discussed further in the "Special-status Species" section of this chapter. The canal is full of SAV; however, the dominant species in the canal is Hydrilla, a nuisance species.

Installation of temporary cofferdams would require the placement of rock with clay layer/liner and geotextile that would serve as the water barrier. The rock would smother the SAV within the cofferdam resulting in a direct loss of those plants. Placement of the rock would potentially result in the release of fine sediment into the river. This could cause a temporary change in water quality, which could impact the SAV populations that grow in the areas adjacent to the cofferdam locations. The same impacts would occur in areas where embankments would be constructed with direct loss of the plants covered by the rock, and indirect impacts on the SAV in areas adjacent to the embankments occurring from a change in water quality. Approximately 4.0 acres of canal and riverbed would be directly affected by the construction of the cofferdams and embankments, resulting in a loss of SAV (table 22). Culverts and piping would be installed to retain flow in the canal, but the canal would be affected by construction of an embankment. SAV populations could be affected by mortality of some plants within the river and canal. The canal and riverbed material below the cofferdams and embankments would be disturbed during the placement and removal of these structures. Upon completion of construction, the temporary cofferdams and embankments would be removed, potentially causing an additional change in water quality from movement of fine sediments. This could potentially impact SAV in areas adjacent to the construction area limit, but the impacts are expected to be temporary. Natural processes would also restore the canal and riverbed material over a short period of time, and SAV would be expected to recolonize in the area within a few years following removal of the temporary structures built during construction (cofferdams and embankments) since dense SAV exists in adjacent areas of the Potomac River and the canal that would not be disturbed by this project. The impacts on aquatic vegetation from construction and removal of cofferdams and embankments would be short-term minor and adverse, as the impacts would occur in a localized area and would not affect the viability of local populations or overall community size, structure, or composition.

The construction of the boat ramp (in-water portion) and intake structure would result in approximately 0.17 acre of permanent loss of SAV habitat (table 23). SAV would be expected to recolonize the area within a few years following removal of structures to support construction. The construction of the boat ramp and submerged intake structure would cause a loss of aquatic vegetation, which would result in a negligible impact due to the small area affected. Time-of-year restrictions for in-river construction activities would occur from the summer to October 15th in order to minimize impacts to SAV that is located beyond the construction are limits. Cofferdam construction activities can take place year round as long as the placement or removal of the temporary cofferdams is undertaken outside the prescribed time-of-year restriction. Following construction activities, monitoring would be conducted in the Potomac River to document the recovery of SAV in the project area (see "Appendix D: Habitat Restoration Plan" for monitoring details).

Alternative 2 would use tunneling to place the new piping from the submerged intake to the junction vault and from the junction vault to the existing intake structure. Tunneling alone would not have an impact on the terrestrial vegetation; however, all areas within the construction area limit on land are expected to be affected through vegetation removal during construction and would be subject to removal of vegetation and grading. Under alternative 2, approximately 4.7 acres of vegetation would be removed for upland construction (table 22). Permanent vegetation impacts would occur from construction of the boat ramp (on-land portion), parking area, junction vault, and boat ramp access road. The installation of these features would result in 0.31 acre of permanent vegetation loss (table 23). Temporary upland construction features would include the temporary construction access road and portions of the river and canal embankments. Available land within the construction area limit would be used as staging areas and all terrestrial land within the construction area limit would be affected through compaction. Negligible

impacts on terrestrial vegetation would occur from construction of the permanent structures due to the small area affected.

After construction, all materials would be removed from the construction area limit and the site would be prepared for revegetation. Because of the installation of the temporary access road, the use of heavy equipment, and the storage of heavy construction materials, the soils in the construction area limits could be compacted. The soils would be aerated prior to revegetation using techniques such as tilling or ripping. The areas would be restored using native vegetation and would be monitored and managed to prevent colonization by nonnative invasive species. The Habitat Restoration Plan (appendix D) includes a detailed plan for monitoring and managing nonnative invasive species.

Restoration goals would be to revegetate the areas in such a way that they would succeed into the current habitat type, deciduous woodlands. A reforestation plan is included in the Habitat Restoration Plan that describes the mitigation and monitoring process for reforestation. However, vegetation removal within the project area would also create edge habitat along the adjacent woodlands, which would expose formerly interior dwelling vegetation along the edge to a different climate and more sun exposure. These changes could change the composition of vegetation along the new edge, ultimately altering the habitat. Overall, impacts on terrestrial vegetation would result in long-term moderate adverse impacts, as the large area affected would not return to its current state (deciduous woodland) in the period of analysis.

Operational Impacts: Alternative 2 would result in approximately 0.48 acre of permanently lost habitat (0.31 acre of terrestrial habitat and 0.17 acre of aquatic habitat, table 23). Negligible impacts on terrestrial and aquatic vegetation would occur from the permanent structures due to the small area affected. However, the intake's submerged structure could increase local flow velocities upstream of the structure and vortices may form downstream, potentially leading to scour of the surrounding riverbed. Between the intake and Unnamed Island downstream of the structure the velocity would be slower and there is the potential for sedimentation (Black and Veatch 2013). The scouring and sedimentation could have an impact on SAV growth in these areas; however, it is expected to result in a negligible impact on aquatic vegetation.

Lock 13 Wetland Mitigation Site: There would be beneficial impacts to vegetation at the Lock 13 wetland mitigation site. No new wetlands are proposed to be created, the proposed wetland mitigation is considered to be enhancement. Enhancement activities include removing the invasive reed canarygrass and planting native species before the reed canarygrass can re-establish itself. The wetland would be upgraded from an emergent wetland dominated by invasive species to a scrub-shrub/forested wetland composed of native species.

Cumulative Impacts: Other past, present, and future planned actions within and around the project area (MM 17.5) have the potential to impact vegetation. Past planning efforts, such as the park's General Plan established goals for the preservation of the park's natural setting including that outdoor recreation should not intrude upon or impair the resources for which the park was established to protect. The Potomac River watershed restoration projects also benefit vegetation. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stream restoration and enhancement and low impact development which directly benefits vegetation. Aspects of these projects include: stabilizing stream banks and enhancing riparian habitats; constructing wetlands; using features such as bioswales and tree box filters. The Washington Aqueduct dam may be adversely impacting the aquatic vegetation of the Potomac River in the vicinity of MM 17.5. Dams alter flow patterns and over time affect stream channel configuration, fisheries habitat, and many other physical and biological processes. Water quality may be reduced in the impounded portion of the river resulting in excessive nutrients and sediments thereby indirectly affecting aquatic plants.

The overall impacts of these past, current, and future actions on water resources in the vicinity of MM 17.5 would be a combination of beneficial and adverse effects. The beneficial effects of these cumulative actions on vegetation are expected to negate some of the adverse impacts of the dam on aquatic plants. Therefore, the adverse impacts described above are not expected to contribute to the negligible to short-term minor adverse impacts on aquatic vegetation and negligible to long-term moderate adverse impacts on terrestrial vegetation under alternative 2. Cumulative impacts on vegetation in the area of analysis would be negligible to short-term minor adverse impacts on aquatic vegetation and negligible to long-term moderate adverse impacts on terrestrial vegetation.

Conclusion: Aquatic and terrestrial vegetation would be affected by construction of the submerged intake structure, boat ramp, parking area, boat ramp access road, and junction vault. Existing terrestrial vegetation would be removed or destroyed from placement of temporary construction features. While the terrestrial habitat would be revegetated, the impacts on vegetation would be long-term moderate and adverse, as the area would not be restored to current conditions within the period of analysis. The available habitat for both aquatic and terrestrial vegetation would be reduced from construction of permanent features (e.g., intake structure, parking area), resulting in negligible impacts. Negligible impacts would also occur from operation of the intake as areas of riverbed downstream of the intake and between the intake and Unnamed Island are subject to scouring and sedimentation, respectfully, and SAV growth in these areas could be affected.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the negligible to short-term minor adverse impacts on aquatic vegetation and negligible to long-term moderate adverse impacts on terrestrial vegetation under alternative 2.

Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake

Construction Impacts: Alternative 3 would involve installation of the conduits using both open-trench and tunneling construction. Open-trench construction would occur from the submerged intake structure to the vault junction and tunneling would occur from the new vault junction to the existing intake. The open-trench would be constructed within the confines of the cofferdam and the tunneling would be below grade on land.

Trenching would have a greater impact on aquatic vegetation than the tunneling activities that would occur under alternatives 2 and 4. Trenching would alter habitat in the localized area of the trench and would require the construction of a cofferdam for the length and width of the trench, which would increase the affected area. With the direct impacts from installation of the intake and boat ramp cofferdams and the canal and river embankments, there would be a direct loss of SAV and benthic substrate in approximately 5.4 acres of the C&O Canal and Potomac River (table 24). The boat ramp (in-water portion), concrete caps that would cover the conduits in the river, and intake structure would result in approximately 0.30 acre of permanent loss of SAV habitat (table 23). The concrete caps that would cover the conduits in the river and channel would add an additional 0.13 acre of lost habitat. As stated for alternative 2, the submerged intake structure would be located in an area with areal coverage of SAV of up to 70% and in which one of the codominant species is a Maryland watch list species. Following construction activities the surface riverbed material would be restored with sand and gravel similar to existing conditions and natural processes would transport riverbed material from upstream to the affected area once the cofferdam was removed. The impacts on aquatic vegetation from construction and removal of cofferdams and embankments would be short-term moderate and adverse, as the impacts would occur in a small, localized area but the trenching would alter riverbed habitat. Negligible impacts would occur from the permanent loss of aquatic vegetation from installation of the submerged intake and concrete

conduit caps, as the area would be small. Time-of-year restrictions for in-river construction activities would occur from the summer to October 15th in order to minimize impacts to SAV that is located beyond the construction are limits. Following construction activities, monitoring would be conducted in the Potomac River to document the recovery of SAV in the project area (see "Appendix D: Habitat Restoration Plan" for monitoring details).

Under alternative 3, approximately 3.7 acres of terrestrial vegetation would be removed for construction of temporary and permanent features or from the use of the area for staging of construction materials (table 22). Because alternative 3 would require the area of trenching to be completely dewatered, the cofferdam would stop the natural flow of water through the river channel that leads to the existing intake. A portion of Unnamed Island would be excavated and a culvert would be installed, causing water from the Potomac River to flow to the channel, supplying water to the existing intake. The larger cofferdam would also require more terrestrial land clearing than described for alternative 2. The loss of terrestrial habitat for alternative 3 would be the same as alternative 2 (0.31 acre for the parking area, boat ramp - on-land portion, boat ramp access road, and junction vault) (table 23). Under alternative 3, deep excavations and replacement of the overburden would disturb the soil layer and existing seed bank within the soil layers and may result in a change in the species abundance and diversity along the trench. After construction, all temporary features (staging areas, embankments, access roads) would be removed, and the terrestrial habitat would be restored as described for alternative 2. Because the terrestrial vegetation in the project area would not be restored to existing conditions in the period of analysis, the impacts would be long-term moderate and adverse. Restoration goals would be to revegetate the areas in such a way that they would succeed into the current habitat type, deciduous woodlands. A reforestation plan is included in the Habitat Restoration Plan (appendix D) that describes the mitigation and monitoring process for reforestation. The Habitat Restoration Plan also includes a detailed plan for monitoring and managing nonnative invasive species.

Operational Impacts: Alternative 3 would result in approximately 0.51 acre of permanently lost habitat (0.31 acre of terrestrial habitat and 0.17 acre of aquatic habitat). Negligible impacts on terrestrial and aquatic vegetation would occur from the permanent structures due to the small area affected. However, the intake's submerged structures could increase local flow velocities upstream of the structure and vortices may form downstream, potentially leading to scour of the surrounding riverbed. Between the intake and Unnamed Island downstream of the structure the velocity would be slower and there is the potential for sedimentation (Black and Veatch 2013). The scouring and sedimentation could have an impact on SAV growth in these areas; however, it is expected to result in a negligible impact on aquatic vegetation.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 3 would be identical to those under alternative 2. The effects of these actions described above are not expected to contribute to the negligible to short-term moderate adverse impacts on aquatic vegetation and negligible to long-term moderate adverse impacts on terrestrial vegetation under alternative 3. Therefore, the cumulative impacts on vegetation in the area of analysis would be negligible to short-term moderate adverse impacts on aquatic vegetation and negligible to long-term moderate adverse impacts on terrestrial vegetation.

Conclusion: Alternative 3 would result in a permanent loss of both terrestrial and aquatic habitats at the project sites. Construction activities would result in the disturbance of terrestrial land and aquatic habitat; this disturbance would include the removal of vegetation. After construction, the temporary features would be removed and the project area would be restored; however, the impacts on vegetation would be considered long-term moderate and adverse since the project area would not be restored to existing conditions within the time period of this EA. Impacts on aquatic vegetation would be short-term moderate and adverse, as the SAV is expected to re-establish following construction. Additionally, areas of riverbed

downstream of the intake and between the intake and Unnamed Island are subject to scouring and sedimentation, respectfully, and SAV growth in these areas could be affected, resulting in negligible impacts on aquatic vegetation from operation of the intake.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the negligible to short-term moderate adverse impacts on aquatic vegetation and negligible to long-term moderate adverse impacts on terrestrial vegetation under alternative 3.

Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake

Construction Impacts: Alternative 4 would differ from alternatives 2 and 3 in the location of the junction vault. The junction vault would be placed east of the existing intake and the conduits would be tunneled from the new submerged intake northeast to the junction vault.

The submerged intake structure would be located in the same area as described for alternatives 2 and 3 and the impacts would be the same as those described for alternative 2. Approximately 4.5 acres of riverbed would be affected from the implementation of alternative 4 (table 22), resulting in impacts on SAV. SAV would be affected by direct mortality or by changes in the water quality from construction activities. Additionally, SAV would be affected in the canal from the placement of the embankments for the construction access road and temporary towpath. The impacts on aquatic vegetation from construction and removal of cofferdams and embankments would be short-term minor and adverse, as the impacts would occur in a localized area and the construction of the submerged intake and boat ramp (in-water portion) would result in negligible impacts from 0.17 acre of permanently lost aquatic vegetation (table 23). Time-of-year restrictions for in-river construction activities would occur from the summer to October 15th in order to minimize impacts to SAV that is located beyond the construction are limits. Following construction activities, monitoring would be conducted in the Potomac River to document the recovery of SAV in the project area (see "Appendix D: Habitat Restoration Plan" for monitoring details).

Approximately 4.4 acres of terrestrial vegetation would be affected by alternative 4 (table 22). The area would be similar to that for alternative 2, vegetation within the construction area limit would be cleared for construction of temporary features (construction access road) and permanent features (parking area, boat ramp, and boat ramp access road). All other available cleared areas could be used for staging construction materials. After construction, all temporary features (staging areas, embankments, access roads) would be removed, and the terrestrial habitat would be restored as described for alternative 2. Because the terrestrial vegetation in the project area would not be restored to existing conditions in the period of analysis, the impacts would be long-term moderate and adverse. Restoration goals would be to revegetate the areas in such a way that they would succeed into the current habitat type, deciduous woodlands. A reforestation plan is included in the Habitat Restoration Plan (appendix D) that describes the mitigation and monitoring process for reforestation. The Habitat Restoration Plan also includes a detailed plan for monitoring and managing nonnative invasive species.

Operational Impacts: Alternative 4 would result in approximately 0.50 acre of permanently lost habitat (0.33 acre of terrestrial habitat and 0.17 acre of aquatic habitat, table 23). Negligible impacts on terrestrial and aquatic vegetation would occur from the permanent structures due to the small area affected. However, the intake submerged structures could increase local flow velocities upstream of the structure and vortices may form downstream, potentially leading to scour of the surrounding riverbed. Between the intake and Unnamed Island downstream of the structure the velocity would be slower and there is the potential for sedimentation (Black and Veatch 2013). The scouring and sedimentation could have an

impact on SAV growth in these areas; however, it is expected to result in a negligible impact on aquatic vegetation.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 4 would be identical to those under alternative 2. The effects of these actions described above are not expected to contribute to the negligible to short-term minor adverse impacts on aquatic vegetation and negligible to long-term moderate adverse impacts on terrestrial vegetation under alternative 4. Therefore, the cumulative impacts on vegetation in the area of analysis would be negligible to short-term minor adverse impacts on aquatic vegetation and negligible to long-term moderate adverse impacts on terrestrial vegetation.

Conclusion: Alternative 4 would impact aquatic and terrestrial habitat. Removal of aquatic vegetation would result in short-term minor adverse impacts, as the vegetation would recolonize the area following construction. This alternative, like alternatives 2 and 3, would result in a loss of habitat from newly constructed features, including the submerged intake, boat ramp, parking area and boat ramp access road, resulting in negligible impacts. Areas of temporary construction features or staging areas would be allowed to revegetate; however, the areas would not be restored to natural conditions in the period of analysis for this assessment, resulting in long-term moderate adverse impacts. During operation of the submerged intake, areas of riverbed downstream of the intake and between the intake and Unnamed Island are subject to scouring and sedimentation, and SAV growth in these areas could be affected, creating a negligible impact on aquatic vegetation.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the negligible to short-term minor adverse impacts on aquatic vegetation and negligible to long-term moderate adverse impacts on terrestrial vegetation under alternative 4.

AQUATIC AND TERRESTRIAL WILDLIFE

Methodology and Assumptions

Information on the parks' wildlife was gathered from existing data from MDNR and Montgomery County DEP. The wildlife species that occur in the project area and that could be measurably affected by actions proposed in this EA include aquatic macroinvertebrates, fish, mussels, reptiles and amphibians, birds, and mammals.

Wildlife impacts were determined by examining the potential effects of the project activities on native wildlife species, their habitats (including quality, quantity, and distribution of habitats), or the natural processes sustaining them.

Project Area

The geographic project area for aquatic wildlife includes the construction area limit (limit of disturbance) for the project and downstream areas within the Potomac River that could be affected by construction and operation of the project. The geographic project area for terrestrial wildlife includes the construction area limit and adjacent terrestrial areas that provide habitat for wildlife that could be affected by construction of the project.

Impact Thresholds

The following thresholds were used to determine the magnitude of impacts on aquatic and terrestrial wildlife:

Negligible – There would be no observable or measurable impacts on native populations, their habitats, or the natural processes sustaining them. Impacts would be well within natural fluctuations.

Minor – Impacts would be detectable but they would not be expected to be outside the natural range of variability of native populations, their habitats, or the natural processes sustaining them. Mitigation measures, if needed to offset adverse effects, would be simple and successful.

Moderate – Impacts on native species, their habitats, or the natural processes sustaining them would be detectable and could be outside the natural range of variability. Mortality or interference with activities necessary for survival, such as feeding, reproduction, overwintering, or migration, could be expected on an occasional basis, but would not be expected to threaten the continued existence of the species in the park. Mitigation measures, if needed to offset adverse effects, would be extensive and likely successful.

Major – Impacts on native populations, their habitats, or the natural processes sustaining them would be detectable and would be expected to be outside the natural range of variability. Key ecosystem processes might be disrupted. Loss of habitat might affect the viability of at least some native populations. Extensive mitigation measures would be needed to offset any adverse effects and their success would not be guaranteed.

Duration – Short-term impacts occur during the construction phase of the alternative; long-term impacts occur during and beyond implementation of the alternative.

Alternative 1: No-action Alternative

Under alternative 1, there would be no additional adverse effects to wildlife habitat at the site as conditions would remain unchanged. No construction activities would occur and the existing facility would continue to operate as it does under current conditions. Impacts from the existing intake and associated structures to wildlife habitat are expected to be negligible. Wildlife would continue to function naturally at the site and wildlife populations would not be affected.

Cumulative Impacts: The existing intake structure is expected to have a negligible impact on wildlife habitat at the project site, so this alternative would not contribute to the cumulative impacts on wildlife from the compiled list of projects and actions included in the "Cumulative Impacts Analysis Method" section.

Conclusion: The no-action alternative would have a negligible effect on aquatic or terrestrial wildlife at the project site due to the existing intake structure. Since this alternative proposed a negligible change to the project area, there would be no cumulative effects associated with the no-action alternative.

Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative)

Construction Impacts: Under alternative 2, placement of the cofferdams, embankments, and the submerged intake structure would have an impact on aquatic populations. Overall, the construction area limits for the project were designed to avoid and minimize impacts to natural resources by constructing

the project in the smallest footprint feasible. Areas within the in-river and canal construction area limit would be affected directly from construction of the cofferdams and embankments, resulting in approximately 4.0 acres of affected aquatic habitat (table 24). Aquatic wildlife that could be affected includes mussels, macroinvertebrates, and fish. Direct impacts from the cofferdam and embankments would include loss of submerged aquatic vegetation, loss of habitat and individuals of resident macroinvertebrate, aquatic insect, mussel, and fish populations from placement of the rock, dewatering the area, and construction activity. Placement of the cofferdam would be a gradual process involving progressive dumping of material outward from the shore. Some of the more mobile species, particularly fish, would be able to relocate at the onset of activity. Some individuals that remain in the cofferdam area and individuals of less mobile species would be lost during the cofferdam dewatering process. Individuals in areas adjacent to construction could be affected temporarily from changes in water quality from suspension of sediment particles during construction activity and the removal of temporary construction features. During removal of the cofferdams and embankments some substrate material may be removed as the cofferdam is removed. Natural processes would restore the river and canal bed material and aquatic biota would repopulate the area. Impacts from installation and removal of the cofferdams and embankments on aquatic wildlife are expected to be short- to long-term minor and adverse. Time-of-year restrictions for in-river construction activities would occur from March 1 – June 15 in order to protect fish species. Cofferdam construction activities can take place year round as long as the placement or removal of the temporary cofferdams is undertaken outside the prescribed time-of-year restriction. Mussels would be collected and relocated from the construction area limits before construction initiation and would be transferred upstream (about 600 m) to a relocation area and out of any physical disturbance occurring in the Potomac River. Details on mussel mitigation, relocation, and monitoring can be found in the Habitat Restoration Plan (appendix D).

Permanent terrestrial habitat loss under alternative 2 would result from the construction of the boat ramp (on-land portion), parking area, boat ramp access road, junction vault resulting in a loss of 0.31 acre of terrestrial habitat (table 23). The construction of the submerged intake and boat ramp (in-water portion) would result in the loss of 0.17 acre of aquatic habitat (table 23). There would be negligible impacts on terrestrial and aquatic wildlife from these small, localized losses.

As stated in the "Aquatic and Terrestrial Vegetation" section, all upland areas within the construction area limits would be subject to removal of vegetation and grading under alternative 2.This could result in the removal of approximately 4.7 acres of vegetation (table 22). The removal of vegetation would fragment the habitats that exist on either side of the project area along the Potomac River. The impacts on wildlife habitat from fragmentation include the loss of habitat, reduced habitat patch size, and increased edge habitat (USDA 2004). The habitat along the Potomac River is not high quality, as it is already disturbed and fragmented in areas by small roads, trails, and ROW. However, the project area is inhabited with species common to eastern deciduous woodlands, including salamanders, frogs, snakes, turtles, birds, deer, fox, and small mammals. The reduction of habitat from construction would have impacts on wildlife habitat. The fragmentation from vegetation removal in the project area could become an obstruction to movement for less mobile species such as invertebrates, small mammals, reptiles, and amphibians. Loss of habitat connections across a landscape is one of the most severe threats to the survival of many wildlife species (USDA 2004). Vegetation removal within the project area would also create edge habitat along the adjacent woodlands, which would expose formerly interior dwelling vegetation along the edge to a different climate and more sun exposure. These changes could change the composition of vegetation along the new edge, ultimately altering the habitat and affecting the wildlife species that use the habitat and facilitate the spread of nonnative invasive plant species.

Alternative 2 has the potential to affect wildlife through disturbance and direct mortality. Vegetation removal and construction activities could result in direct mortality of less mobile terrestrial species, such as crawling invertebrates and small mammals, as a result of their inability to escape during clearing

activities. Vegetation removal would directly impact wildlife eggs and nests as well. These impacts would occur during preparation for the construction phase of the project but would not be expected to affect the viability of a population. Impacts on wildlife during their breeding seasons could be minimized by planning the vegetation clearing around those species that may be most vulnerable. The more mobile species, such as birds and larger mammals would be displaced upon the onset of vegetation removal. Because the project area would be cleared for construction activities, the area would be unsuitable for most wildlife during construction and an extended period following onset of restoration. Currently, the habitat is deciduous woodlands with many large mature trees. Post-construction, the habitat would be in the very early succession stages and would provide a completely different habitat than currently exists, thus altering the wildlife that would inhabit the area.

After construction, all materials would be removed from the construction area limit and the site would be prepared for revegetation. The areas would be restored using native vegetation and would be monitored and managed to prevent colonization by nonnative invasive species. The Habitat Restoration Plan (appendix D) includes a detailed plan for monitoring and managing nonnative invasive species. Restoration goals would be to revegetate the areas in such a way that they would succeed into the current habitat type, deciduous woodlands. A reforestation plan is included in the Habitat Restoration Plan that describes the mitigation and monitoring process for reforestation. Wildlife would begin to use the area after construction activities are complete and the area replanted with vegetation. Complete restoration would take many years and would extend beyond the scope of this assessment. As the area grows and succeeds toward mature forest, the structure of the habitat would change, supporting different species of wildlife. The terrestrial wildlife species that currently inhabit the project area may not repopulate the area within the scope of this analysis; therefore, impacts are expected to be long-term moderate and adverse.

Operational Impacts: Alternative 2 would result in approximately 0.48 acre of permanently lost habitat – 0.31 acre of terrestrial habitat and 0.17 acre of aquatic habitat (table 23). Beyond the decrease in habitat, the operation of the new submerged intake would not have an impact on terrestrial wildlife. Some aquatic wildlife could be affected by the new intake through scouring of the riverbed, altering the habitat, as well as through impingement and entrainment; however, these impacts are expected to be long-term minor adverse. Depending on the extent of impingement and entrainment operations on the river floor, there could be adverse impacts to native unionid species to recolonize in the area of the new intake.

Lock 13 Wetland Mitigation Site: There would be beneficial impacts to wildlife at the Lock 13 wetland mitigation site. Enhancement activities include removing invasive species and planting native species which would benefit wildlife by enhancing the existing habitat.

Cumulative Impacts: Other past, present, and future planned actions within and around the project area (MM 17.5) have the potential to impact wildlife. Past planning efforts, such as the park's General Plan established goals for the preservation of the park's natural setting including that outdoor recreation should not intrude upon or impair the resources for which the park was established to protect. The Potomac River watershed restoration projects also benefits vegetation. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stream restoration, enhancement, and low impact development which directly and indirectly benefits wildlife. Aspects of these projects include: stabilizing stream banks and enhancing riparian habitats; improving fish passage; improving aquatic habitat conditions; and constructing wetlands. The Washington Aqueduct Dam may be adversely impacting the aquatic communities of the Potomac River in the vicinity of MM 17.5. Dams alter flow patterns and affect stream channel configuration, fisheries habitat, and many other physical and biological processes. Stream changes induced by dams are often reflected in the fish community. Native and desirable stream species are almost always displaced in river segments affected by dams. Dams also limit the normal movement of fish and other aquatic organisms.

The overall impacts of these past, current, and future actions on wildlife in the vicinity of MM 17.5 would have a combination of beneficial and adverse effects. The beneficial effects of these cumulative actions on wildlife are expected to negate some of the adverse impacts of the dam on fish and other aquatic organisms. Therefore the adverse impacts described above are not expected to contribute to the negligible and short- to long-term minor to moderate adverse impacts on aquatic wildlife and negligible to long-term moderate adverse impacts on terrestrial wildlife under alternative 2. Cumulative impacts on wildlife in the area of analysis would be negligible and short- to long-term minor to moderate adverse impacts on aquatic wildlife and negligible to long-term moderate adverse impacts on terrestrial wildlife.

Conclusion: Alternative 2 would result in a permanent loss of both terrestrial and aquatic habitats at the project sites. The loss of permanent habitat would be small and localized and therefore negligible. Construction activities would result in the disturbance of terrestrial land and aquatic habitat. Removal of vegetation and disturbance of substrate in these areas would affect wildlife through direct mortality or displacement. After construction, the temporary features would be removed and the project area would be restored. Aquatic species are expected to return to the disturbed areas as natural processes build up the streambed and SAV is established again. The composition of aquatic wildlife may differ from current conditions as conditions would be similar but not exactly the same. Impacts on aquatic wildlife species are expected to be short- to term minor and adverse. Terrestrial habitat areas would be revegetated following construction, but would not succeed to the deciduous woodlands currently present at the project site within the scope of this analysis. Therefore, the wildlife species that populate the area are not expected to mirror those that inhabit the area currently. Impacts on terrestrial wildlife species are expected to be long-term moderate and adverse. Operation of the submerged intake would result in long-term minor adverse impacts from scouring of the substrate and possible impingement/entrainment.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the negligible and short- to long-term minor to moderate adverse impacts on aquatic wildlife and negligible to long-term moderate adverse impacts on terrestrial wildlife under alternative 2.

Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake

Construction Impacts: The types of impacts on wildlife and wildlife habitat under alternative 3 would be similar to those described for alternative 2; however, alternative 3 would have added impacts from trenching activities. A larger cofferdam would be required for installing the conduits from the submerged intake to the vault junction because trenching would be the employed installation method. Areas within the in-river and canal construction area limit would be affected directly from construction of the cofferdams and embankments, resulting in approximately 5.4 acres of affected aquatic habitat (table 24). The SAV would be removed and in the area of trenching, the bedrock would be excavated, creating greater impacts. Mobile species would likely vacate the construction areas; however, individuals that remain in the area and less mobile species would suffer direct mortality during placement of the cofferdam/embankment materials or during dewatering. Following construction, the trenched area would be restored using gravels and sand similar to the existing streambed. The cofferdam and embankment materials would be removed and the areas allowed to return to natural conditions. Natural processes would transport sediment from upstream and deposit them in the disturbed areas and SAV would revegetate. As restoration progresses, aquatic wildlife species would begin to use the area; however, both vegetation and wildlife species may differ from current composition due to changes in the construction areas. Impacts from installation and removal of the cofferdams and embankments on aquatic wildlife are expected to be short- to long-term minor and adverse. Time-of-year restrictions for in-river construction activities would occur from March 1 – June 15 in order to protect fish species. Mussels would be collected and relocated from the construction area limits before construction initiation and would be transferred upstream (about 600 m) to a relocation area and out of any physical disturbance occurring in

the Potomac River. Details on mussel mitigation, relocation, and monitoring can be found in the Habitat Restoration Plan (appendix D).

Permanent terrestrial habitat loss under alternative 3 would result from the construction of the boat ramp (on-land portion), parking area, and boat ramp access road, resulting in a loss of 0.31 acre of terrestrial habitat (table 23). The in-water portion of the boat ramp and the submerged intake and concrete caps that would cover the conduits in the river and channel would account for approximately 0.30 acre of permanently lost aquatic habitat (table 23). There would be negligible impacts on terrestrial and aquatic wildlife from these losses, as they would be in small localized areas.

Alternative 3 would impact approximately 3.7 acres of terrestrial habitat (table 22), thus impacting terrestrial wildlife. The impacts would be the same as those described for alternative 2: direct mortality of less mobile species (e.g., crawling insects, some reptiles, and small mammals), eggs and nests; and displacement of more mobile species such as flying insects, birds, and larger mammals. Removal of vegetation would likely be complete within the construction area limit, as all areas would be used for permanent or temporary features or staging areas. Deep excavations such as those that would be needed to install the conduits and the culvert and embankment on Unnamed Island would disturb the existing seed bank within the soil layers and may result in a change in species abundance and diversity along the trench. All ground disturbance, particularly trenching and tree removal, would increase the likelihood of nonnative invasive plants replacing the existing native vegetation. The Habitat Restoration Plan (appendix D) includes a detailed plan for monitoring and managing nonnative invasive species. The entire disturbed area would be restored by replacement of topsoil and revegetation would occur with native species including both shrubs and trees. A reforestation plan is included in the Habitat Restoration Plan that describes the mitigation and monitoring process for reforestation. As stated for alternative 2, wildlife species would begin to repopulate the project area after completion of construction; however, the species composition would change as the habitat ages. The habitat would not be restored to current conditions in the period of this analysis; therefore, wildlife populations would likely not return to their current conditions. Impacts on terrestrial wildlife would be long-term moderate and adverse.

Operational Impacts: Alternative 3 would result in the permanent loss of approximately 0.30 acre of aquatic habitat and 0.31 acre of terrestrial habitat (table 23). Beyond the decrease in habitat, the operation of the new submerged intake would not have an impact on terrestrial wildlife. Some aquatic wildlife could be affected by the new intake through scouring of the riverbed, altering the habitat, as well as through impingement and entrainment; however, these impacts are expected to be long-term minor adverse.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 3 would be identical to those under alternative 2. The effects of these actions described above are not expected to contribute to the negligible and short- to long-term minor to moderate adverse impacts on aquatic wildlife and negligible to long-term moderate adverse impacts on terrestrial wildlife under alternative 3. Therefore, the cumulative impacts on wildlife in the area of analysis would be negligible and short- to long-term minor to moderate adverse impacts on aquatic wildlife and negligible to long-term moderate adverse impacts on terrestrial wildlife.

Conclusion: Under alternative 3, a permanent loss of both terrestrial and aquatic habitats at the project sites would occur. This alternative would result in a loss of habitat from newly constructed features, including the submerged intake, boat ramp, parking area and boat ramp access road. Impacts from loss of habitat would result in negligible impacts on aquatic and terrestrial wildlife. Construction would affect wildlife through direct mortality or dispersal. Areas of temporary construction features or staging areas would be allowed to revegetate; however, the areas would not be restored to natural conditions in the period of analysis for this assessment, resulting in long-term impacts for the wildlife as well as the

habitat. Impacts on terrestrial wildlife would be long-term moderate and adverse. Operation of the submerged intake would result in long-term minor adverse impacts from scouring of the substrate near the intake and possible impingement/entrainment of aquatic wildlife.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the negligible and short- to long-term minor to moderate adverse impacts on aquatic wildlife and negligible to long-term moderate adverse impacts on terrestrial wildlife under alternative 3.

Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake

Construction Impacts: Impacts under alternative 4 would be similar to those described for alternative 2. The junction vault would be located to the east of the existing intake, but construction methods would be the same (tunneling to install the conduits) and all of the temporary construction elements (cofferdams, embankments, and access road) would be similar.

The submerged intake structure and permanent terrestrial features would be located in the same area as described for alternatives 2 and 3 and the impacts would be the same as those described for alternative 2, negligible. Areas within the canal and in-river construction area limit would be affected directly from construction of the cofferdams and embankments (including the embankment needed for the relocation of the temporary towpath), resulting in approximately 4.5 acres of affected aquatic habitat (table 24). Immobile species would suffer direct mortality from placement of cofferdam and embankment materials in the water and by dewatering of the areas within the cofferdams. Mobile species would be displaced from these construction areas. Impacts from installation and removal of the cofferdams and embankments on aquatic wildlife are expected to be short- to long-term minor and adverse. Time-of-year restrictions for in-river construction activities would occur from March 1 – June 15 in order to protect fish species. Mussels would be collected and relocated from the construction area limits before construction initiation and would be transferred upstream [about 2000 feet (600 m)] to a relocation area and out of any physical disturbance occurring in the Potomac River. Details on mussel mitigation, relocation, and monitoring can be found in the Habitat Restoration Plan (appendix D).

Approximately 4.4 acres of terrestrial vegetation would be affected by alternative 4 (table 22). The area affected would be similar to that for alternative 2; however, an additional piece of land would be required east of the existing intake to facilitate the installation of the vault junction. Similar to aquatic species, mobile terrestrial species would be displaced and immobile species would suffer mortality during vegetation removal and construction. Nests and eggs of ground nesting species could also be affected by heavy construction equipment and materials. After construction is complete, all construction materials would be removed and the areas restored. A reforestation plan is included in the Habitat Restoration Plan (appendix D) that describes the mitigation and monitoring process for reforestation. Ground disturbance, particularly tree removal, would increase the likelihood of nonnative invasive plants replacing the existing native vegetation. The Habitat Restoration Plan includes a detailed plan for monitoring and managing nonnative invasive species. The composition of the wildlife populations could differ from current conditions because the aquatic habitat would be altered and the terrestrial habitat would not be fully restored in the period of this analysis; therefore, wildlife populations would likely not return to their current conditions. Impacts on terrestrial wildlife would be long-term moderate and adverse.

Operational Impacts: Alternative 4 would result in the permanent loss of approximately 0.17 acre of aquatic habitat and 0.33 acre of terrestrial habitat (table 23). Beyond the decrease in habitat, the operation of the new submerged intake would not have an impact on terrestrial wildlife. Some aquatic wildlife could be affected by the new intake through scouring of the riverbed, altering the habitat, and impingement/entrainment; however, these impacts are expected to be long-term minor adverse.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 4 would be identical to those under alternative 2. The effects of these actions described above are not expected to contribute to the negligible and short- to long-term minor to moderate adverse impacts on aquatic wildlife and negligible to long-term moderate adverse impacts on terrestrial wildlife under alternative 4. Therefore the cumulative impacts on wildlife in the area of analysis would be negligible and short- to long-term minor to moderate adverse impacts on aquatic wildlife and negligible to long-term moderate adverse impacts on terrestrial wildlife.

Conclusion: Aquatic and terrestrial habitats would be permanently reduced by construction of the submerged intake structure, the boat ramp, the parking area, the boat ramp access road, and the junction vault, thus affecting the wildlife that inhabit the area, resulting in negligible impacts. Existing habitats would also be removed or destroyed due to placement of temporary construction features. Impacts on aquatic wildlife would be short- to long-term minor and adverse from mortality or displacement. While the affected terrestrial areas would be restored, the project would have long-term impacts on wildlife because the habitats would be altered from their current conditions. Impacts on terrestrial wildlife would be long-term moderate and adverse. Operation of the submerged intake would result in long-term minor adverse impacts from scouring of the substrate near the intake and possible impingement/entrainment of aquatic wildlife.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the negligible and short- to long-term minor to moderate adverse impacts on aquatic wildlife and negligible to long-term moderate adverse impacts on terrestrial wildlife under alternative 4.

SPECIAL-STATUS SPECIES

Methodology and Assumptions

Section 7 of the ESA mandates all federal agencies to determine how to use their existing authorities to further the purposes of the Act to aid in recovering listed species, and to address existing and potential conservation issues. Section 7(a)(2) states that each federal agency shall, in consultation with the Secretary of the Interior, ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. NPS Management Policies 2006 (NPS 2006) state that potential effects of agency actions would also be considered for state or locally-listed species. In this section, special-status species (rare, threatened, and endangered species) include wildlife and plants that are federally- or state-listed, proposed, or candidates for listing, and other species of concern within C&O Canal NHP that are rare or otherwise merit special consideration.

In order to evaluate potential impacts on special-status species that have been documented or have the potential to occur within the proposed project area, several natural resource surveys were conducted through coordination with USFWS and MDNR. Three seasonal rare, threatened, and endangered plant species surveys were conducted in the spring, summer, and fall of 2013. In August 2013, a qualitative freshwater mussel survey was conducted in the Potomac River to determine the presence of live bivalves in the project area. Two SAV surveys were conducted: one in early summer and the second in late summer, 2013. In September 2014, a floating paspalum survey was conducted in the locations where the species was found in 2013 as well as additional upstream locations.

The primary means of evaluation for special-status species was the documented occurrence during surveys, the habitat preference of the federal- or state-listed species, and the availability of the preferred habitats within the project area and surrounding land.

Project Area

The geographic project area for aquatic special-status species includes the construction area limit (limit of disturbance) for the project and downstream areas within the Potomac River that could be affected by construction and operation of the project. The geographic project area for terrestrial special-status species includes the construction area limit and adjacent terrestrial areas that provide habitat for wildlife that could be affected by construction of the project.

Impact Thresholds

The following thresholds were used to determine the magnitude of impacts on state-listed special-status species:

Negligible – No special-status species would be affected, or the action would affect an individual or its habitat, but the change would be so small that it would not be of any measurable or perceptible consequence to the individual or its population.

Minor – The action would result in detectable impacts on an individual(s), their habitat, or to the natural processes sustaining them but the effects would be limited and localized. Sufficient habitat would remain functional to maintain the viability of the population. Mitigation measures, if needed to offset adverse effects, would be simple and successful.

Moderate – The action would result in detectable impacts on individuals or a relatively small proportion of the population, habitat, or the natural processes sustaining them over a large area. Impacts would have limited changes to population demographics (e.g., population numbers, structure) but would not affect the viability of the population. Mitigation measures, if needed to offset adverse effects, could be extensive, but would likely be successful.

Major – Populations, habitat, or the natural processes sustaining them would be measurably affected such the viability of the population would likely be affected. Extensive mitigation measures would be needed to offset any adverse effects and their success would not be guaranteed.

Duration – Short-term impacts occur during the construction phase of the alternative; long-term impacts occur during and beyond implementation of the alternative.

The following thresholds were used to determine the magnitude of impacts on federally-listed special-status species as required for Section 7 ESA consultation:

No effect:	A proposed action would not affect a federally listed species, candidate species, or designated critical habitat.
May affect, not likely to adversely affect:	Effects on federally listed or candidate species would be discountable (i.e., extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or would be beneficial.

May affect, likely to adversely affect:	Adverse effects on a federally listed or candidate species may occur as a direct or indirect result of proposed actions and the effects would be either not discountable or not beneficial.
Likely to jeopardize proposed species or adversely modify proposed critical habitat (impairment):	The appropriate conclusion when the NPS or the USFWS identifies situations in which the proposal could jeopardize the continued existence of a federally listed or candidate species or adversely modify critical habitat for a species within or outside park boundaries.

Alternative 1: No-action Alternative

Under alternative 1, no additional effects to special-status species are expected at the site as conditions would remain unchanged. No construction activities would occur and the existing facility would continue to operate as it does under current conditions. Impacts from the existing intake and associated structures to special-status species are expected to be negligible. Special-status species would continue to function naturally at the site and populations would not be affected.

Cumulative Impacts: The existing intake structure is expected to have a negligible impact on special-status species at the project site, so this alternative would not contribute to the cumulative impacts on special-status species from the compiled list of projects and actions included in the "Cumulative Impacts Analysis Method" section.

Conclusion: The no-action alternative would have a negligible effect on special-status species at the project site due to the existing intake structure. Since this alternative proposed a negligible change to the project area, there would be no cumulative effects associated with the no-action alternative.

Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative)

Overall, the construction area limits for the project were designed to avoid and minimize impacts to natural resources including special-status species by constructing the project in the smallest footprint feasible.

Construction Impacts: Alternative 2 has the potential to impact four special-status plant species of concern and one federally-listed wildlife species identified in the "Affected Environment" chapter.

Southern water nymph is a floating plant species that was observed within the Potomac River along the shoreline in the area of the proposed boat ramp and along the shoreline of Unnamed Island during 2013 surveys. This species would not be directly affected by any terrestrial activities. The construction of the temporary construction features (cofferdams and embankments) would result in the release of fine sediment into the river. This could cause a temporary change in water quality, which could impact the aquatic plant populations; however, this impact would be temporary. The water quality would be temporarily disrupted again when the cofferdam and embankment materials are removed from the river. Impacts on southern water nymph, a watch list species, under alternative 2 would be negligible. To clarify, species that are listed on state watch lists are not considered threatened or endangered by federal standards.

Floating paspalum (state endangered species) and halberd-leaved hibiscus (watch list species) were observed along the shoreline of Unnamed Island as well as the shoreline in the area of the proposed boat ramp. The entire shoreline of Unnamed Island and most of the shoreline west of the existing intake would be affected during construction. Vegetation would be removed for temporary and permanent construction features and staging of construction materials. Alternative 2 would result in 0.03 acre of permanently lost shoreline habitat in the area where the in-water portion of the boat ramp would be constructed (table 23). Since there would be a permanent loss of shoreline habitat due to the boat ramp, impacts on halberd-leaved hibiscus and floating paspalum would be considered adverse. The temporary loss of shoreline habitat for the construction of temporary features such as the cofferdams and embankments would also affect these two species resulting in adverse impacts due to complete vegetation clearing of 4.7 acres for the temporary features.

Since floating paspalum is a state endangered species, additional surveys for this species were conducted to determine the extent of the species along the Potomac River in the vicinity of the project area to better understand the context of the potential impacts and the opportunity for recolonization of the species following construction. The results of the survey found that a large population of floating paspalum exists outside of the construction areas limits. It is therefore likely that floating paspalum would not have trouble reestablishing its population in the project area following construction. In addition, time-of-year restrictions for in-river construction would occur during dormancy (winter) of floating paspalum to protect this state endangered species. The reestablishment of halberd-leaved hibiscus is also expected after construction and the time-of-year restrictions for floating paspalum would also be beneficial to halberd-leaved hibiscus. Since there would be complete restoration of the project area, reestablishment is expected for both species, and with time-of-year restrictions the impacts on floating paspalum and halberd-leaved hibiscus would be long-term minor and adverse.

For long term protection, monitoring of floating paspalum would occur following completion of construction activities to document the reestablishment of this species in the project area. The Habitat Restoration Plan (appendix D) includes details on monitoring protocols for floating paspalum.

Rough avens, a watch list species, was observed within the understory of the area west of the existing intake facility. This area would be cleared for construction of permanent features (on-land portion of the boat ramp, parking area, boat ramp access road, and vault junction) resulting in approximately 0.31 acre of lost habitat. Impacts on rough avens would be adverse due to vegetation clearing for these permanent features. Following construction, the areas cleared for temporary features would be restored through revegetation (see “Appendix D: Habitat Restoration Plan”) and it is likely that this species would reestablish itself. In addition, if rough avens plants are available for purchase through a nursery at the time of restoration, then this species would be included on the replanting list of native vegetation. Since there would be restoration of the project area, reestablishment is expected for this species, and rough avens (if nursery stock is available for this species) would be included on the restoration replanting list, the impacts on rough avens would be long-term minor and adverse.

In addition to plant species, alternative 2 has the potential to impact one special-status wildlife species of concern, the federally-listed northern long-eared bat (NLEB). During the summer, NLEBs roost singly or in colonies underneath bark, in cavities or in crevices of both live trees and dead trees and the bats roost in trees based on their suitability to retain bark or provide cavities or crevices (USFWS 2015b). Approximately 4.7 acres of vegetation (e.g., trees, shrubs, and invasives) would be removed for construction under alternative 2. Deciduous trees including the American sycamore, boxelder, red maple, silver maple, red oak, and sawtooth oak dominate at the project site. After construction, the area would be restored using native vegetation and would be monitored and managed to prevent colonization by nonnative invasive species (see “Appendix C: Habitat Restoration Plan”). Restoration goals would be to revegetate the areas in such a way that they would succeed into the current habitat type, deciduous

woodlands; however, the area affected would not return to its current state (deciduous woodland) in the period of analysis. In consultation with the USFWS, it has been determined that the proposed project will "*not likely to adversely affect*" the northern long-eared bat given that vegetation clearing will not occur between April 15 and August 30 (see appendix B for USFWS consultation).

Operational Impacts: Alternative 2 would result in the permanent loss of approximately 0.31 acre of terrestrial habitat (table 23). Beyond the decrease in habitat, the operation of the new submerged intake would not have an impact on terrestrial special-status plant species. The aquatic special-status species of concern are floating plants; therefore, the loss of riverbed from the submerged intake would not affect them.

Lock 13 Wetland Mitigation Site: No special-status species are expected to be effected by the proposed enhancement since no special-status species are known to occur at this site.

Cumulative Impacts: Other past, present, and future planned actions within and around the project area (MM 17.5) have the potential to impact special-status species. Past planning efforts, such as the park's General Plan established goals for the preservation of the park's natural setting including that outdoor recreation should not intrude upon or impair the resources of for which the park was established to protect. The Potomac River watershed restoration projects also benefit special-status species. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stream restoration and enhancement and low impact development which directly benefits special-status species. Aspects of these projects include: stabilizing stream banks and enhancing riparian habitats; constructing wetlands; using features such as bioswales and tree box filters. The Washington Aqueduct dam may be adversely impacting the aquatic vegetation of the Potomac River in the vicinity of MM 17.5. Dams alter flow patterns and over time affect stream channel configuration, fisheries habitat, and many other physical and biological processes. Water quality may be reduced in the impounded portion of the river resulting in excessive nutrients and sediments thereby indirectly affecting aquatic special-status species.

The overall impacts of these past, current, and future actions on special-status species in the vicinity of MM 17.5 would be a combination of beneficial and adverse effects. The beneficial effects of these cumulative actions on special-status species is expected to negate some of the adverse impacts of the dam on aquatic special-status species. Therefore, the adverse effects of the actions described above are not expected to contribute to the negligible to long-term minor and adverse impacts on special-status species under alternative 2. Cumulative impacts on special-status species in the area of analysis would be negligible to long-term minor and adverse impacts.

Conclusion: Alternative 2 would impact four special-status species plants and potentially impact one federally-listed wildlife species. Removal of vegetation at the site could potentially affect the northern long-eared bat. Construction of temporary and permanent construction features would impact terrestrial plants by direct mortality. Aquatic species (southern water nymph) would be affected through changes in water quality; however, these impacts are expected to be short-term and negligible. Impacts on terrestrial special-status species would affect entire populations of the plants in the project area. When the beneficial impacts from complete restoration of the project area, expected reestablishment for special-status plant species, and time-of-year restrictions are considered, the impacts on floating paspalum, halberd-leaved hibiscus, and rough avens would be long-term minor and adverse. When time-of-year restrictions are considered for the northern long-eared bat it has been determined through consultation with USFWS that the proposed project will "*not likely to adversely affect*" the bat.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the negligible to long-term minor and adverse impacts on special-status species under alternative 2.

Alternative 3: Trenching/Tunneling to Onshore Shaft – West of Existing Intake

Construction Impacts: Impacts on special-status species under alternative 3 would be similar to those described for alternative 2. Impacts on terrestrial plant species (floating paspalum, halberd-leaved hibiscus, and rough avens) would be the same as described for alternative 2. Approximately 3.7 acres of vegetation (e.g., trees, shrubs, and invasives) would be removed in order to construct temporary features such as the construction access road. These areas would be revegetated following construction. Approximately 0.31 acre of terrestrial habitat would be lost to construction of permanent features (table 23). Since there would be a permanent loss of habitat, impacts on these species would be considered adverse. In consultation with the USFWS, it has been determined that the proposed project will "*not likely to adversely affect*" the northern long-eared bat given that vegetation clearing will not occur between April 15 and August 30 (see appendix B for USFWS consultation).

Under alternative 3, the area of aquatic impacts would be greater because of the need to fully dewater the area to be trenched. Plants would be lost during the construction of the cofferdam and embankments. Southern water nymph, a floating aquatic plant, would not be able to float through the channel, reducing available habitat; however, impacts are expected to be negligible to this species.

The impacts on floating paspalum, halberd-leaved hibiscus, and rough avens would be reduced through complete restoration of the project area, expected reestablishment for these special-status species, and time-of-year restrictions resulting in long-term minor and adverse impacts.

Operational Impacts: Alternative 3 would result in the permanent loss of approximately 0.31 acre of terrestrial habitat. Beyond the decrease in habitat, the operation of the new submerged intake would not have an impact on terrestrial special-status plant species. The aquatic special-status species of concern are floating plants; therefore the loss of riverbed from the submerged intake would not affect them.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 3 would be identical to those under alternative 2. The effects of these actions described above are not expected to contribute to the negligible to long-term minor adverse impacts on special-status species under alternative 3. Therefore the cumulative impacts on special-status species in the area of analysis would be negligible to long-term minor and adverse.

Conclusion: Alternative 3 would impact four special-status species plants and potentially impact one federally-listed wildlife species. Removal of vegetation at the site could potentially affect the northern long-eared bat. Construction of temporary and permanent construction features would impact terrestrial plants by direct mortality. Aquatic species (southern water nymph) would be affected through changes in water quality and temporary loss of habitat through dewatering; these impacts would be negligible. Impacts on terrestrial special-status species would affect entire populations of the plants in the project area. When the beneficial impacts from complete restoration of the project area, expected reestablishment for special-status species, and time-of-year restrictions are considered, the impacts on floating paspalum, halberd-leaved hibiscus, and rough avens would be long-term minor and adverse. When time-of-year restrictions are considered for the northern long-eared bat it has been determined through consultation with USFWS that the proposed project will "*not likely to adversely affect*" the bat.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the negligible to long-term minor and adverse impacts on special-status species under alternative 3.

Alternative 4: Tunneling to Onshore Shaft – East of Existing Intake

Construction Impacts: Impacts under alternative 4 would be nearly identical to those described under alternative 2. Southern water nymph would not be directly affected by construction; however, placement and removal of material for the cofferdams and embankments would temporarily change the water quality, potentially affecting this species, resulting in negligible impacts.

The special-status terrestrial plants (floating paspalum, halberd-leaved hibiscus, and rough avens) would be affected through vegetation removal, and construction of temporary and permanent project features. Approximately 4.4 acres of vegetation (e.g., trees, shrubs, invasives) would be removed from the site for construction and approximately 0.33 acre of terrestrial habitat would be permanently lost to the construction of the boat ramp, parking area and the boat ramp access road (table 23). An additional 0.10 acre would be lost from the construction of the junction vault east of the existing intake structure (table 23); however, no special-status species were observed in this area. Impacts would be adverse due to the construction of permanent structures on the site. In consultation with the USFWS, it has been determined that the proposed project will "*not likely to adversely affect*" the northern long-eared bat given that vegetation clearing will not occur between April 15 and August 30 (see appendix B for USFWS consultation).

The impacts on floating paspalum, halberd-leaved hibiscus, and rough avens would be reduced through complete restoration of the project area, expected reestablishment for these special-status species, and time-of-year restrictions resulting in long-term minor and adverse impacts.

Operational Impacts: Alternative 4 would result in the permanent loss of approximately 0.33 acre of terrestrial habitat (table 23). Beyond the decrease in habitat, the operation of the new submerged intake would not have an impact on terrestrial special-status plant species. The aquatic special-status species of concern are floating plants; therefore, the loss of riverbed from the submerged intake would not affect them.

Cumulative Impacts: Past, present, and reasonably foreseeable future actions that have the potential for cumulative impacts under alternative 4 would be identical to those under alternative 2. The effects of these actions described above are not expected to contribute to the negligible to long-term minor and adverse impacts on special-status species under alternative 4. Therefore the cumulative impacts on special-status species in the area of analysis would be negligible to long-term minor and adverse.

Conclusion: Alternative 4 would impact four special-status species plants and potentially impact one federally-listed wildlife species. Removal of vegetation at the site could potentially affect the northern long-eared bat. Construction of temporary and permanent construction features would impact terrestrial plants by direct mortality. Aquatic species (southern water nymph) would be affected through changes in water quality and temporary loss of habitat through dewatering; these impacts would be negligible. Impacts on terrestrial special-status species would affect entire populations of the plants in the project area. When the beneficial impacts from complete restoration of the project area, expected reestablishment for special-status species, and time-of-year restrictions are considered, the impacts on floating paspalum, halberd-leaved hibiscus, and rough avens would be long-term minor and adverse. When time-of-year restrictions are considered for the northern long-eared bat it has been determined through consultation with USFWS that the proposed project will "*not likely to adversely affect*" the bat.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the negligible to long-term minor and adverse impacts on special-status species under alternative 4.

SCENIC RESOURCES – AESTHETICS AND VIEWSHEDS

Methodology and Assumptions

The NPS *Management Policies 2006* includes scenic views in the definition of park resources: "Natural resources, processes, systems, and values found in parks include highly valued associated characteristics, such as scenic views."

Impacts on the visual aesthetics and viewsheds were determined by considering the effect of the proposed construction and operation of the project on the visual experience of park visitors.

Project Area

The project area for scenic resources includes the immediate location of the construction area limit (limit of disturbance) and where viewsheds extend into the surrounding area.

Impact Thresholds

The following thresholds were used to determine the magnitude of impacts on scenic resources:

Negligible – Visual quality would not be measurably altered from existing conditions. Few visitors would be affected by the change.

Minor – Visual quality would be measurably altered from existing conditions. More than a few visitors would be affected by the change. Visitors would notice the change but visitor satisfaction would remain stable.

Moderate – Visual quality would be measurably altered from existing conditions. Many visitors would be affected by the change. Some visitors who want to continue using and enjoying the C&O Canal NHP in the vicinity of the proposed project might pursue their choices in other areas of the park. Visitor satisfaction would begin to decline.

Major – Visual quality would be measurably altered from existing conditions. The majority of visitors would be affected by the change. Visitors who want to continue using and enjoying the C&O Canal NHP might pursue their choices in other available local or regional areas. Visitor satisfaction would markedly decline.

Duration – Short-term impacts occur during the construction phase of the alternative; long-term impacts occur during and beyond implementation of the alternative.

Alternative 1: No-action Alternative

Currently, the aesthetics along the towpath in the vicinity of the Potomac WFP are affected by structures belonging to the water treatment plant. The towpath viewshed consists mainly of forested or grassed areas along most of the WSSC property, which shields most of the water treatment plant's structures from sight. However, there is a bridge and paved road that cross above the towpath and canal for WSSC to access the existing intake along the Potomac River. The road to the intake south of the towpath is lined with a solid fence that is visible from the towpath, and portions of the WFP raw water pumping stations

are visible looking uphill through a thinly forested area and a chain-link fence located north of the towpath and canal.

The viewshed for boaters on the Potomac River differs from that of the towpath. Boaters have a greater field of vision due to the open nature of the river. The project area only affects approximately 0.2-mile of the towpath, as much of the development on the WSSC property is screened by forested area. However, boaters can see the project area from a greater distance.

Impacts on both towpath and river-users would be long-term minor and adverse due to the presence of the existing WFP structures resulting in modification of the natural habitat.

Cumulative Impacts: Other past, present, and future planned actions 10 miles to the north and 10 miles to the south of the project area (MM 17.5) have the potential to impact the scenic resources of the park from the perspective of visitors on the towpath and boaters on the Potomac River. Past planning efforts, such as the park's General Plan established goals for the preservation of the park's natural setting including that outdoor recreation should not intrude upon or impair the resources for which the park was established to protect. The Potomac River watershed restoration projects also benefit scenic resources. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stream restoration and enhancement which indirectly benefits scenic resources. Aspects of these projects include stabilizing stream banks, enhancing riparian habitats, and constructing wetlands. Repairing canal structures, water areas, and Locks 5 to 22 indirectly benefits the scenic resources of the park. Historic canal features must be in good condition for the interpretive canal boat program, and other interpretive and educational resources for visitors.

The towpath viewshed in the cumulative project area consists mainly of forested areas located along the towpath, which shields most of the nearby developments from sight. However, there are several noticeable developments along the towpath that would adversely affect the scenic resources of visitors on the towpath or in boats in the river. Utility corridor ROWs and the Capital Beltway cross above the towpath and Potomac River. Other developments visible to visitors on the towpath include structures associated with WSSC's Potomac WFP including a bridge, paved road, fence, and portions of the WFP raw water pumping stations. Adverse impacts from these developments to scenic resources would add to the long-term minor adverse impacts of the existing WFP structures. However, cumulative impacts are not expected to increase to moderate when the beneficial effects of the other cumulative actions discussed above are factored into the analysis. These beneficial effects would help to negate some of these adverse impacts; therefore, cumulative impacts on scenic resources in the area of analysis would be long-term minor and adverse.

Conclusion: Under alternative 1, the scenic resources would remain unchanged. Within the project area, the viewshed is a combination of wooded and grassed areas, interrupted by development in the WSSC property resulting in a long-term minor and adverse impact on the scenic resources.

Cumulative impacts on scenic resources in the area of analysis would be long-term minor and adverse. Cumulative impacts are not expected to increase to moderate when the beneficial effects of the other cumulative actions are factored into the analysis.

Impacts of the Action Alternatives

The impacts from construction and operation of the proposed submerged intake would be similar under the action alternatives. While the methods of construction would be different, the differences between alternatives would be minimal.

Construction Impacts: During the construction phase of the project, a fence would be installed along both sides of the towpath for the length of the project area. This fence would be installed prior to onset of construction and would remain until construction was complete, approximately 4 years for alternatives 2 and 3 and 4.5 years for alternative 4. This fence would obscure or block visitors on the towpath from seeing all phases of the construction south of the towpath, or the area between the towpath and the Potomac River. These construction activities include vegetation removal, building of temporary access roads, staging of large amounts of construction materials, installing temporary cofferdams and embankments, trenching and tunneling for installation of the conduits, constructing permanent features (submerged intake, junction vault, boat ramp, parking area and boat ramp access road), removing all of the temporary construction features (cofferdams, embankments, and access roads), and initiating revegetation efforts. Visitors would see an exclusion fence instead of forested area for approximately 0.2-mile along the towpath in the project area. The viewshed for visitors on the towpath would be affected north of the towpath as well. Two embankments would be constructed in the canal to support the temporary access road. These embankments would be built using culverts with a pipe connecting them to maintain flow in the channel past the work areas. These features would be blocked or obscured by fence, which would change the viewshed. The view of the canal from the towpath is not blocked by trees; therefore, visitors on the towpath would be able to see the fence and possibly the embankments and piping from a distance, not just as they pass the project area.

Boaters would be affected by the action alternatives differently than those visitors who use the towpath, as they would have a different viewshed. Boaters would see the project area from the Potomac River, where a fence would not be constructed to block the view during construction. All aspects of construction would be visible to boaters, except the embankments and piping in the canal. Boaters would be able to see the transition of the project area from deciduous woodlands to a construction site, with little to no remaining vegetation, temporary access roads, cofferdams, embankments, material staging areas, and construction vehicles. While the affected area is small, encompassing approximately 0.2-mile of the river, boaters would have an unobstructed view of the project area from upstream of the project area.

Impacts on both towpath and river-users would be short-term moderate and adverse due to the presence of construction equipment and fencing and construction features. Impacts would be long-term moderate and adverse due to modification of the natural habitat.

Operational Impacts: Once construction is complete, all temporary construction features would be removed, the soils would be restored, and revegetation would be initiated. The areas would be restored using native vegetation and would be monitored and managed to prevent colonization by invasive species. Restoration goals would be to revegetate the areas in such a way that they would succeed into the current habitat type, deciduous woodlands; however, the large area affected would not return to its current state (deciduous woodland) in the period of analysis. The landscape of the project area would be altered from current conditions, and vegetation would be considerably different. Additionally, there would be permanent vegetation removal where the junction vault, boat ramp, parking area, and boat ramp access road would be constructed. These elements of the project would be out of place within C&O Canal, a historic park, resulting in a change in visual resources.

Boaters would be affected by these changes on land, as well as visual impacts from the submerged intake structure. The submerged intake would create a dimple in the surface of the water directly above it during periods of high withdrawal, and downstream of the structure, vortices could occur, disrupting the usually calm surface of the Potomac River in this area.

The impacts from operation on the scenic resources for towpath and river users would be long-term minor and adverse.

Cumulative Impacts: Other past, present, and future planned actions 10 miles to the north and 10 miles to the south of the project area (MM 17.5) have the potential to impact the scenic resources of the park from the perspective of visitors on the towpath and boaters on the Potomac River. Past planning efforts, such as the park's General Plan established goals for the preservation of the park's natural setting including that outdoor recreation should not intrude upon or impair the resources for which the park was established to protect. The Potomac River watershed restoration projects also benefit scenic resources. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stream restoration and enhancement which indirectly benefits scenic resources. Aspects of these projects include stabilizing stream banks, enhancing riparian habitats, and constructing wetlands. Repairing canal structures, water areas, and Locks 5 to 22 indirectly benefits the scenic resources of the park. Historic canal features must be in good condition for the interpretive canal boat program, and other interpretive and educational resources for visitors.

The towpath viewshed in the cumulative project area consists mainly of forested areas located along the towpath, which shields most of the nearby developments from sight. However, there are several noticeable developments along the towpath that would adversely affect the scenic resources of visitors on the towpath or in boats in the river. Utility corridor ROWs and the Capital Beltway cross above the towpath and Potomac River. Other developments visible to visitors on the towpath include structures associated with WSSC's Potomac WFP including a bridge, paved road, fence, and portions of the WFP raw water pumping stations. Adverse impacts from these developments to scenic resources would add to the short- to long-term minor to moderate and adverse impacts of construction and operation actions proposed under the action alternatives. However, cumulative impacts are not expected to increase to major when the beneficial effects of the other cumulative actions discussed above are factored into the analysis. These beneficial effects would help to negate some of these adverse impacts; therefore, cumulative impacts on scenic resources in the area of analysis would be short- to long-term minor to moderate and adverse.

Conclusion: Under action alternatives 2, 3, and 4, the scenic resources would be affected. Prior to construction, a fence would be constructed, obscuring most of the construction on both sides of the towpath from visitors' view. Boaters on the Potomac River would be able to see all aspects on construction except for those that impact the canal. The impacts from construction equipment and features would be short-term moderate and adverse. Following construction, which would last approximately 4 years for alternatives 2 and 3 and 4.5 years for alternative 4, all users would be able to see the change in vegetation, which would result in long-term moderate impacts. The new permanent terrestrial features (i.e., junction vault, boat ramp, parking area, boat ramp access road, and security fencing) would be visible for both towpath and river users; boaters would also see a change in the river at and downstream of the submerged intake. Impacts on visual resources from operation of the proposed submerged intake would be long-term minor and adverse.

Adverse impacts from other past, present, and future planned actions in the project area are not expected to contribute cumulatively to the short- to long-term minor to moderate and adverse impacts on scenic resources under the action alternatives.

CULTURAL RESOURCES

Methodology and Assumptions

The analyses of effects on cultural resources that are presented in this section respond to the requirements of NEPA. Compliance with Section 106 of the National Historic Preservation Act (NHPA) is being handled separately through ongoing consultation with the Maryland Historical Trust (MHT). In

accordance with the Advisory Council's regulations implementing Section 106 (36 CFR Part 800, *Protection of Historic Properties*), impacts on historic properties were identified and evaluated by (1) determining the Area of Potential Effects (APE); (2) identifying historic properties present in the APE that are either listed in or eligible to be listed in the NRHP; (3) applying the criteria of adverse effect on affected historic properties; and (4) considering ways to avoid, minimize, or mitigate adverse effects from the undertaking.

A Phase II Evaluation of two sites (18MO633 and 18MO719) located within the project site APE has been completed. The Phase II Evaluation recommended both archeological sites eligible for listing on the NRHP (Klein et al. 2015). Because the project would diminish the characteristics that render these sites eligible for the NRHP, it was determined that the undertaking will have an adverse effect on these sites. A Memorandum of Agreement (MOA) would be prepared to guide the Section 106 process. The provisions of the MOA would also guide the implementation of this project

Project Area

For purposes of this EA, the project area for historic properties can be defined as the section of the C&O Canal and adjacent properties from Mile 17.3 through Mile 17.7 of the towpath along the Potomac River; approximately halfway between MM 17 and MM 18. This area does not include MM 17.5 and Culvert #25 (Watts Branch Culvert), the closest individual elements within the district. The APE is approximately 21.4 acres and follows the C&O Canal NHP towpath for approximately 0.4 mile.

Historic Structures, Buildings, Objects, and Districts

Impact Thresholds

For an historic structure, building, object, or district to be listed on the NRHP, it must possess significance (the meaning or value ascribed to the historic structure building, object, or district) and have integrity of those features necessary to convey its significance. Impacts on historic structures, buildings, objects, or districts occur if the action would alter or eliminate the qualities that gave the resource its historic significance. In the case of structures, buildings, objects, and districts at the park, modifications (e.g., repairs, renovations, additions) to the physical aspects of structures and their environments have a potential to change their appearance, layout, or function and consequently diminish their historical value. Changes that can impact historic districts generally entail the loss of enough buildings and structures, or the introduction of newer structures and buildings, such that the district no longer conveys a sense of a coherent whole. Beneficial impacts may also occur if elements that are not characteristics (e.g., modern additions to buildings or later buildings) are removed. For purposes of analyzing potential impacts on historic structures and districts, the thresholds of change for the intensity of an impact are defined as follows:

> *Negligible* – The impact would be at the lowest level of detection with neither adverse nor beneficial consequences.
>
> *Minor* – Alteration of a pattern(s) or feature(s) of a historic structure, building, object, or district listed on or eligible for the NRHP would be easily detectable but would not diminish the integrity of a character-defining feature(s) or the overall integrity of the historic property.
>
> *Moderate* – The impact would alter a character-defining feature(s) of a historic structure, building, object, or district and diminish the integrity of that feature(s) of the historic property.

Major – The impact would alter a character-defining feature(s) of the historic structure, building, object, or district and severely diminish the integrity of that feature(s) and the overall integrity of the historic property. Mitigation through the provisions of the MOA would be unlikely to be successful because the impacts would be of such a large and broad extent as to diminish the overall integrity of the historic district within the project area.

Beneficial – No levels of intensity for beneficial impacts are defined. Beneficial impacts can occur under the following scenarios: when character-defining features of the historic structure, building, object, or district would be stabilized/preserved, rehabilitated, restored, or reconstructed in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties* (Weeks and Grimmer 1995).

A*dverse* - when an impact alters, directly or indirectly, any characteristic of a historic property that qualifies it for inclusion in the NRHP (by diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the undertaking that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5).

Duration – Short-term impacts occur during the construction phase of the alternative; long-term impacts occur during and beyond implementation of the alternative.

Alternative 1: No-action Alternative

Under alternative 1, the park would continue to manage the historic resources to prevent further deterioration. In addition, the park would repair any problems to these above-ground resources as they develop. There would be no change in the integrity of historic structures, buildings, objects, and districts within the APE or any of the contributing resources associated with these elements. In additions, there would be no changes to the current configuration of the WSSC facilities on either side of the towpath. The existing WSSC facilities within the Potomac WFP are mostly not visible to visitors due to trees, the slope of the land, and the security fence. Since no direct or indirect impact on historic structures, buildings, objects, and districts within the APE is expected, impacts would be characterized as negligible.

Cumulative Impacts: No other past, present, and future planned projects were identified within the project area with the potential to impact historic structures, buildings, objects, and districts beyond the park's General Plan; therefore, no cumulative impacts are expected to historic structures, buildings, objects, and districts.

Conclusion: Because resources would receive periodic maintenance but would not be improved, alternative 1 would result in negligible impacts on historic structures, buildings, objects, and districts there would be no cumulative effects associated with the no-action alternative.

Alternative 2: Tunneling to Onshore Shaft – West of Existing Intake (Preferred Alternative)

Many of the construction activities associated with alternative 2 would be temporary in nature. A temporary construction access road would be built across the historic canal prism and towpath. The road would be constructed on an embankment with a culvert to allow water flow to continue in the canal. Construction activities would necessitate clearing much of what is currently wooded; however, there would be no ground disturbing activities associated with construction of the embankment. Site preparation, such as tree removal, would be completed without ground disturbance. A protective barrier would be installed to protect the canal prism and towpath from the installation of the embankment and temporary ramps would be used to carry the towpath over the construction access road and would be

removed upon completion of construction. Once construction is complete, the embankment would be removed and this section of the canal prism and the towpath would be restored to its current condition according to the Secretary of the Interior's Standards. There would be short-term minor adverse impacts to the canal prism and towpath within the APE as a result of alternative 2 due to the construction of a temporary embankment across the canal prism and towpath to provide access for heavy equipment to the construction site.

The clearing of vegetation (4.7 acres) at the site and the introduction of a permanent boat ramp, parking area, and access road would have a long-term moderate adverse impact on the C&O NHP district's landscape. Approximately 4.4 acres of forest would be restored at the site; however, the mature deciduous woodland would not be restored in the period of analysis, which would be a long-term impact to the landscape.

Cumulative Impacts: No other past, present, and future planned projects were identified within the project area beyond the park's General Plan that would have the potential to affect historic structures, buildings, objects, and districts. Therefore, there would be no cumulative effects on historic structures, buildings, objects, or districts.

Conclusion: The construction and installation of the temporary embankment for the construction access road would have short-term minor adverse impacts on the canal prism and the towpath within the APE. However, once construction is complete, the embankment would be removed and this section of the canal prism and the towpath would be restored utilizing Secretary of the Interior's Standards. The clearing of vegetation and the introduction of permanent features at the site would have a long-term moderate adverse impact on the C&O NHP district's landscape. There would be no cumulative effects on historic structures buildings, objects, or districts.

Alternative 3 – Trenching/Tunneling to Onshore Shaft – West of Existing Intake

Impacts on historic structures, buildings, objects, and districts under alternative 3 would be similar to those described for alternative 2. There would be short-term minor adverse impacts to the canal prism and towpath within the APE as a result of alternative 3 due to the construction of a temporary embankment across the canal prism and towpath to provide access for heavy equipment to the construction site. However, a protective barrier would be installed to protect the canal prism and towpath from the installation of the embankment and temporary ramps would be used to carry the towpath over the construction access road. Once construction is complete, the embankment would be removed and this section of the canal prism and the towpath would be restored to its current condition according to the Secretary of the Interior's Standards. The clearing of vegetation (3.7 acres) at the site and the introduction of a permanent boat ramp, parking area, and access road would have a long-term moderate adverse impact on the C&O NHP district's landscape. Approximately 3.4 acres of forest would be restored at the site; however, the mature deciduous woodland would not be restored in the period of analysis, which would be a long-term impact to the landscape.

Cumulative Impacts: No other past, present, and future planned projects were identified within the project area beyond the park's General Plan that would have the potential to affect historic structures, buildings, objects, and districts. Therefore, there would be no cumulative effects on historic structures, buildings, objects, or districts.

Conclusion: The construction and installation of the temporary embankment for the construction access road would have short-term minor adverse impacts on the canal prism and the towpath within the APE. However, once construction is complete, the embankment would be removed and this section of the canal prism and the towpath would be restored utilizing Secretary of the Interior's Standards. The clearing of

vegetation and the introduction of permanent features at the site would have a long-term moderate adverse impact on the C&O NHP district's landscape. There would be no cumulative effects on historic structures buildings, objects, or districts.

Alternative 4 – Tunneling to Onshore Shaft –East of Existing Intake

Impacts on historic structures, buildings, objects, and districts under alternative 4 would be similar to those described for alternatives 2 and 3, except that this alternative has an additional embankment in the C&O Canal for the temporary relocation of the towpath. There would be short-term minor adverse impacts to the canal prism and towpath within the APE as a result of alternative 4 due to the construction of the temporary embankments within the canal prism and towpath to provide access for heavy equipment to the construction site and for the temporary relocation of the towpath. However, a protective barrier would be installed to protect the canal prism and towpath from the installation of the embankments and temporary ramps would be used to carry the towpath over the construction access road and along the canal for the temporary towpath relocation. Once construction is complete, the embankments would be removed and this section of the canal prism and the towpath would be restored to its current condition according to the Secretary of the Interior's Standards. The clearing of vegetation (4.4 acres) at the site and the introduction of a permanent boat ramp, parking area, and access road would have a long-term moderate adverse impact on the C&O NHP district's landscape. Approximately 4.1 acres of forest would be restored at the site; however, the mature deciduous woodland would not be restored in the period of analysis, which would be a long-term impact to the landscape.

Cumulative Impacts: No other past, present, and future planned projects were identified within the project area beyond the park's General Plan that would have the potential to affect historic structures, buildings, objects, and districts. Therefore, there would be no cumulative effects on historic structures, buildings, objects, or districts.

Conclusion: The construction and installation of the temporary embankments for the construction access road and temporary towpath relocation would have short-term minor adverse impacts on the canal prism and the towpath within the APE. However, once construction is complete, the embankments would be removed and this section of the canal prism and the towpath would be restored utilizing Secretary of the Interior's Standards. The clearing of vegetation and the introduction of permanent features at the site would have a long-term moderate adverse impact on the C&O NHP district's landscape. There would be no cumulative effects on historic structures buildings, objects, or districts.

Archeological Sites

Impact Thresholds

Potential impacts on archeological resources mainly occur as a result of activities that cause disturbance to below-ground environments or that can trigger or worsen such consequences, for example by causing erosion at previously stable locations. Changing the nature of subsurface environments, by altering moisture levels for instance, would also be considered disturbance. Impact thresholds for archeological resources are described below.

Negligible – Impact is at the lowest levels of detection with neither adverse nor beneficial consequences.

Minor – Disturbance of a site(s) results in little, if any, loss of integrity.

Moderate – Disturbance of a site(s) results in loss of integrity to the extent that there is a partial loss of the character-defining features and information potential that form the basis of the site's NRHP eligibility. Mitigation is accomplished by a combination of archeological data recovery and in-place preservation.

Major – Disturbance of a site(s) results in loss of integrity to the extent that it is no longer eligible for the NRHP. Its character-defining features and information potential are lost to the extent that archeological data recovery is the primary form of mitigation.

Beneficial – A beneficial impact would occur when actions were taken to actively preserve or stabilize a site in its preexisting condition, or when it would be preserved in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties* (Weeks and Grimmer 1995) to accurately depict its form, features, and character as it appeared during its period of significance.

A*dverse* - when an impact alters, directly or indirectly, any characteristic of a historic property that qualifies it for inclusion in the NRHP (by diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the undertaking that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5).

Duration – All impacts on archeological resources are considered long-term.

Alternative 1: No-action Alternative

Alternative 1 would involve no ground disturbance. Archeological resources would be preserved in their current state, which can be assumed to be stable. This alternative would not cause any affects to known resources and therefore would result in no impacts.

Cumulative Impacts: No other past, present, and future planned actions were identified within the project area beyond the park's General Plan that would have the potential to affect archeological resources. Therefore, there would be no cumulative effects on archeological resources.

Conclusion: There would be no impacts on archeological resources as a result of alternative 1 since there would be no new ground disturbance and there would be no cumulative effects associated with the no-action alternative.

Impacts of the Action Alternatives

The impacts on archeological resources from construction and operation of the proposed submerged intake structure would be similar under the action alternatives.

Under the action alternatives, construction associated with the permanent access road, parking area associated with the new boat ramp, and part of the temporary construction access road would disturb intact portions of the eastern quarter of archeological site 18MO633. The western approximately three quarters of the site would be preserved in place. Due to the ground disturbing activities associated with construction of the roads and parking area within the eastern quarter of the site, all action alternatives would have impacts to site 18MO633. The revised project footprint for the boat ramp and parking area did result in avoidance of impacts to the western portion of site 18MO633; however, some impact cannot be avoided to this site. Therefore long-term moderate adverse impacts are expected to site 18MO633 for all action alternatives. The Phase II evaluation recommended that archeological site 18MO633 is eligible for listing on the NRHP (Klein et al. 2015). An MOA will be prepared with stipulations that outline

appropriate treatment measures to minimize or mitigate these adverse effects. This MOA would stipulate that, prior to any ground disturbing activities within the project site, data recovery excavations within the portion of the site to be impacted by construction be undertaken. The MOA would be completed and signed before initiation of construction activities. Consultation with the MHT is ongoing.

All of the action alternatives propose construction of a temporary construction access road that would cross archeological site 18MO719. This site contains stratified deposits; however the site's significant data potential and eligibility for the NRHP rests on the deeply buried deposits associated with the Woodland and Contact era. To minimize the traffic load on the archeological deposits, steel plates would be placed across the archeological site at the location of the temporary construction road. Placement of these weight bearing buffers on top of the site would disperse the force of the weight of the construction vehicles and prevent compaction to the deeply buried deposits. In addition, site preparation, such as tree removal, would be completed without ground disturbance. The physical placement of these plates and site preparation activities may create some limited impacts; therefore, the action alternatives would have long-term minor and adverse impacts on site 18MO719.

Lock 13 Wetland Mitigation Site: There would be no impacts to archeological resources at the Lock 13 wetland mitigation site. The site has been examined by NPS staff, and it has been determined that there are no archeological resources present there that would prevent wetland mitigation from occurring.

Cumulative Impacts: No other past, present, and future planned actions were identified within the project area beyond the park's General Plan that would have the potential to affect archeological resources. Therefore, there would be no cumulative effects on archeological resources.

Conclusion: The action alternatives have the potential to have long-term moderate adverse impacts on archeological site 18MO633 due to construction associated with the permanent access road and parking area associated with the new boat ramp; however, an MOA would be prepared with stipulations outlining appropriate treatment measures to minimize or mitigate these adverse effects. Long-term minor adverse impacts are expected on site 18MO719 due to the placement of the temporary construction road. There would be no cumulative effects on archeological resources.

Cultural Landscapes

Impact Thresholds

Following the definition used by the NPS to describe rural historic landscapes, a cultural landscape is a "geographical area that historically has been used by people, or shaped or modified by human activity, occupancy, or intervention and that possess a significant concentration, linkage, or continuity of land use, vegetation, buildings and structures, roads, waterways, and natural features" (McClelland et al. 1999). Potential impacts on a cultural landscape include the removal of features or elements (e.g., buildings, structures, vegetation) that contribute to the historic character. Alternatively, adding new elements, such as roads or buildings that are of a scale or design that is inconsistent with the historic setting is also considered an impact. Finally, impacts can be beneficial if they remove intrusive modern or incompatible features or restore original or matching ones.

> *Negligible* – The impact would be at the lowest level of detection with neither adverse nor beneficial consequences.
>
> *Minor* – Alteration of a cultural landscape feature listed on or eligible for the NRHP would be easily detectable but would not diminish the integrity of a character-defining feature(s) or the overall integrity of the cultural landscape.

Moderate – The impact would alter a cultural landscape feature(s) and diminish the integrity of that feature(s) of the cultural landscape.

Major – The impact would alter a cultural landscape feature(s) and severely diminish the integrity of that cultural landscape feature(s).

Beneficial – No levels of intensity for beneficial impacts are defined. Beneficial impacts can occur under the following scenarios: when character-defining features of the cultural landscape feature would be stabilized/preserved, rehabilitated, restored, or reconstructed in accordance with the *Secretary of the Interior's Guidelines for the Treatment of Cultural Landscapes* (NPS 1996).

A*dverse* - when an impact alters, directly or indirectly, any characteristic of a historic property that qualifies it for inclusion in the NRHP (by diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the undertaking that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5).

Duration – Short-term impacts occur during the construction phase of the alternative; long-term impacts occur during and beyond implementation of the alternative.

Alternative 1: No-action Alternative

The no-action alternative would have a negligible impact on the cultural landscape in the project area. Regular maintenance of the canal and towpath would sustain the established landscape for this location. The existing WSSC facilities within the Potomac WFP are mostly not visible to visitors due to trees, the slope of the land, and the security fence.

Cumulative Impacts: No other past, present, and future planned actions were identified within the project area beyond the park's General Plan that would have the potential to affect cultural landscapes. Therefore, there would be no cumulative effects on cultural landscapes.

Conclusion: The no-action alternative would have a negligible direct impact on cultural landscapes and there would be no cumulative effects associated with the no-action alternative.

Impacts of the Action Alternatives

The impacts on the cultural landscapes from construction and operation of the proposed submerged intake structure would be similar under the action alternatives. Impacts to the landscape would include the introduction of the temporary embankments, construction access road, fencing, and construction equipment needed during the construction period which would be visual intrusions on the cultural landscape. This would result in short-term moderate adverse impacts on the cultural landscape.

Long-term impacts would occur to the cultural landscape due to the clearing of existing vegetation (trees) to accommodate the construction of the new intake and the addition of new permanent features (e.g., boat ramp, parking lot, and access road). The clearing of vegetation would result in long-term impacts, as the area affected would not return to its current state (deciduous woodland) in the period of analysis. Long-term impacts are also expected through the addition of the new features to the landscape. Impacts would be reduced by planting approved native trees and shrubs which would eventually provide a buffer between the towpath and the new features (e.g., boat ramp, parking lot). The Habitat Restoration Plan (appendix D) includes a planting plan for vegetation restoration at the site. The clearing of vegetation at the site and the addition of new features (e.g., boat ramp, parking lot, and access road) would result in long-term moderate adverse impacts on the cultural landscape.

Cumulative Impacts: No other past, present, and future planned actions were identified within the project area beyond the park's General Plan that would have the potential to affect cultural landscapes. Therefore, there would be no cumulative effects on cultural landscapes.

Conclusion: Impacts on cultural landscapes under the action alternatives would be a combination of short- and long-term adverse impacts. Short-term moderate adverse impacts would occur due to the introduction of temporary embankments, construction access road, fencing, and construction equipment within the historic landscape. Long-term moderate adverse impacts would occur as a result of the clearing of vegetation at the site and the addition of new features (e.g., boat ramp, parking lot, and access road) to the landscape.

VISITOR USE AND EXPERIENCE

Methodology and Assumptions

The purpose of the visitor use and experience impact analysis was to determine if the activities proposed among the alternatives are compatible or in conflict with the purpose of the park, its visitor experience goals, and the direction provided by NPS *Management Policies 2006*.

The potential for change in visitor experience was evaluated by assessing the limitations and assumed changes to visitor access and associated visitor uses related to the proposed alternatives and determining whether these projected changes would affect the visitor experience.

Project Area

The project area for visitor use and experience includes the immediate location of the construction area limit (limit of disturbance) and the surrounding area.

Impact Thresholds

The following thresholds were used to determine the magnitude of impacts on visitor use and experience:

Negligible – Visitors would likely be unaware of impacts associated with construction and operation of the alternative. There would be no noticeable change in visitor use and experience.

Minor – Visitors would be aware of the effects associated with the alternative, but only slightly. Changes in visitor use and experience would be slight and detectable, but would not appreciably limit or enhance visitor access or recreational/interpretive opportunities. Some individuals would be affected.

Moderate – Visitors would be aware of the effects associated with the alternative. Changes in visitor use and experience would be noticeable. Visitor access or recreational/interpretive opportunities may be limited or enhanced. Some visitors who desire their continued use and enjoyment of the activity might pursue their choices in other areas of the park. Mitigation measures would be necessary to offset adverse impacts and would likely be successful.

Major – Visitors would be highly aware of the effects associated with the alternative. Changes in visitor use and experience would be highly apparent and visitor access or recreational/interpretive opportunities would be appreciably limited or enhanced. Visitors who desire to use and enjoy the park in their current manner would be required to pursue their choices in other areas of the park or available local areas. Extensive mitigation measures to offset adverse impacts would be needed, and success would not be guaranteed.

Duration – Short-term impacts occur during the construction phase of the alternative; long-term impacts occur during and beyond implementation of the alternative.

Alternative 1: No-action Alternative

There would be no additional impact on visitor use and experience under the no-action alternative. No construction activities would occur, and there would be no change to the park or surrounding area. Currently the facilities within the Potomac WFP are mostly not visible to visitors on the towpath due to trees, the slope of the land, and the security fence. Within the project site, non-natural human-caused sounds may include the occasional noise from equipment and maintenance activities associated with the WFP. Therefore, there would be a long-term minor adverse impact on visitor use and experience under alternative 1 due to the minor intrusion of the WFP to the visitor experience.

Cumulative Impacts: Other past, present, and future planned actions within and around the project area (MM 17.5) have the potential to impact soundscapes of the park from the perspective of visitors on the towpath and boaters on the Potomac River. Past planning efforts, such as the park's General Plan calls "for the stabilization and partial restoration of the historic canal and its structures, the preservation of its charming natural setting, the interpretation of the rich array of historical and natural values found along the canal, and provisions for as much outdoor recreation as will not intrude upon or impair the resources which the park was established to protect" (NPS 1976). The Potomac River watershed restoration projects benefits visitor use and experience. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stream restoration and enhancement (stabilizing stream banks, improving fish passage, improving aquatic habitat conditions, and constructing wetlands) which benefits the natural resources in the project area therefore indirectly benefiting the visitor experience along the towpath and boating along the river. Repairing canal structures, water areas, and Locks 5 to 22 benefits the visitor experience at the park. Historic canal features must be in good condition for the interpretive canal boat program, and other interpretive and educational resources for visitors.

The visitor experience along the towpath is a natural forested area setting, which shields most of the nearby developments from sight. However, in the project area there are several noticeable developments along the towpath that would adversely affect the visitor experience on the towpath or from boats in the river. A utility corridor ROW crosses over the towpath and Potomac River structures associated with WSSC's Potomac WFP including a bridge, paved road, fence and portions of the WFP raw water pumping stations are also in the park's natural setting. Adverse impacts from these developments to visitor use and experience would add to the long-term minor adverse impacts from alternative 1. However, cumulative impacts are not expected to increase to moderate when the beneficial effects of the other cumulative actions discussed above are factored into the analysis. The beneficial effects would help to negate some of these adverse impacts; therefore, the cumulative impacts on visitor use and experience in the area of analysis would be long-term minor and adverse.

Conclusion: There would be a long-term minor adverse impact on visitor use and experience under alternative 1 due to current facilities within the Potomac WFP. However, the facilities are mostly not visible to visitors on the towpath due to trees, the slope of the land, and the security fence and noise from equipment and activities associated with the WFP would be minor and occasional.

The cumulative impacts on visitor use and experience in the area of analysis would be long-term minor and adverse. Cumulative impacts are not expected to increase to moderate when the beneficial effects of the other cumulative actions discussed above are factored into the analysis. The beneficial effects would help to negate some of these adverse impacts.

Impacts of the Action Alternatives

The impacts on visitor use and experience from construction and operation of the proposed submerged intake would be similar under the action alternatives since all alternatives would involve construction of a cofferdam, removal of vegetation at the site, and installation of a construction fence resulting in visitors being aware that there is active construction within the park. While the methods of construction would be different, the differences between alternatives would not change the intensity impact for visitor use and experience among the alternatives. For alternative 4, the location of the onshore shaft would move to the eastern side of the site, and would be slightly closer to the towpath resulting in an additional embankment in the C&O Canal for the temporary relocation of the towpath. This would alter the specific location of certain construction activities.

Construction Impacts: The Potomac River, C&O Canal, and towpath are used by visitors for recreational activities (i.e., hiking, biking, boating, horseback riding, etc.) and also to enjoy the scenery of the Potomac River and the historic canal. Most visitors to the site are traversing the project area, as part of an overall walk/run, bike trip, or river activities. Under the action alternatives, impacts on visitor use and experience in each of these areas would occur during the construction period.

Towpath visitors would traverse a construction site, which would impact their experience. Instead of experiencing the natural and historical features of the park, they would be in the midst of an active construction area. Fencing would be present along a 0.2-mile section of the towpath on both sides of the towpath for the duration of the construction. The fencing would prevent visitors from entering the construction site and would also likely block or obscure views on either side of the towpath. Other impacts on towpath users could include temporary delays as towpath traffic would need to be halted periodically for vehicle crossings and blasting and drilling operations. A flag person would control traffic. These disruptions would be temporary, not to exceed 15 minutes in duration. If longer disruption would be necessary, such as during construction of the embankments, it may be necessary to temporarily re-route towpath users. Alternative 4 does require the temporary relocation of the towpath due to the design of this alternative; therefore, a greater impact to the visitor's experience would occur under this alternative but this effect on visitors is not expected to increase the impact intensity.

The noise of the construction operations would also impact the visitor experience. Noise would be generated from construction equipment and blasting activities for construction of the intake and intake tunnels, and would be audible by visitors using the C&O Canal towpath, as well as those boating on the Potomac River. However, there are no residences within close proximity to the project site that would be disturbed during construction activities. Alternative 3 would have similar impacts to visitors using the towpath as alternatives 2 and 4 except that this alternative involves trenching for the construction of the conduit tunnel to the junction vault/onshore shaft. This would result in surface blasting of bedrock as compared to subsurface blasting that would occur during tunneling for the construction of the conduit tunnel under alternatives 2 and 4. Trenching construction would create louder and more intense noise from blasting at the construction site resulting in a greater adverse impact on visitors than under alternatives 2 and 4; however, this increase in noise from alternative 3 is not expected to increase the impact intensity. Impacts on towpath users would be temporary as they move through the project site and would not extend beyond the project site, the remainder of their experience at the park would not be affected.

Following construction, visitor experience would result primarily from the change in the environment between the towpath and the river. The removal of forested areas for construction and the addition of permanent structures, such as the boat ramp, parking area, and onshore shaft would alter the experience

for visitors. Currently visitors experience a mature, forested area. Following construction, it would take up to 20 years before the area returns to a comparable condition.

Temporary cofferdams would be constructed in the Potomac River to provide dry working areas for construction of the intake shaft and boat ramp. River users, primarily recreational boating, would be detoured around the cofferdams by means of signage for safety reasons. The experience for river users would also be affected by the ongoing construction activity, instead of the natural setting of the Potomac River; river users traversing the area would experience an active construction site in the river.

Impacts on visitor use for towpath and river users would be short-term moderate and adverse due to the interruption of normal use of the park and long-term minor and adverse from the change in natural environment for a 0.2-mile section of the park.

Operational Impacts: Operation of the submerged intake would not impact the use of the towpath, following construction visitors would be able to use the towpath as they did prior to construction. However, the change to the natural setting (removal of forest) would have a long-term minor adverse impact on visitor experience for towpath users since it could take up to 20 years before the area returns to a comparable condition. There would be no additional noise impacts to visitors since operation of the offshore intake would not result in additional noise generation.

Upon completion of the intake, the structure's roof would be placed at least 30 inches below the minimum water level in order to avoid affecting boaters in this segment of the Potomac River. This would enable either intake structure to comply with the Potomac River Protection Act of 2000. While the structure may be visible to boaters depending on water clarity, it would not interfere with recreational activities. The feasibility report notes that intake operation could slightly alter velocity in the vicinity of the intake, causing a "dimple" on the surface of the river when intake velocities are at the upper range. While this may be visible to boaters, the velocity difference is small enough that it would not impact boaters, or their ability to navigate this area. Since the submerged intake may be visible to boaters there would be long-term, minor, adverse impacts on visitor use and experience from operation of the submerged intake.

Cumulative Impacts: Other past, present, and future planned actions within and around the project area (MM 17.5) have the potential to impact soundscapes of the park from the perspective of visitors on the towpath and boaters on the Potomac River. Past planning efforts, such as the park's General Plan calls "for the stabilization and partial restoration of the historic canal and its structures, the preservation of its charming natural setting, the interpretation of the rich array of historical and natural values found along the canal, and provisions for as much outdoor recreation as will not intrude upon or impair the resources which the park was established to protect" (NPS 1976). The Potomac River watershed restoration projects benefits visitor use and experience. Montgomery County is currently addressing channel erosion and habitat degradation within the Potomac River watershed through a variety of restoration projects, including stream restoration and enhancement (stabilizing stream banks, improving fish passage, improving aquatic habitat conditions, and constructing wetlands) which benefits the natural resources in the project area therefore indirectly benefiting the visitor experience along the towpath and boating along the river. Repairing canal structures, water areas, and Locks 5 to 22 benefits the visitor experience at the park. Historic canal features must be in good condition for the interpretive canal boat program, and other interpretive and educational resources for visitors.

The visitor experience along the towpath is a natural forested area setting, which shields most of the nearby developments from sight. However, in the project area there are several noticeable developments along the towpath that would adversely affect the visitor experience on the towpath or from boats in the river. A utility corridor ROW crosses over the towpath and Potomac River structures associated with WSSC's Potomac WFP including a bridge, paved road, fence and portions of the WFP raw water

pumping stations are also in the park's natural setting. Adverse impacts from these developments to visitor use and experience would add to the negligible to short- to long-term minor to moderate adverse impacts from the proposed action alternatives. However, cumulative impacts are not expected to increase to moderate when the beneficial effects of the other cumulative actions discussed above are factored into the analysis. The beneficial effects would help to negate some of these adverse impacts; therefore, the cumulative impacts on visitor use and experience in the area of analysis would be negligible to short- to long-term minor to moderate and adverse.

Conclusion: Short-term moderate adverse impacts on visitor use and experience would occur during construction activities, due to disruption in use of the towpath and the river, and the impacts on visitor experience caused by the alteration of the environment and ongoing construction activities. The permanent structures and the length of time needed to restore the environment to a mature forested area would cause long-term minor adverse impacts. It is important to note that both short-term and long-term impacts would be localized to a small section of the park, approximately 0.2 mile in length, and that visitors would only experience impacts as they traverse the project area.

Any adverse impacts from other past, present, and future planned actions within and around the project area are not expected to contribute cumulatively to the short- to long-term minor to moderate and adverse impacts on visitor use under the action alternatives.

HUMAN HEALTH AND SAFETY

Methodology and Assumptions

The analysis of human health and safety was determined by examining the potential effects of construction activities on the health and safety of park visitors and staff.

Project Area

The geographic project area for human health and safety includes the construction area limit (limit of disturbance) for the project.

Impact Thresholds

The following thresholds were used to determine the magnitude of impacts on human health and safety:

Negligible – Human health and safety for both park visitors and park employees would not be affected, or the effects would be at such low levels of detection that no appreciable effect on human health or safety would be measurable.

Minor – Effects on human health and safety for both park visitors and park employees would be detectable but would not be large enough to be quantified. Changes to human health and safety would be slight and localized and the visitor would be aware of the effects.

Moderate – Effects would be readily apparent and would result in substantial, noticeable effects on human health and safety for both park visitors and park employees.

Major – Effects would be readily apparent and long-term and would result in substantial, noticeable effects on human health and safety for both park visitors and park employees. Changes in visitor use and/or experience would be readily apparent, severely adverse, or exceptionally beneficial, and have important long-term consequences. The visitor would be aware of the effects associated with the alternative and would likely express a strong opinion about the changes.

Duration – Short-term impacts occur during the construction phase of the alternative; long-term impacts occur during and beyond implementation of the alternative.

Alternative 1: No-action Alternative

Under the no-action alternative, there would be no construction activities, and therefore, there would be no additional impacts on human health and safety. Impacts to human health and safety under alternative 1 would be negligible.

Cumulative Impacts: No other past, present, and future planned actions were identified within and around the project area (MM 17.5) that would have the potential to affect human health and safety. Therefore, there would be no additional cumulative effects on human health and safety.

Conclusion: Under the no-action alternative, there would be no additional effects on human health and safety and there would be no cumulative effects associated with the no-action alternative. Impacts to human health and safety under alternative 1 would be negligible.

Impacts of the Action Alternatives

The impacts on human health and safety from construction and operation of the proposed submerged intake would be similar under the action alternatives.

Construction Impacts: Construction activities could pose a potential risk to the health and safety of park visitors, NPS staff, and WSSC staff and contractors. Specifically, the presence and operation of heavy equipment, and the activities proposed (blasting, excavation, earth movement, movement of large equipment, the construction of deep shafts) in the vicinity of a national park could cause impact on the health and safety of park visitors, NPS staff, and WSSC staff and contractors.

To address potential health and safety concerns, prior to construction, WSSC would file a Health and Safety Plan for NPS review and approval. The plan would meet Occupational Safety and Health Act (OSHA) and NPS requirements and would identify areas of concern to health and safety and would describe measures to eliminate or reduce these risks. WSSC would work closely with NPS to protect the health and safety of all people within the vicinity of the project site. Visitors would be excluded from all construction areas by the use of construction fencing around the perimeter of the project, and if appropriate, by the use of guards. Flag people would control towpath traffic to keep visitors safe during blasting and drilling, and when construction vehicles cross the towpath. In spite of measures taken to protect visitors, the proximity of the construction site to a high-use area such as the towpath means that there is a potential for visitors to trespass and thus for potential impacts on human health and safety. However, this potential would be minimized and managed through appropriate measures as described above.

During construction of the embankment, temporary access roads, and the cofferdams, the C&O Canal, towpath, and portions of the Potomac River would be temporarily closed to visitors; however, detours would be provided to avoid having visitors within close proximity to the construction zone. Signage would also be installed to inform towpath visitors of closures and detours. Signage would be present for the duration of the construction phase of the project.

During construction, the impacts on human health and safety would be short-term minor and adverse. While heavy construction equipment would be at the project site, the Health and Safety Plan would eliminate or reduce the potential for safety incidents to occur.

Operational Impacts: Upon completion of the intake, the top of the structure would be placed at least 30 inches below the minimum water level in order to avoid affecting boaters in this segment of the Potomac River. This would enable either intake structure to comply with the Potomac River Protection Act of 2000. While the structure may be visible to boaters depending on water clarity, it would not interfere with recreational activities. The feasibility report notes that intake operation could slightly alter velocity in the vicinity of the intake, causing a "dimple" on the surface of the river when intake velocities are at the upper range. While this may be visible to boaters, the velocity difference is small enough that it would not impact boaters, or their ability to navigate this area; therefore there would be negligible impacts on visitor health and safety from operation of the submerged intake.

Cumulative Impacts: No other past, present, and future planned actions were identified within and around the project area (MM 17.5) that would have the potential to affect human health and safety. Therefore, there would be no cumulative effects on human health and safety.

Conclusion: Short-term minor adverse impacts could occur to human health and safety as a result of construction activities. WSSC would implement an approved Health and Safety Plan to reduce or eliminate the potential for these impacts. Negligible impacts on health and safety would result from the operation of the submerged intake. No other past, present, and future planned actions were identified within and around the project area (MM 17.5) that would have the potential to affect human health and safety; therefore, there would be no cumulative effects on human health and safety.

LAND USE

Methodology and Assumptions

The purpose of this impact analysis was to determine if the alternatives are compatible or in conflict with the purpose of the parks, their land protection goals, adjacent township's land use goals and regulations, and the direction provided by NPS *Management Policies 2006*. The land use analysis was based mostly on a qualitative assessment of changes to land use and consistency with existing plans, policies, land use, and zoning within the project area.

Project Area

The geographic project area for land use includes the construction area limit (limit of disturbance) for the project.

Impact Thresholds

The following thresholds were used to determine the magnitude of impacts on land use:

Negligible – Impacts from the alternative would have no measurable or perceptible changes to the current land use at the park.

Minor – Impacts from the alternative would be measurable or perceptible compared to the current land use at the park but would be within a localized area.

Moderate – Impacts from the alternative would cause a change in the current land use at the park; however, the impact would remain localized.

Major – Impacts from the alternative to the current land use at the park would be substantial, highly noticeable, and permanent.

Duration – Short-term impacts occur during the construction phase and long-term impacts occur during and beyond implementation of the alternative.

Alternative 1: No-action Alternative

Under the no-action alternative, land use would not be affected. The Potomac River, the C&O Canal NHP, and the Potomac WFP would remain unchanged and the existing intake would continue to be used.

Cumulative Impacts: No other past, present, and future planned actions were identified within and around the project area (MM 17.5) that would have the potential to affect land use. Therefore, there would be no cumulative effects on land use.

Conclusion: No impacts would occur to land use under the no-action alternative and there are no cumulative effects associated with the no-action alternative.

Impacts of the Action Alternatives

The impacts on land use from construction and operation of the proposed submerged intake would be similar under the action alternatives.

Construction Impacts: Under the action alternatives, park lands would be affected during construction. The forest along a 0.2-mile section of the towpath would be removed for up to 4 years for project construction, regardless of the alternative. Even though all cleared areas within the construction area limits would be re-graded and re-planted to resemble the existing vegetation after construction is complete, trees along the 0.2-mile section of the towpath would take up to 20 years before the area returns to a comparable condition. Therefore, impacts on the land use of the park would be long-term moderate and adverse, as the area would not be restored to current conditions within the period of analysis.

Operational Impacts: The proposed Potomac submerged channel intake facilities, as well as a major portion of the existing intake facilities, reside on NPS property as part of the C&O Canal NHP. As mentioned in the "Affected Environment" chapter, WSSC would purchase and provide land to NPS in exchange for a perpetual easement for the existing intake facilities, regardless of which alternative is selected as the preferred. Prior to the issuance by NPS of the SUP for construction, a signed legally binding agreement between WSSC and NPS describing the easement, the associated monetary value and the plan for land acquisition as compensation would be complete, as would the acquisition and transfer of the land to NPS. WSSC would acquire properties that have been identified and recommended by NPS. Therefore, although the land use of these properties is unknown at this time, it is anticipated that the newly acquired lands would meet the purpose of the park and their land protection goals. Consequently, negligible impacts on land use would be expected for the future NPS land exchange properties.

Cumulative Impacts: No other past, present, and future planned actions were identified within and around the project area (MM 17.5) that would have the potential to affect land use. Therefore, there would be no cumulative effects on land use.

Conclusion: Land use at the project site would not change under the action alternatives. Impacts to land use of the park along a 0.2-mile section of the towpath would be long-term moderate and adverse, as the area would not be restored to current conditions within the period of analysis. Negligible impacts on land

use are expected to the future NPS land exchange properties since these lands are expected to be comparable to current NPS lands.

There would be no cumulative effects associated with this alternative since no other past, present, and future planned actions were identified within and around the project area (MM17.5) that would have the potential to affect land use.

CONSULTATION AND COORDINATION

Scoping refers to the effort to involve agencies and the general public in determining the scope of issues to be addressed in the environmental document. Among other tasks, scoping determines important issues and eliminates issues determined to be not important; allocates assignments among the interdisciplinary team members and/or participating agencies; identifies related projects and associated documents; identifies other permits, surveys, consultations, etc. required by other agencies; and creates a schedule that allows adequate time to prepare and distribute the environmental document for public review and comment before a final decision is made. Scoping includes consultation with any interested agency, or any agency with jurisdiction by law or expertise to obtain early input and permits needed for implementation. Scoping also includes coordination with the public regarding the proposed project. This section of the EA describes events that occurred relating to agency consultation and public involvement, enabling NPS to meet the requirements outlined in Director's Order 12 for an EA. Public involvement documents are included in appendix A, and agency consultation and coordination documents are included in appendix B.

PUBLIC INVOLVEMENT

Public scoping is the process used to gather public input on proposed projects. For this project, a news release was issued on July 19, 2013 to announce to the public that an EA is being prepared for the offshore submerged channel intake project and to provide information on the scoping newsletter and upcoming public scoping meeting. The newsletter was emailed to numerous individuals, organizations, stakeholders, and agencies. The newsletter provided a description of the project, purpose and need for action, impact topics, how to comment, and information on the public scoping meeting. The public was encouraged to use the NPS Planning, Environment, and Public Comment (PEPC) website to submit comments. The newsletter was available for public comment for a total of 31 days (July 19, 2013 through August 18, 2013). The newsletter is included in appendix A. One correspondence was received during the public comment period.

A public scoping meeting was held in Potomac, Maryland on August 1, 2013 from 6:00 to 8:00 pm. The attendees of the meeting included agency representatives from Montgomery County and the USACE, along with WSSC and NPS staff members. The meeting included discussions on general information about the Potomac WFP, current water quality issues, purpose and need for the project, and potential issues associated with the project.

This EA has been distributed for public and agency review and comment. If no substantive issues are raised, then the process will move forward toward a Finding of No Significant Impact.

AGENCY CONSULTATION

External scoping refers to the interdisciplinary process used to define issues, alternatives, and data needs. Through the Policy Review Group meetings, federal, state, and local agencies were involved in the NEPA planning process for this project. The first Policy Review Group meeting was held on June 10, 2013 and included representatives from WSSC, NPS, MDE, Montgomery County, the USACE, and the MDNR. An additional meeting was held on October 22, 2013.

Formal consultation letters were mailed to state and federal agencies on December 10, 2013 requesting consultation and comments regarding the proposed submerged channel intake project. Letters were sent to:

- USFWS Chesapeake Bay Field Office
- MDE
- MDNR
- MHT [Maryland State Historic Preservation Officer (SHPO)]

Appendix B contains copies of the consultation letters sent to the agencies. Copies of the agency responses are also included in appendix B. One response was received from USFWS as discussed below under "Section 7 Consultation".

In addition, informal consultation was conducted with NPS, USACE, USFWS, and MDNR regarding the need for resource studies. Communication with these agencies began in early spring of 2013 concerning the need to conduct natural resource surveys in the project area. The agencies recommended and agreed that surveys should be completed for freshwater mussels, SAV, wetlands, forest stands, and rare plants. NPS also recommended that a phase II archeology study be completed in the area of the boat ramp. The agencies reviewed and approved study plans for the proposed surveys.

Upon completion of the surveys for mussels, SAV, wetlands, and rare plants, draft summary reports that contained the results of the surveys were submitted to the agencies. A survey for floating paspalum (state endangered plant species) was also conducted for the species to better understand the context of the potential impacts and the opportunity for recolonization of the species following construction. A Phase II Archeological Report was submitted to MHT. A FSD Report will be submitted to MDNR and Montgomery County for review. A summary of the results of the surveys can be found in the "Affected Environment" chapter.

Section 7 Consultation

In accordance with federal and state requirements for special-status species, consultation letters were mailed to state and federal agencies on December 10, 2013, including the USFWS Chesapeake Bay Field Office and the MDNR Wildlife and Heritage Service (appendix B). The letters requested information from the agencies on the presence of species which are federally listed or proposed for listing as endangered or threatened within the vicinity of the project area. Information about the proposed project was also included in the consultation letter. One response was received from the USFWS on January 15, 2014. The USFWS stated in the letter that no federally proposed or listed endangered or threatened species are known to exist within the project impact area and thus no Biological Assessment or further Section 7 Consultation with the USFWS is required.

Consultation was again conducted with the USFWS on the recently federally listed northern long-eared bat. The USFWS has determined in a response letter on August 5, 2015 that the proposed submerged channel intake project will "*not likely to adversely affect*" the northern long-eared bat given that vegetation clearing will not occur between April 15 and August 30 (appendix B).

Section 106 Consultation

Compliance with Section 106 of the National Historic Preservation Act (NHPA) is being handled separately through ongoing consultation with the Maryland Historical Trust (MHT). A formal consultation letter was sent to the MHT on December 10, 2013 (appendix B). The consultation letter provided information about the proposed project. MHT was sent the Phase II Archeological Evaluation draft report for review and comments were received from MHT on October 9, 2015 (appendix B). The report was revised and finalized and delivered to MHT on December 8, 2015 (appendix B). The report

recommended two archeology sites (18MO633 and 18MO719) located within the project site eligible for listing on the NRHP. An MOA will be prepared to guide the Section 106 process. The provisions of the MOA would also guide the implementation of this project and would stipulate appropriate treatment measures to minimize or mitigate any adverse effects to the potentially eligible sites from the proposed action. Consultation with MHT is ongoing.

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GLOSSARY AND ACRONYMS

GLOSSARY OF TERMS

Advisory Council on Historic Preservation (ACHP)—The Advisory Council on Historic Preservation (ACHP) is an independent federal agency that promotes the preservation, enhancement, and productive use of our nation's historic resources, and advises the President and Congress on national historic preservation policy.

Affected environment—The existing environment to be affected by a proposed action and alternatives.

Area of Potential Effects (APE)—The geographic area or areas within which an undertaking or project may directly or indirectly cause alterations in the character or use of historic properties.

Archeological resources—Any material remnants or physical evidence of past human life or activities of archeological interest, including the record of the effects of human activities on the environment. They are capable of revealing scientific or humanistic information through archeological research. Any material remnants of human life or activities at least 100 years of age, and of archeological interest (32 CFR 229.3(a)).

Artifact—A material object made or modified in whole or in part by man. Among the most common artifacts on archeological sites are fragments of broken pottery (sherds), stone tools, chips (debitage), projectile points, and similar lithic debris.

Best management practices (BMPs)—Methods that have been determined to be the most effective, practical means of preventing or reducing pollution or other adverse environmental impacts.

Canal Prism—The trapezoidal cross-sectional shape of a canal's channel. The canal prism for the C&O Canal was typically 60-feet wide at the top, 40-feet wide at the bottom, and 6-feet deep.

Contributing resource—A building, site, structure, or object that adds to the historic significance of a NRHP property or district.

Council on Environmental Quality (CEQ)—Established by Congress within the Executive Office of the President with passage of the National Environmental Policy Act of 1969. The CEQ coordinates federal environmental efforts and works closely with agencies and other White House offices in the development of environmental policies and initiatives.

Cultural landscape—A geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values.

Cultural resources—Historic districts, sites, buildings, objects, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or any other reason.

Deciduous—Describing tree species that have leaves that fall off every season.

Endangered species—"…any species (including subspecies or qualifying distinct population segment) that is in danger of extinction throughout all or a significant portion of its range (ESA Section 3(6))." The lead federal agency, U.S. Fish and Wildlife Service, for the listing of a species as endangered is responsible for reviewing the status of the species on a 5-year basis.

Endangered Species Act [16 U.S. Code (USC) 1531 et seq.]—An Act to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved and to provide a program for the conservation of such endangered species and threatened species.

Environmental assessment (EA)—An environmental assessment is prepared pursuant to the National Environmental Policy Act to determine whether a federal action would significantly affect the environment and thus require a more detailed environmental impact statement.

Ethnographic resource—A site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it.

Executive Order—Official proclamation issued by the President that may set forth policy or direction or establish specific duties in connection with the execution of federal laws and programs.

Finding of No Significant Impact—A document prepared by a federal agency showing why a proposed action would not have a significant impact on the environment and thus would not require preparation of an Environmental Impact Statement. It is based on the results of an Environmental Assessment.

Floodplain—The flat or nearly flat land along a river or stream or in a tidal area that is covered by water during a flood.

Historic district—A geographically definable area, urban or rural, possessing a significant concentration, linkage, or continuity of sites, landscapes, structures, or objects, united by past events or aesthetically by plan or physical developments. A district may also be composed of individual elements separated geographically but linked by association or history.

Historic landscape—A cultural landscape associated with events, persons, design styles, or ways of life that are significant in American history, landscape architecture, archeology, engineering, and culture; a landscape listed in or eligible for the National Register of Historic Places.

Historic property—A district, site, structure, or landscape significant in American history, architecture, engineering, archeology, or culture that meets National Register significance criteria.

Historical significance—The meaning or value ascribed to a structure, landscape, object, or site based on the National Register criteria for evaluation. It normally stems from a combination of association and integrity.

Integrity—The authenticity of a property's historic identity evidenced by the survival of physical characteristics that existed during its historic or prehistoric period; the extent to which a property retains its historic appearance.

List of Classified Structures—A database maintained by the NPS that lists and describes all NHRP-eligible structures in the national park system.

Lock—A device for raising and lowering boats between stretches of water of different levels on river and canal waterways that has been extended in a certain direction to allow for passage of larger vessels.

Memorandum of Agreement (MOA)—A written agreement among a federal agency, SHPO, and ACHP that stipulates how a program or a class of undertakings repetitive in nature or similar in effect will be carried out so as to avoid or mitigate adverse effects on cultural resources.

Mile Marker (MM)—The use of mile markers as a locational convenience follows historical convention. The zero milestone or beginning of the canal is located in Georgetown, where the canal empties into Rock Creek. Canal mile markers are widely used in guidebooks (e.g., Hahn 1997), and many are still extant along the canal today.

Museum collection—Assemblage of archeological collections, objects, works of art, historic documents, and/or natural history specimens collected according to a rational scheme and maintained so they can be preserved, studied, and interpreted for public benefit. Museum collections normally are kept in park museums, although they may also be maintained in archeological and historic preservation centers.

National Environmental Policy Act of 1969 (USC 432 1-4347) (NEPA)—The Act as amended articulates the federal law that mandates protecting the quality of the human environment. It requires federal agencies to systematically assess the environmental impacts of their proposed activities, programs, and projects including the "no-action" alternative of not pursuing the proposed action. NEPA requires agencies to consider alternative ways of accomplishing their missions in ways which are less damaging to the environment.

National Historic Preservation Act of 1966 (16 USC 470 et seq.) (NHPA)—An Act to establish a program for the preservation of historic properties throughout the nation, and for other purposes, approved October 15, 1966 [Public Law 89-665; 80 STAT.915; 16 USC 470 as amended by Public Law 91-243, Public Law 93- 54, Public Law 94-422, Public Law 94-458, Public Law 96-199, Public Law 96-244, Public Law 96-515, Public Law 98-483, Public Law 99-514, Public Law 100-127, and Public Law 102-575].

National Register of Historic Places (NRHP)—A register of districts, sites, buildings, structures, and objects important in American history, architecture, archeology, and culture, maintained by the Secretary of the Interior under authority of Section 2(b) of the Historic Sites Act of 1935 and Section 101(a)(1) of the National Historic Preservation Act of 1966, as amended. The National Register provides for three levels of significance: National, State, and Local.

Organic Act—Enacted in 1916, this Act commits the NPS to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations.

Period of significance—The span of time in which a property attained the significance for which it meets the National Register criteria.

Planning, Environment, and Public Comment (PEPC)—The NPS web site for public involvement. This site provides access to current plans, environmental impact analyses, and related documents on public review. Users of the site can submit comments for documents available for public review.

Rehabilitation—The act or process of making possible an efficient compatible use for a historic structure or landscape through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural and architectural values.

Scoping—Scoping, as part of the National Environmental Policy Act (NEPA), requires examining a proposed action and its possible impacts; establishing the depth of environmental analysis needed; determining analysis procedures, data needed, and task assignments. The public is encouraged to participate and submit comments on proposed projects during the scoping period.

Section l06—Refers to Section l06 of the National Historic Preservation Act of l966, which requires federal agencies to take into account the effects of their proposed undertakings on properties included or eligible for inclusion in the National Register of Historic Places and give the Advisory Council on Historic Preservation a reasonable opportunity to comment on the proposed undertakings.

Significance—Significance of cultural resources is evaluated in terms of NRHP criteria published in 36 CFR 60.

State Historic Preservation Officer (SHPO)—Official appointed by the governor of each state and U.S. Territory, responsible for certain responsibilities relating to federal undertakings within the state. In Maryland, the duties of the SHPO are carried out by the Maryland Historical Trust, an agency of the Maryland Department of Planning.

Wetlands—The U.S. Army Corps of Engineers (Federal Register 1982) and the Environmental Protection Agency (Federal Register, 1980) jointly define wetlands as: Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

ACRONYMS

AADT	Annual Average Daily Traffic
AAWDT	Annual Average Weekday Traffic
ACHP	Advisory Council on Historic Preservation
APE	Area of Potential Effect
AQCR	Air Quality Control Region
BMP	Best Management Practice
C&O Canal NHP	Chesapeake and Ohio Canal National Historical Park
CAA	Clean Air Act
$CaCO_3$	Calcium Carbonate
CEQ	Council on Environmental Quality
CFD	Computational Fluid Dynamics
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CWA	Clean Water Act
DBH	Diameter at Breast Height
DC Water	District of Columbia Water and Sewer Authority
DEP	Department of Environmental Protection
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPT	Ephemeroptera, Plecoptera, or Trichoptera
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIDS	Forest Interior Dwelling Bird Species
FONSI	Findings of No Significant Impact
FSD	Forest Stand Delineation
GHG	Greenhouse Gas
GPS	Global Positioning System
HEA	Habitat Equivalency Analysis
IBA	Important Bird Areas
MBSS	Maryland Biological Stream Survey
MDE	Maryland Department of the Environment
MDNR	Maryland Department of Natural Resources
MHT	Maryland Historic Trust
MM	Mile Marker
MOA	Memorandum of Agreement
MPD	Maryland Department of Planning
MPN	Most Probable Number
MSE	Mechanically Stabilized Earth
MSL	Mean Sea Level

N/A	Not Applicable
NAAQS	National Ambient Air Quality Standards
NCR	National Capital Region
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NLEB	Northern Long-Eared Bat
NMIM	National Mobile Inventory Model
NO_X	Nitrogen Oxides
NPS	National Park Service
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Units
NWI	National Wetland Inventory
O_3	Ozone
OHWM	Ordinary High Water Mark
OSHA	Occupational Safety and Health Act
OTR	Ozone Transport Region
PACl	polyaluminum chloride
PEM1E	Palustrine, Emergent, Persistent, Seasonally Flooded/Saturated
PEPC	Planning, Environment, and Public Comment
PFO1A	Palustrine, Forested, Broad-Leaved Deciduous, Temporary Flooded
PFO1B	Palustrine, Forested, Broad-Leaved Deciduous, Saturated
$PM_{2.5}$	Particulate Matter with Size Less than 2.5 Microns in Diameter
PM_{10}	Particulate Matter with Size Less than 10 Microns in Diameter
PUBHx	Palustrine, Unconsolidated Bottom, Permanently Flooded, Excavated
R2UBH	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded
R2UBHx	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Excavated
ROW	Right-of-Way
RPW	Relatively Permanent Water
SAV	Submerged Aquatic Vegetation
SCC	Source Classification Codes
SHA	State Highway Administration
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SOF	Statement of Findings
SUP	Special Use Permit
SWA	Source Water Assessment
TMDL	Total Maximum Daily Load
TNW	Traditionally Navigable Waters

USACE	United States Army Corps of Engineers
USC	United States Code
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOCs	Volatile Organic Compounds
WASO	(NPS) Washington Office
WRD	Water Resources Division
WFP	Water Filtration Plant
W.U.S.	Waters of the United States
WSSC	Washington Suburban Sanitary Commission

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