
SECTION 4

ENVIRONMENTAL CONSEQUENCES

4.1 METHODS

This section analyzes the potential environmental consequences associated with the alternatives and is organized by the impact topics described in Section 3. Potential impacts are described in terms of duration (short-term, long-term, or permanent), intensity (negligible, minor, moderate, or major), type (beneficial or adverse), and context (local, parkwide, or regional). Definitions of duration and intensity vary by impact topic and are provided at the beginning of each impact topic section below.

The analysis considers direct and indirect impacts, cumulative impacts, and impairment of park resources or values, as well as resource protection measures (see Table 2.1). An example of an indirect impact would be increased mortality of an aquatic species that would occur because an alternative would increase soil erosion, which would reduce water quality. The Council on Environmental Quality regulations, which implement NEPA, require 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 non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for the alternatives and the other actions identified in "Section 1.4 - Relationship to Other Projects and Planning."

National Park Service *Management Policies 2006* requires analysis of potential effects to determine whether or not actions would impair park resources or values. Impairment, which is prohibited by the Organic Act, is an impact that "would harm the integrity of park resources or values, including opportunities that otherwise would be present for the enjoyment of those resources or values." Determining whether an impact meets this definition of impairment depends on the resource(s) affected; the severity, duration, and timing of the impact; the direct

and indirect effects of the impact; and the cumulative effects of the impact in conjunction with other impacts.

An impact on any park resource may constitute impairment, but an impact would be more likely to result in impairment if it affects a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park.
- Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park.
- Identified as a goal in the park's general management plan or other relevant NPS planning documents.

A determination of impairment is included for each alternative in the impact analysis section for all impact topics relating to the resources and values of the C&O Canal NHP. Visitor use and experience, park operations, public health and safety, and socioeconomic environment are not considered park resources. Therefore, impairment findings are not included as part of the impact analysis for these topics.

4.2 SOILS

4.2.1 Impact Threshold Definitions

Impact threshold definitions for soils are as follows:

- Negligible - Any effects would be so small that they would not be of any measurable or perceptible consequence.
- Minor - Effects would be detectable, but any changes would be of little consequence.
- Moderate - Effects would be readily apparent and measurable.
- Major - Effects would be readily apparent, and would substantially change soil characteristics.

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- Short-term - Following completion of the project or effect, recovery of previously disturbed or reclaimed soils would take less than one year.
 - Long-term - Following completion of the project or effect, recovery of natural soil conditions would take more than one year.

4.2.2 Alternative A – No Action – Continue Current Maintenance

The Catoctin Aqueduct would not be restored and no new ground disturbing activities would occur within the project area under Alternative A (No Action Alternative). Soil erosion would continue to occur throughout the project area at baseline levels, which are low because of the existing vegetative cover. The pedestrian bridge abutment on the west bank of Catoctin Creek would not be removed and imbricated rip-rap would not be installed in this area. Soil erosion under this abutment would continue during high stream flows, but would be localized. Alternative A would result in long-term, negligible, adverse effects to soils.

Cumulative Effects

The stone inventory and recovery completed in the project area by the NPS in late 2006 included operation of light construction equipment, resulting in ground disturbance and minor, adverse effects to soils (e.g., compaction and increased potential for erosion). However, the effects were localized and short-term. When the effects of other actions and Alternative A are combined, the cumulative, long-term, adverse effects to soils would remain negligible and localized.

Conclusions

Alternative A would result in long-term, negligible, adverse effects to soils based on continued baseline soil erosion conditions. Other actions would not contribute to long-term cumulative impacts to soils. Alternative A would not result in impairment of park soil resources or values.

4.2.3 Alternative B – Stone Masonry Arches

Alternative B would involve operation of construction equipment, vegetation clearing, construction of temporary access roads, grading, permanent and temporary placement of fill materials, and other activities that would result in temporary disturbances to the ground surface. The total area of ground disturbance is estimated to be approximately 1.5 acres, which does not include the area of the towpath where equipment would be operated. These activities would result in soil compaction, and would temporarily increase the potential for soil erosion and loss of soil productivity and fertility. Primary soil erosion concerns would be associated with work conducted on or near steep slopes in the immediate vicinity of the aqueduct, including the temporary access road from the towpath to Catoctin Creek. Soil map units found in these areas include Codorus and Hatboro silt loams and Lindside silt loam, both of which have slight erosion hazards (see Table 3.1 and Figure 3-1).

Alternative B includes implementation of resource protection measures to avoid and minimize impacts to soils (Table 2.1). An erosion and sediment control plan would be prepared and implemented in accordance with *Maryland Erosion and Sediment Control Guidelines for State and Federal Projects* (MDE 2004a). The plan would include resource protection measures that conform to *Maryland Standards and Specifications for Erosion and Sediment Control* (MDE 1994) and would be submitted to the Maryland Department of the Environment, Water Management Administration for approval. In addition, coverage under Maryland's *General Permit for Construction Activity* would be obtained by submitting a Notice of Intent to the Maryland Department of the Environment. Alternative B would result in short-term, minor, adverse effects to soils based on implementation of resource protection measures and the relatively small area of disturbance.

Cumulative Effects

The stone inventory and recovery completed in the project area by the NPS in late 2006 included operation of light construction equipment, resulting in ground disturbance and minor, adverse effects to soils (e.g., compaction and increased potential for erosion) in areas that would be affected by Alternative B. Soils in the project area would be expected to recover prior to implementation of Alternative B. When the effects of other actions and Alternative B are combined, the cumulative, short-term, adverse effects to soils would remain minor and localized.

Conclusions

Construction activities associated with Alternative B would result in short-term, minor, adverse effects to soils based on implementation of resource protection measures and the relatively small area of disturbance (1.5 acres). Other actions would not contribute cumulative impacts to soils. Alternative B would not result in impairment of park soil resources or values.

4.2.4 Alternative C – Reinforced Concrete Arches

The location and size (1.5 acres) of the area of disturbance; the type and magnitude of ground disturbing activities; and resource protection measures for Alternative C would be the same as Alternative B. Therefore, the analysis of soils impacts presented in Section 4.2.3 is applicable to this alternative. Alternative C would result in short-term, minor, adverse effects to soils.

Cumulative Effects

As discussed for Alternative B, soils in the project area affected by past stone inventory activities would be expected to recover prior to implementation of Alternative C. When the effects of other actions and Alternative C are combined, the cumulative, short-term, adverse effects to soils would remain minor and localized.

Conclusions

Construction activities associated with Alternative C would result in short-term, minor, adverse effects to soils based on implementation of resource protection measures and the relatively small area of disturbance (1.5 acres). Other actions would not contribute cumulative impacts to soils. Alternative C would not result in impairment of park soil resources or values.

4.3 GEOLOGY

4.3.1 Impact Threshold Definitions

Impact threshold definitions for geology are as follows:

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- Negligible - Any effects would be so small that they would not be of any measurable or perceptible consequence.
 - Minor - Effects would be detectable, but any changes would be of little consequence.
 - Moderate - Effects would be readily apparent and measurable.
 - Major - Effects would be readily apparent, and would substantially change geologic conditions.
 - Short-term - Following completion of the project or effect, recovery would take less than one year.
 - Long-term - Following completion of the project or effect, recovery of natural conditions would take more than one year and might extend indefinitely.

4.3.2 Alternative A – No Action – Continue Current Maintenance

The Catoctin Aqueduct would remain in its current configuration under Alternative A. Scouring from stream flow would continue to occur around the aqueduct abutments, wing walls, and piers. Geologic materials would continue to slowly erode in these areas. The scour evaluation conducted for the Catoctin Aqueduct (MDSHA 2006 and W.J. Castle 2006, see Appendix B) indicates that the only area where substantial scouring has occurred is under the remains of the west pier. Scouring would continue under Alternative A and would eventually lead to collapse of the remaining portions of the west pier. The effects of Alternative A on geological resources would be long-term, negligible, and adverse. The effects would be localized.

Cumulative Effects

Other actions have not affected geology in the project area. When the effects of other actions and Alternative A are combined, the cumulative, long-term, adverse effects to geology would remain negligible.

Conclusions

Alternative A would result in long-term, negligible, localized, adverse effects to geology based on continued scour around Catoctin Aqueduct. Other actions would not contribute cumulative impacts to geological resources. Alternative A would not result in impairment of park geological resources or values.

4.3.3 Alternative B – Stone Masonry Arches

Alternative B involves restoring the Catoctin Aqueduct by reconstructing the center and west arches in their original footprint. The restored aqueduct would decrease the waterway opening of Catoctin Creek, increasing stream velocities during high flow events. Increased velocities would increase the potential for scour and erosion of geologic materials around and under the structure's foundation. A scour evaluation has been completed on the existing structure to identify scour issues that would be addressed during design of the restored structure (MDSHA 2006 and W.J. Castle 2006, see Appendix B). Standard engineering practices would be used in construction to repair existing scour damage and prevent or minimize future scour.

Increased stream velocities also have the potential to erode geologic materials immediately downstream of the restored aqueduct. Similar erosion forces were present in this area prior to partial collapse of the aqueduct in 1973. Further erosion of geologic materials would be minimal based on the backwater effects of the Potomac River, relatively low Froude numbers, and the substantial amount of rock outcropping in the area (see hydrologic and hydraulic analysis in Appendix C). Overall, Alternative B would result in long-term, negligible, beneficial effects to geology by correcting existing scour issues at the Catoctin Aqueduct.

Cumulative Effects

Other actions have not affected geology in the project area. When the effects of other actions and Alternative B are combined, the cumulative, long-term, beneficial effects to geology would remain negligible.

Conclusions

Overall, Alternative B would result in long-term, negligible, beneficial effects to geology by correcting existing scour issues at the Catoctin Aqueduct. Other actions would not contribute cumulative impacts to geological resources. Alternative B would not result in impairment of park geological resources or values.

4.3.4 Alternative C – Reinforced Concrete Arches

The instream footprint of the restored Catoctin Aqueduct and scour-related design issues for Alternative C would be the same as Alternative B. Therefore, the analysis of geology impacts presented in Section 4.3.3 is applicable to this alternative. Overall, Alternative C would result in long-term, negligible, beneficial effects to geology by correcting existing scour issues at the Catoctin Aqueduct.

Cumulative Effects

Similar to Alternative B, when the effects of other actions and Alternative C are combined, the cumulative, long-term, beneficial effects to geology would remain negligible.

Conclusions

Overall, Alternative C would result in long-term, negligible, beneficial effects to geology by correcting existing scour issues at the Catoctin Aqueduct. Other actions would not contribute cumulative impacts to geological resources. Alternative B would not result in impairment of park geological resources or values.

4.4 SURFACE WATER QUALITY

4.4.1 Impact Threshold Definitions

Impact threshold definitions for surface water are as follows:

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- Negligible - Chemical, physical, or biological changes to water quality would be below detection or barely detectable, and would be within historical or desired water quality conditions.
 - Minor - Chemical, physical, or biological changes to water quality would be detectable and would be within historical or desired water quality conditions.
 - Moderate - Chemical, physical, or biological changes to water quality would be detectable and readily apparent. Water quality would be altered compared to historical baseline or desired water quality conditions.
 - Major - Chemical, physical, or biological changes to water quality would be readily measurable, and would be frequently altered from the historical baseline or desired water quality conditions.
 - Short-term - Effects would primarily exist during active implementation of a given action. Effects would cease within a year following implementation of the element.
 - Long-term - Effects would extend more than a year beyond implementation of an action.

4.4.2 Alternative A – No Action – Continue Current Maintenance

The Catoctin Aqueduct would not be restored under the Alternative A. Therefore, no instream work or ground disturbing activities would occur. Baseline condition for surface water would not change and Alternative A would have no effect on surface water quality.

Cumulative Effects

Other actions have not affected surface water quality in the project area. When the effects of other actions and Alternative A are combined, there would be no cumulative effect.

Conclusions

Alternative A would have no effect on surface water quality. Other actions would not contribute cumulative impacts to surface water quality. Alternative A would not result in impairment of park surface water resources or values.

4.4.3 Alternative B – Stone Masonry Arches

As discussed above in Section 4.1.2, Alternative B would involve several activities that would result in temporary disturbances to the ground surface during construction work (total area of approximately 1.5 acres). These activities would temporarily increase the potential for soil erosion and subsequent transport of sediment-laden stormwater runoff to Catoctin Creek and the Potomac River. Resulting effects to surface water quality would include temporary and localized increases in turbidity, total suspended solids concentrations, and loading of nutrients such as nitrogen and phosphorus.

Alternative B includes implementation of resource protection measures to avoid and minimize impacts to surface water quality resulting from construction-related ground disturbances (Table 2.1). An erosion and sediment control plan would be prepared and implemented in accordance with *Maryland Erosion and Sediment Control Guidelines for State and Federal Projects* (MDE 2004a). The plan would include resource protection measures that conform to *Maryland Standards and Specifications for Erosion and Sediment Control* (MDE 1994) and would be submitted to the Maryland Department of the Environment, Water Management Administration for approval. In addition, coverage under Maryland's *General Permit for Construction Activity* would be obtained by submitting a Notice of Intent to the Maryland Department of the Environment. Based on implementation of resource protection measures and the relatively small area of disturbance, Alternative B would result in short-term, minor, adverse effects to surface water quality from construction-related ground disturbing activities. These effects would be localized and limited to Catoctin Creek. Changes in water quality of the Potomac River are expected to be negligible based on its large dilution capacity.

Restoration of the Catoctin Aqueduct would also require that work be performed instream (e.g., repairing scour around and under the structure, rebuilding the west pier, and repairing the east pier, wing walls, and abutments). Specific instream construction methods would be determined during the design process and could include "in-the-wet" and/or "in-the-dry" techniques. In-the-wet methods could include cement grouting by tremie pipe (pipe used to pump grout to an underwater void) behind temporarily placed grout bags and a turbidity curtain. In-the-dry methods could include temporarily diverting stream flow or placement of a temporary cofferdam. A small barge would also be used in Catoctin Creek to facilitate this work.

Instream work would result in temporary and localized disturbances to the stream bottom (less than 0.2 acres), which is described as silt over rock in the immediate vicinity of the aqueduct (W.J. Castle 2006). Silt would become re-suspended, increasing turbidity and total suspended solids concentrations. Underwater cement grouting or placement of concrete also has the potential to affect surface water quality. During field studies conducted in Virginia, Fitch (2003) found that pH was the primary water quality parameter affected by placement of grout underwater for the rehabilitation of scour. Results showed pH levels downstream of grout placement without a turbidity curtain often exceeded 9.0 (Virginia's upper water quality criteria for pH) and in some cases approached 12. The studies also showed that instream pH could be kept below 9.0 using a combination of placement techniques, such as turbidity curtains and slow grout pumping rates, and/or an anti-washout admixture (an additive that decreases the percentage of fines and cement paste that are washed out prior to setting). Higher stream flows also minimized downstream increases in pH (Fitch 2003). Maryland water quality criteria specify that normal pH values may not be less than 6.5 or greater than 8.5.

Alternative B includes implementation of resource protection measures to avoid and minimize impacts to surface water quality resulting from instream work (Table 2.1). The construction documents would include specifications for temporary stream diversion/cofferdam installation, dewatering techniques, and underwater grouting. Where applicable, instream work would be accomplished in accordance with *Maryland's Waterway Construction Guidelines* (MDE 2000). Turbidity curtains, anti-washout admixture, and appropriate pumping rates would be used during underwater placement of cement grout or concrete to maintain instream pH levels below 8.5. A *Joint Federal/State Application for the Alteration of any Floodplain, Waterway, Tidal or Nontidal Wetland in Maryland* would be submitted and applicable permits obtained from the Maryland Department of the Environment and U.S. Army Corps of Engineers prior to initiating work. All regulated activities within Waters of the United States and Waters of the State, including the 100-year floodplain and jurisdictional wetlands, would be conducted in accordance with permit conditions. Based on implementation of resource protection measures and the relatively small area of disturbance, Alternative B would result in short-term, minor, adverse effects to surface water quality from instream work. These effects would be localized and limited to Catoctin Creek. Changes in water quality of the Potomac River are expected to be negligible based on its large dilution capacity.

Surface water also has the potential to be contaminated by incidental spills of petroleum products or other materials used during the restoration work. All fuel storage, equipment

refueling, and equipment maintenance would be accomplished in designated areas with secondary containment in accordance with NPS-approved procedures to avoid incidental spills. The contractor would be required to have contingency procedures in place to respond to incidental spills in accordance with federal, state, and local regulations and NPS policy. The contractor would remove all equipment and fuel from the area, as directed by NPS staff, if conditions indicate that flooding might occur. Contractor will be responsible for submitting a Spill Response Plan to address the above listed requirements. Based on these protection measures, incidental spills are not expected to occur and no effects to surface water are anticipated.

Cumulative Effects

Other actions have not affected surface water in the project area. When the effects of other actions and Alternative B are combined, the cumulative, short-term, adverse effects to surface water quality would remain minor and localized.

Conclusions

Construction activities associated with Alternative B would result in short-term, minor, adverse effects to surface water quality. Minimal increases in turbidity, total suspended solids, nutrient loading, and pH are anticipated. Implementation of resource protection measures would minimize impacts. The effects would be localized and limited to Catoctin Creek. Other actions would not contribute cumulative impacts to surface water quality. Alternative B would not result in impairment of park surface water resources or values.

4.4.4 Alternative C – Reinforced Concrete Arches

The types, locations, and sizes of ground and instream disturbance for Alternative C would be the same as Alternative B. Therefore, the analysis of surface water quality impacts presented in Section 4.4.3 is applicable to this alternative. Alternative C would result in short-term, minor, adverse effects to surface water quality from construction-related ground disturbances and instream work. These effects would be localized and limited to Catoctin Creek.

Cumulative Effects

Similar to Alternative B, when the effects of other actions and Alternative C are combined, the cumulative, short-term, adverse effects to surface water quality would remain minor and localized.

Conclusions

Construction activities associated with Alternative C would result in minor, short-term adverse effects to surface water quality. Minimal increases in turbidity, total suspended solids, nutrient loading, and pH are anticipated. Implementation of resource protection measures would minimize impacts. The effects would be localized and limited to Catoctin Creek. Other actions would not contribute cumulative impacts to surface water quality. Alternative C would not result in impairment of park surface water resources or values.

4.5 FLOODPLAINS

4.5.1 Impact Threshold Definitions

Impact threshold definitions for floodplains are as follows:

- Negligible - Changes in floodplain values, functions, and ability to distribute floodwaters would not be measurable. The frequency and/or magnitude of floods would not increase.
- Minor - Changes in floodplain values, functions, and ability to distribute floodwaters would be slightly measurable and local. The frequency and/or magnitude of floods would not increase.
- Moderate - Changes in floodplain values, functions, and ability to distribute floodwaters would be measurable and local. The frequency and/or magnitude of floods could increase.
- Major - Changes in floodplain values, functions, and ability to distribute floodwaters would be measurable and widespread. The frequency and/or magnitude of floods would increase.

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- Short-term - Effects would occur during construction and up to two years after construction is completed.
 - Long-term - Effects would continue more than two years following construction.

4.5.2 Alternative A – No Action – Continue Current Maintenance

The Catoctin Aqueduct would not be restored under Alternative A and the remaining structure would be susceptible to further collapse. If further collapse were to occur, less of Catoctin Creek's flow area would be blocked compared to current conditions. This reduction in blocked flow area would decrease water surface elevations during flood events and would likely reduce the magnitude of flooding slightly. If further collapse of the aqueduct were to occur under Alternative A, the long-term, beneficial effects on floodplains would be minor and localized. Floodplains would not be affected if further collapse were not to occur.

Cumulative Effects

Other actions have not affected floodplains in the project area. When the effects of other actions and Alternative A are combined, the cumulative effects on floodplains would range from no effect to long-term, minor, beneficial effects.

Conclusions

If further collapse of the aqueduct were to occur under Alternative A, the long-term, beneficial effects on floodplains would be minor and localized. Floodplains would not be affected if further collapse were not to occur. Other actions would not contribute cumulative effects to floodplains.

4.5.3 Alternative B – Stone Masonry Arches

The entire Catoctin Aqueduct restoration project area is located in the 100-year floodplain of the Potomac River and Catoctin Creek, as mapped by the Federal Emergency Management Agency. As such, all activities implemented under Alternative B would have the potential to affect floodplain resources and values. The analysis presented in this section focuses on flooding effects that would result from restoring the Catoctin Aqueduct to its original

configuration. Potential effects to other floodplain resources (vegetation, wetlands, surface water, etc.) are analyzed in other sections of this EA.

Alternative B would involve restoring the Catoctin Aqueduct to its original configuration by reconstructing the center and west arches. Reconstructing these arches in and above Catoctin Creek would cause more of the creek's flow area to be blocked compared to current conditions. The blocked flow area would increase water surface elevations during flood events, causing additional areas to be flooded. Results of a hydrologic and hydraulic analysis (see Appendix C) conducted for the proposed restoration indicate that Alternative B would increase water surface elevations associated with Catoctin Creek's 50- and 100-year flood events (Table 4.1). Water surface elevations associated with the Potomac River's 100-year flood event would also increase. Existing and proposed floodplain limits for the Catoctin Creek 100-year flood event are shown in Figure 2 of the hydrologic and hydraulic analysis report (Appendix C).

Downstream of the aqueduct, the existing and proposed 100-year floodplain limits would coincide and no additional areas would be subjected to flooding. The proposed 100-year floodplain limits would increase upstream of the Catoctin Aqueduct and upstream of the CSX Railroad viaduct. The canal prism east and west of the aqueduct would be subjected to flooding, as would forest and pasture upstream of the railroad viaduct.

As modeled during the hydrologic and hydraulic analysis, the proposed 50- and 100-year Catoctin Creek water surface elevations would exceed the low cord (top of the arch opening) of the aqueduct (228.14 feet), but would not overtop the aqueduct (top of aqueduct elevation = 240.49 feet) or towpath. The modeling indicates that water surface elevations associated with the 100-year Potomac River flood event would overtop the aqueduct for existing and proposed conditions.

TABLE 4.1

**EXISTING AND PROPOSED WATER SURFACE ELEVATIONS ASSOICATED WITH
CATOCTIN CREEK 50- AND 100-YEAR FLOOD EVENTS AND POTOMAC RIVER 100-YEAR FLOOD EVENT**

Cross Section Location⁽¹⁾	Water Surface Elevation - Catoctin Creek Flood Events (feet above mean sea level)						Water Surface Elevation – Potomac River Flood Event (feet above mean sea level)		
	50-yr Existing	50-yr Proposed	Change in 50-yr	100-yr Existing	100-yr Proposed	Change in 100-yr	100-yr Existing	100-yr Proposed	Change in 100-yr
Downstream of Aqueduct (351 ft)	230.43	230.43	0.00	232.74	232.74	0.00	240.97	240.97	0.00
Downstream of Aqueduct (24 ft)	230.08	230.22	+0.14	232.13	232.33	+0.20	240.98	240.98	0.00
Upstream of Aqueduct (24 ft)	231.40	233.36	+1.96	234.08	237.74	+3.66	241.60	242.46	+0.86
Downstream of RR (210 ft)	231.56	233.44	+1.88	234.35	237.91	+3.56	241.54	242.40	+0.86
Upstream of RR (279 ft)	232.57	234.37	+1.80	235.91	239.44	+3.53	242.15	243.02	+0.87
Upstream of RR (824 ft)	232.57	234.37	+1.80	235.91	239.44	+3.53	242.44	243.34	+0.87
Upstream House Site 1 (3,626 ft)	236.31	237.22	+0.91	239.29	241.65	+2.36	242.76	243.59	+0.83
Upstream House Site 2 (5,787 ft)	242.09	242.25	+0.16	244.40	245.12	+0.72	243.85	244.51	+0.66

⁽¹⁾(xxx ft) indicates distance in feet from the Catoctin Aqueduct. RR indicates CSX Railroad viaduct.

A decrease in hydraulic efficiency would occur, causing the restored aqueduct to run under pressure conditions for the 50- and 100-year storm events. A structure acts under pressure flow conditions when it blocks enough of the flow area to cause both the upstream and downstream water surface elevations to be above the low chord elevation, thus acting like a sluice gate or orifice. With pressure flow, the maximum velocity immediately at the restored aqueduct would increase from 14.11 to 16.37 feet per second for the 100-year storm event. This increase in velocity would increase the potential for localized scour at the abutments and piers of the replacement structure. These issues would be accounted for during design and construction. It appears that the increase in velocity is localized and that the potential for downstream scour is minimal based on the backwater effects of the Potomac River, relatively low Froude numbers, and the substantial amount of rock outcropping in the area. The Froude number for the existing and proposed conditions models are below 1.0. This means that the Catoctin Creek channel is a subcritical flow regime, which is characterized by relatively smooth laminar type flow.

As modeled, the existing CSX Railroad structure effectively passes all flow from the 50- and 100-year storm events. Upstream of the railroad structure the Catoctin Creek proposed 100-year water surface elevation (239.44 feet) would be 0.61 feet above the low cord of the railroad structure (238.83 feet), but the water surface elevation would be 0.92 feet below the low cord downstream of the structure. This indicates that the railroad structure would not run under pressure flow conditions for the Catoctin Creek 100-year storm event. The existing water surface elevation for the Potomac River 100-year event is 3.32 feet above the railroad structure low chord and the proposed Potomac River water surface elevation would be 4.19 feet above the railroad structure low chord. The railroad structure would not be overtopped in any of the storm events modeled (top of rail elevation = 245.8 feet).

The hydrologic and hydraulic analysis results indicate that water surface elevation increases would also be expected to occur in the upper reaches of the study area in the vicinity of East Boss Arnold Road, but no structures would be affected. As modeled for the upstream house site 1, the proposed water surface elevation for the Catoctin Creek 100-year storm event would be 241.65 feet and the proposed water surface elevation for the Potomac River 100-yr storm event would be 243.59 feet. The structure elevation at this site is 283.45 feet. As modeled for the upstream house site 2, the proposed water surface elevation for the Catoctin Creek 100-year storm event would be 245.12 feet and the proposed water surface elevation for

the Potomac River 100-year storm event would be 244.51 feet. The structure elevation at this site is 249.07 feet. Both structures would continue to be outside the 100-year flood limits.

Restoration of the Catoctin Aqueduct would be regulated by the U.S. Army Corps of Engineers and the Maryland Department of the Environment (COMAR 26.17.04, Construction on Nontidal Waters and Floodplains). A *Joint Federal/State Application for the Alteration of any Floodplain, Waterway, Tidal or Nontidal Wetland in Maryland* would be submitted and applicable permits obtained prior to initiating work. All regulated activities would be conducted in accordance with permit conditions. As discussed in Section 3.4, Director's Order #77-2: Floodplain Management (NPS 2003) does not apply to the Catoctin Aqueduct because it is a historic structure and its location on Catoctin Creek is integral to its significance. Therefore, a Statement of Findings for floodplains is not required for the Catoctin Aqueduct restoration.

Alternative B would result in long-term, moderate, adverse effects to floodplains by increasing water surface elevations and the magnitude of the 50- and 100-year flood events. The effects would be localized and no inhabited structures would be affected. Localized flooding under Alternative B is expected to be similar to conditions experienced prior to the partial collapse of Catoctin Aqueduct in 1973. However, the magnitude of flooding under proposed conditions could be slightly greater than pre-1973 conditions if Catoctin Creek discharge volumes have increased since 1973. Some increase in discharge volume would be expected from increased development, impervious surfaces, and runoff in the Catoctin Creek watershed.

Cumulative Effects

Other actions have not affected floodplains in the project area. When the effects of other actions and Alternative B are combined, the cumulative, long-term, adverse effects to floodplains would remain moderate and localized.

Conclusions

Alternative B would result in long-term, moderate, adverse effects to floodplains by increasing water surface elevations and the magnitude of the 50- and 100-year flood events. The effects would be localized and no inhabited structures would be affected. Localized

flooding under Alternative B is expected to be similar to conditions experienced prior to the partial collapse of Catoctin Aqueduct in 1973. However, the magnitude of flooding could be slightly greater if Catoctin Creek discharge volume has increased since 1973, as a result of increased development and runoff in the Catoctin Creek watershed. Other actions would not contribute cumulative impacts to floodplains. Alternative B would not result in impairment of park floodplain resources or values.

4.5.4 Alternative C – Reinforced Concrete Arches

The flow area of Catoctin Creek that would be blocked under Alternative C would be the same as Alternative B. Therefore, the analysis of floodplain impacts presented in Section 4.5.3 is applicable to this alternative. Alternative C would result in long-term, moderate, adverse effects to floodplains by increasing water surface elevations and the magnitude of the 50- and 100-year flood events. The effects would be localized and no inhabited structures would be affected.

Cumulative Effects

Similar to Alternative B, when the effects of other actions and Alternative C are combined, the cumulative, long-term, adverse effects to floodplains would remain moderate and localized.

Conclusions

Alternative C would result in long-term, moderate, adverse effects to floodplains by increasing water surface elevations and the magnitude of the 50- and 100-year flood events. The effects would be localized and no inhabited structures would be affected. Localized flooding under Alternative B is expected to be similar to conditions experienced prior to the partial collapse of Catoctin Aqueduct in 1973. However, the magnitude of flooding could be slightly greater if Catoctin Creek discharge volume has increased since 1973, as a result of increased development and runoff in the Catoctin Creek watershed. Other actions would not contribute cumulative impacts to floodplains. Alternative C would not result in impairment of park floodplain resources or values.

4.6 VEGETATION

4.6.1 Impact Threshold Definitions

Impact threshold definitions for vegetation are as follows:

- Negligible - Individual native plants may occasionally be affected, but measurable or perceptible changes in plant community size, integrity, or continuity would not occur.
- Minor - Effects on native plant species and/or communities would be measurable or perceptible. The viability of the plant community would not be affected and the community, if left alone, would recover.
- Moderate - Effects to plant species would be readily apparent from a given activity. Changes to the natural function and character of a plant community in terms of abundance, distribution, structure, and/or diversity could occur.
- Major - Effects on native plant communities would be readily apparent based on parameters such as abundance, distribution, structure, and/or diversity. The natural function and character of one or more plant communities would be substantially changed.
- Short-term - The effect would occur only during or shortly after a specified action or treatment. Within a year, there would be stable biological processes that will produce conditions similar to those that predominated previously.
- Long-term - Biological processes would not stabilize within a year, and would not result in conditions similar to those that predominated previously.

4.6.2 Alternative A – No Action – Continue Current Maintenance

Under Alternative A routine grass cutting would continue to occur around the Catoctin Aqueduct. Vegetation growing in cracks of the aqueduct ruins would be periodically removed to retard further deterioration of the structure. Trees growing in the immediate vicinity of the structure could be removed if they had the potential to damage the ruins. Alternative A would result in long-term, negligible, adverse effects to vegetation and the effects would be localized.

Cumulative Effects

Approximately 0.14 acres of early successional forest and shrubby vegetation were cleared in the project area to accomplish the stone inventory in late 2006, resulting in long-term, negligible, adverse effects to vegetation. When the effects of other actions and Alternative A are combined, the cumulative, long-term, adverse effects would remain negligible and localized.

Conclusions

Alternative A would result in long-term, negligible, adverse effects to vegetation and the effects would be localized. When the effects of other actions and Alternative A are combined, the cumulative, long-term, adverse effects would remain negligible and localized. Alternative A would not result in impairment of park vegetation resources or values.

4.6.3 Alternative B – Stone Masonry Arches

Construction activities under Alternative B would result in temporary disturbance and permanent clearing of vegetation, as summarized in Table 4.2. The limits of vegetation disturbance/clearing would be established by NPS staff prior to construction. These limits would be clearly noted on construction documents and marked in the field by NPS staff. Trees to be retained within the disturbance/clearing limits would be marked and NPS, National Capital Region *Guidelines for Tree Preservation* (NPS 2004) would be followed. Large trees would be retained to the maximum extent possible. Approximately 50 trees (diameter at breast height of 6 inches or greater) would be cleared from the project area.

Approximately 0.5 acres of vegetation would be temporarily disturbed and restored following completion of the project. These areas would include about 0.2 acres of maintained grass immediately east and west of the aqueduct, 0.1 acres of forest associated with the access road/causeway to the towpath, and 0.2 acres of forest associated with the access road to the east bank of Catoctin Creek. Clearing for the two temporary access roads (approximately 0.3 acres total) would primarily consist of shrubby, understory vegetation, but a few larger trees could be selectively removed. Although these areas would be restored upon completion of the work,

TABLE 4.2
SUMMARY OF VEGETATION DISTURBANCE FOR ALTERNATIVES B AND C

Location	Vegetation Type	Approximate Acreage	Type of Disturbance and Restoration
Immediately east and west of aqueduct	Maintained grass	0.2	Temporary, restored to same
Access road/causeway to towpath	Forest	0.1	Temporary, selective tree cutting, restore to same
Access road to east bank of Catoctin Creek	Forest	0.2	Temporary, selective tree cutting, restore to same
Subtotal temporary disturbance =		0.5	
Canal prism east and west of aqueduct	Forest	1.0	Permanent, selective tree cutting, plant in grass and maintain
Total =		1.5	

they would be susceptible to colonization by invasive plants such as multiflora rose (*Rosa multiflora*), garlic mustard (*Alliaria petiolata*), and Japanese stilt grass (*Microstegium vimineum*).

Approximately 1 acre within the canal prism east and west of the aqueduct would be subjected to selective vegetation clearing to accommodate construction of the transitional ramps leading from the towpath to the restored aqueduct. A majority of the prism is characterized by dense understory vegetation such as spicebush. While a few mature trees such as American sycamore, box elder, tulip popular are growing directly in the canal prism, larger trees primarily occur along the edges of the prism. Therefore, vegetation cleared from these areas would primarily consist of shrubby, understory vegetation and a few large trees growing directly in the canal prism. Trees along the towpath would be retained to the extent possible and all trees between the canal prism and railroad would be retained. Specimen trees would also be retained. Grass would be planted and maintained in the cleared portion of the canal prism to enhance the cultural landscape and visitor interpretation of the "crooked aqueduct."

As discussed in Section 3.5, the Catoctin Aqueduct is located in an area mapped as a green infrastructure hub (MD DNR 2006b) and the forested lands in the immediate vicinity of the aqueduct are ranked as high or medium ecological value (MD DNR 2006c). The forested areas that would be disturbed or cleared under Alternative B are located close to the forest edge formed by the railroad to the north, not in the higher quality forest interior south of the towpath. While the proposed clearing would create additional forest edge, fragmentation would be minimal. The area that would be affected is also very small relative to the extensive forests along the Potomac River in this part of the park. Consequently, the short- and long-term, adverse effects of Alternative B to vegetation would be minor and localized.

Cumulative Effects

Approximately 0.14 acres of early successional forest and shrubby vegetation were cleared in the project area to accomplish the stone inventory in late 2006, resulting in long-term, negligible, adverse effects to vegetation. These previously cleared areas are contiguous to areas that would be cleared under Alternative B. When the effects of other actions and Alternative B are combined, the cumulative, long-term, adverse effects would remain minor and localized.

Conclusions

Construction activities under Alternative B would result in temporary disturbance (0.5 acres) and permanent clearing (1.0 acres) of vegetation. The total area of vegetation disturbance would be approximately 1.5 acres. The short- and long-term, adverse effects of Alternative B to vegetation would be minor and localized. The cumulative adverse effects to vegetation from other actions and Alternative B would be long-term, minor, and localized. Alternative B would not result in impairment of park vegetation resources or values.

4.6.4 Alternative C – Reinforced Concrete Arches

The locations and total area of temporary disturbance and permanent clearing of vegetation for Alternative C would be the same as Alternative B (1.5 acres total). Therefore, the analysis of vegetation impacts presented in Section 4.6.3 is applicable to this alternative. The short- and long-term, adverse effects of Alternative C to vegetation would be minor and localized.

Cumulative Effects

Similar to Alternative B, the cumulative adverse effects to vegetation from other actions and Alternative C would be long-term, minor, and localized.

Conclusions

Construction activities under Alternative C would result in temporary disturbance (0.5 acres) and permanent clearing (1.0 acres) of vegetation. The total area of vegetation disturbance would be approximately 1.5 acres. The short- and long-term, adverse effects of Alternative C to vegetation would be minor and localized. The cumulative adverse effects to vegetation from other actions and Alternative C would be long-term, minor, and localized. Alternative C would not result in impairment of park vegetation resources or values.

4.7 WETLANDS

4.7.1 Impact Threshold Definitions

Impact threshold definitions for wetlands are as follows:

- Negligible – No measurable or detectable changes in terms of wetland area, structure, hydrologic utility, function, or values. Federal and/or state permits would not be required.
- Minor – Changes would be measurable or detectable in terms of wetland area, structure, hydrologic utility, function, or values, but the changes would be temporary. Restoration might be necessary, but replacement of lost wetlands would not be required. Federal and/or state permits would likely be required.
- Moderate - Changes would be readily apparent in terms of wetland area, structure, hydrologic utility, function, or values. Some changes would be permanent, but the total area of lost wetlands would not exceed one acre. Replacement of lost wetlands would be required and could be accomplished on site or within the watershed. Federal and/or state permits would be required.
- Major - Changes would be readily apparent in terms of wetland area, structure, hydrologic utility, function, and values. Many changes would be permanent and

the total area of lost wetlands would exceed one acre. Replacement of lost wetlands would be required, but might not be feasible on site or within the watershed. Federal and/or state permits would be required.

- Short-term - The effect would occur only during or shortly after a specified action or treatment. Within a year, there would be stable conditions similar to those that predominated previously.
- Long-term - Effects to wetlands would not stabilize within a year, and would not result in conditions similar to those that predominated previously.

4.7.2 Alternative A – No Action – Continue Current Maintenance

Under Alternative A the Catoctin Aqueduct would not be restored and wetlands, wetland buffers, and/or waters of the U.S./State would not be disturbed. Continuing current maintenance would have no affect on wetlands.

Cumulative Effects

Other actions have not affected wetlands in the project area. When the effects of other actions and Alternative A are combined, no cumulative effects would result.

Conclusions

Alternative A would have no affect on wetlands and there would be no cumulative effects from other actions. Alternative A would not result in impairment of park wetland resources or values.

4.7.3 Alternative B – Stone Masonry Arches

Construction and ground disturbing activities associated with Alternative B have the potential to affect jurisdictional wetlands and/or associated buffers. Maryland Department of Natural Resources wetlands mapping shows palustrine forested wetlands in the Potomac River floodplain south of the C&O Canal towpath. Wetlands of Special State concern are also located in the immediate vicinity of the project area. Site inspections conducted in October 2006 suggest that small pockets of wetlands exist within the canal prism in the project area, but

that none are present in the proposed area of disturbance. The presence or absence of jurisdictional wetlands and/or buffers in the proposed area of disturbance would be confirmed during the design and permitting process. A formal wetland delineation would be completed, if necessary.

Regardless of the presence or absence of jurisdictional wetlands, Alternative B would be subject to the joint federal/state wetland permitting process because the entire canal prism is considered navigable waters of the U.S. and the entire project area is in the 100-year floodplain, which is considered waters of the State. Therefore, the analysis presented below includes proposed activities potentially affecting wetlands, wetland buffers, and/or waters of the U.S./State are discussed below.

Reconstruction of the aqueduct's center and west arches would involve instream work, which would include temporary disturbance of the stream bottom (less than 0.2 acres) and could include placement of fill in Catoctin Creek. Restoration would occur within the aqueduct's existing footprint, so any additional fill would be limited to that required to repair existing scour damage and to prevent future scour (not expected to exceed 300 square feet). The pedestrian bridge abutment and associated stone wall on the west bank of Catoctin Creek (Figure 2-7) would be removed. Imbricated rip-rap would be installed in this area (approximately 200 square feet) to stabilize the creek bank. Total additional fill from these two activities would be minimal (approximately 500 square feet, 0.01 acres). The short- and long-term, adverse effects would be negligible and localized.

Construction of the transitional ramps from the towpath to the aqueduct would involve selective tree clearing, grading, and placement of fill in the canal prism. The total area of disturbance in the canal prism would be approximately 1 acre and permanent fill would be approximately 0.1 acres. Construction of the temporary access causeway would involve limited vegetation clearing and temporary placement of fill in the canal prism (approximately 0.06 acres). Construction of the temporary access road from the towpath to the east bank of Catoctin Creek would include limited vegetation clearing and temporary placement of fill in the floodplain (approximately 0.09 acres). The total temporary and permanent fill from these activities would be minimal (0.25 acres). The short- and long-term, adverse effects would be minor and localized.

The total area of disturbance to resources that could be classified as wetlands, wetland buffers, and/or waters of the U.S./State would be approximately 1.3 acres. The approximate total area of temporary fill would be 0.15 acres and total area of permanent fill would be 0.11 acres in these areas. Based on available data, none of the areas affected are expected to be classified as jurisdictional wetlands. Therefore, permanent loss of jurisdictional wetlands is not expected to occur and the need to mitigate (create replacement wetlands) is not anticipated. Overall, Alternative B would result in short- and long-term, minor, adverse effects to wetlands, wetland buffers, and waters of the U.S./State. The adverse effects would be localized.

Cumulative Effects

Other actions have not affected wetlands in the project area. When the effects of other actions and Alternative B are combined, the cumulative, long-term, adverse effects to wetlands would remain minor and localized.

Conclusions

The total area of disturbance to resources that could be classified as wetlands, wetland buffers, and/or waters of the U.S./State would be approximately 1.3 acres for Alternative B. The approximate total area of temporary fill would be 0.15 acres and total area of permanent fill would be 0.11 acres in these areas. Overall, Alternative B would result in short- and long-term, minor, adverse effects to wetlands, wetland buffers, and waters of the U.S./State. The adverse effects would be localized. Permanent loss of jurisdictional wetlands is not expected to occur and the need to mitigate (create replacement wetlands) is not anticipated. Other actions would not contribute to cumulative effects. Alternative B would not result in impairment of park wetland resources or values.

4.7.4 Alternative C – Reinforced Concrete Arches

The types, locations, and magnitude of activities that could potentially affect wetlands for Alternative C would be the same as Alternative B. Therefore, the analysis of wetlands impacts presented in Section 4.7.3 is applicable to this alternative. Alternative C would result in short- and long-term, minor, adverse effects to wetlands, wetland buffers, and waters of the U.S./State. The adverse effects would be localized. Permanent loss of jurisdictional wetlands

is not expected to occur and the need to mitigate (create replacement wetlands) is not anticipated.

Cumulative Effects

Similar to Alternative B, when the effects of other actions and Alternative C are combined, the cumulative, long-term, adverse effects to wetlands would remain minor and localized.

Conclusions

The total area of disturbance to resources that could be classified as wetlands, wetland buffers, and/or waters of the U.S./State would be approximately 1.3 acres for Alternative C. The approximate total area of temporary fill would be 0.15 acres and total area of permanent fill would be 0.11 acres in these areas. Overall, Alternative C would result in short- and long-term, minor, adverse effects to wetlands, wetland buffers, and waters of the U.S./State. The adverse effects would be localized. Permanent loss of jurisdictional wetlands is not expected to occur and the need to mitigate (create replacement wetlands) is not anticipated. Other actions would not contribute to cumulative effects. Alternative C would not result in impairment of park wetland resources or values.

4.8 WILDLIFE AND AQUATIC LIFE

4.8.1 Impact Threshold Definitions

Impact threshold definitions for wildlife and aquatic life are as follows:

- Negligible - Effects to animal species, their habitats, and the natural processes sustaining them would be at or below the level of detection. There would not be any measurable or perceptible effects on wildlife or aquatic life populations.
- Minor - Detectable impacts on animals and/or their habitats would occur within a small area, but would not result in substantial changes in populations or the natural processes sustaining them. While the mortality of individual animals

might occur, population effects would be within the range of natural variation and the viability of native populations would not be affected.

- Moderate - Readily detectable impacts outside the range of natural variability would occur on native animal populations, their habitats, or the natural processes sustaining them. The change would be measurable in terms of population abundance, distribution, quantity, or quality, and would occur over a relatively large area.
- Major - Readily apparent impacts outside the range of natural variability would occur on native animal populations, their habitats, or the natural processes sustaining them. The change would be measurable in terms of population viability and could involve the displacement, loss, or restoration of a wildlife or aquatic life population or assemblage.
- Short-term - The effect would occur only during or shortly after a specified action or treatment. Within a year, conditions would be similar to those that predominated previously.
- Long-term - Species would continue to be affected beyond one year's time, and/or conditions would not be similar to those that predominated previously.

4.8.2 Alternative A – No Action – Continue Current Maintenance

Under Alternative A routine maintenance of the Catoctin Aqueduct would continue and short-term disturbances to wildlife could occur. Continuing current maintenance would have a negligible effect on wildlife and aquatic life.

Cumulative Effects

Other actions have not affected wildlife and aquatic life in the project area. When the effects of other actions and Alternative A are combined, the cumulative effects would be negligible.

Conclusions

Alternative A would have a negligible effect on wildlife and aquatic life. Other actions would not contribute cumulative effects. Alternative A would not result in impairment of park wildlife and aquatic life resources or values.

4.8.3 Alternative B – Stone Masonry Arches

Equipment operations and other construction activities under Alternative B would temporarily increase noise and human activity within the project area, resulting in disturbance of terrestrial wildlife. Responses of mobile wildlife species, such as birds and mammals, would include flushing to adjacent areas and avoiding the immediate project area. Adverse effects to wildlife such as stress or lost foraging opportunities would be minimal because individuals could easily move to adjacent, high-quality habitats, which are extensive in this part of the park. The adverse effects would be short-term, occurring only while construction is taking place, and would be negligible and localized.

Alternative B could result in direct mortality of less mobile terrestrial wildlife species, including certain reptiles and amphibians, through crushing by construction equipment. These direct, adverse effects would be minor and localized based on the relatively small total area of disturbance (approximately 1.5 acres), and would not have lasting population-level effects.

Vegetation removal, including selective cutting of large trees, could directly affect occupied bird nests, eggs, and chicks, if these activities were to occur during the nesting season. The Migratory Bird Treaty Act prohibits take (i.e., wounding, killing, etc.) of migratory birds, including eggs and occupied nests, even when such activities are unintentional. Executive Order 13186 *Responsibilities of Federal Agencies to Protect Migratory Birds* directs federal agencies to design migratory bird habitat and population conservation measures into agency plans and planning processes; evaluate the effects of actions and agency plans on migratory birds; and develop and use practices that will lessen the amount of unintentional take. Accordingly, Alternative B includes resource protection measures (Table 2.1) to avoid unintentional take of migratory birds, including no vegetation clearing during the breeding season (typically April through August) and/or no removal of occupied bird nests.

Clearing of forest vegetation in the canal prism and subsequent planting of grass would result in permanent alteration of wildlife habitat in a small area (approximately 1 acre). The forests in the general project area are high-quality habitat for a variety of wildlife species. The area contains potentially suitable habitat for forest interior dwelling bird species. Populations of many forest interior dwelling bird species are declining in Maryland and the Maryland Department of Natural Resources identified conservation of their habitat as an important issue during the scoping process for this EA. The forested areas that would be affected by Alternative B are located close to the forest edge formed by the railroad to the north, not in the higher quality forest interior to the south. While the proposed clearing would create additional forest edge, fragmentation would be minimal. The area that would be affected is also very small relative to the extensive forests along the Potomac River in this part of the park. Consequently, the long-term, adverse effects of Alternative B to terrestrial wildlife habitat would be minor and localized. In summary, Alternative B would result in short- and long-term, adverse effects to terrestrial wildlife and their habitat. All adverse effects would be localized and the intensity would range from negligible to minor.

Instream work conducted under Alternative B to restore the Catoctin Aqueduct would temporally disturb aquatic life in the immediate vicinity of the aqueduct. Fish would be spooked and would seek cover nearby. Adverse effects to fish, such as stress or lost foraging or spawning opportunities, would be minimal because individuals could easily move to adjacent habitat. Disturbance of the stream bottom (primarily silt over rock) would displace macroinvertebrates such as insect larvae and crayfish, causing them to move from the area or drift downstream. Direct mortality of macroinvertebrates could also result from bottom disturbances, but no lasting population-level effects would occur. The area of instream disturbance would be small (less than 0.2 acres) and the adverse effects on aquatic life would be short-term, minor, and localized.

As discussed above in Section 4.4.3, instream work and ground disturbances would result in short-term, minor, adverse effect to water quality in the form of localized increases in turbidity, total suspended solids, nutrient loading, and pH. These effects would be limited to Catoctin Creek. Any changes in water quality of the Potomac River are expected to be negligible based on its large dilution capacity. The surface water resource protection measures and permitting processes described in Section 4.4.3 and Table 2.1 would also serve to protect aquatic life from indirect effects of changing water quality. The primary water quality concern for aquatic life would be the possibility for instream pH to temporarily increase during

underwater placement of cement grout or concrete. Without proper controls, these practices have been shown to increase pH to levels that are lethal to fish and other aquatic life (Fitch 2003). Accordingly, Alternative B includes resource protection measures to ensure that instream pH remains within Maryland water quality criteria (6.5 to 8.5). These measures would include the use of turbidity curtains, anti-washout admixture, and appropriate pumping rates. Consequently, the indirect, adverse effects of changing water quality on aquatic life would be short-term, negligible, and localized.

The Catoctin Aqueduct would be restored in its original footprint. Therefore, permanent changes to existing aquatic habitat would be limited. Existing scour damage would be repaired and rip-rap could be used around portions of the piers, abutments, and wing walls to prevent future scour. Rip-rap could provide cover for fish and substrate for macroinvertebrates. Imbricated rip-rap would be placed in a small area along the west bank of Catoctin Creek following removal of the pedestrian bridge abutment, and would aid in long-term protection of aquatic habitat. Reconstruction of the aqueduct's center and west arches would increase shading on Catoctin Creek, but removal of the Bailey bridge would result in a corresponding decrease in shading. The long-term effects of Alternative B on aquatic habitat would be negligible, beneficial, and localized.

Cumulative Effects

Other actions have not affected wildlife and aquatic life in the project area. When the effects of other actions and Alternative B are combined, the cumulative adverse effects to wildlife and aquatic life would remain negligible to minor.

Conclusions

Alternative B would result in short- and long-term, adverse effects to terrestrial wildlife and their habitat. All adverse effects to terrestrial wildlife would be localized and the intensity would range from negligible to minor. Alternative B would result in short-term, negligible to minor, adverse effects to aquatic life and long-term, negligible benefits to their habitat. Other actions would not contribute to cumulative effects. Alternative B would not result in impairment of park wildlife and aquatic life resources or values.

4.8.4 Alternative C – Reinforced Concrete Arches

The types, locations, and sizes of ground and instream disturbance for Alternative C would be the same as Alternative B. Therefore, the analysis of wildlife and aquatic life impacts presented in Section 4.8.3 is applicable to this alternative. Alternative C would result in short- and long-term, adverse effects to terrestrial wildlife and their habitat. All adverse effects to terrestrial wildlife would be localized and the intensity would range from negligible to minor. Alternative C would result in short-term, negligible to minor, adverse effects to aquatic life and long-term, negligible benefits to their habitat.

Cumulative Effects

Similar to Alternative B, when the effects of other actions and Alternative C are combined, the cumulative adverse effects to wildlife and aquatic life would remain negligible to minor.

Conclusions

Alternative C would result in short- and long-term, adverse effects to terrestrial wildlife and their habitat. All adverse effects to terrestrial wildlife would be localized and the intensity would range from negligible to minor. Alternative C would result in short-term, negligible to minor, adverse effects to aquatic life and long-term, negligible benefits to their habitat. Other actions would not contribute to cumulative effects. Alternative C would not result in impairment of park wildlife and aquatic life resources or values.

4.9 RARE, THREATENED, AND ENDANGERED SPECIES

4.9.1 Impact Threshold Definitions

Federally proposed or listed endangered or threatened species are not known occur in the project area. Therefore, the impact thresholds used by the U.S. Fish and Wildlife Service for Endangered Species Act compliance purposes are not presented here. The impact threshold definitions for state-listed rare, threatened, and endangered species are as follows:

-
- Negligible - No measurable or perceptible consequences to individuals, populations, or suitable habitat.
 - Minor - Measurable or perceptible consequences would occur to one or more individuals or suitable habitat, but the change would not affect the distribution or viability of any populations or the ability of the habitat to continue to support the species of concern.
 - Moderate - Noticeable consequences would occur to one or more individuals, a population, or known occupied habitat. However, the change would not affect the continued existence of the species within or outside the park.
 - Major - Noticeable consequences would occur to a population or known occupied habitat. The change would affect the continued existence of the species within or outside the park.
 - Short-term - The effect would occur only during or shortly after a specified action or treatment. Within a year, conditions would be similar to those that predominated previously.
 - Long-term - Species would continue to be affected beyond one year's time, and/or conditions would not be similar to those that predominated previously.

4.9.2 Alternative A – No Action – Continue Current Maintenance

During the scoping process for this EA, the U.S. Fish and Wildlife Service indicated that except for occasional transient individuals, no federally proposed or listed endangered or threatened species are known to exist in the project impact area. No critical habitat has been designated in the area. Therefore, Alternative A would have no effect on federally proposed or listed species or critical habitat. Continuation of current maintenance at the Catoctin Aqueduct would not include activities such as ground disturbance that could potentially affect the state-listed plants that have been recorded nearby. Likewise, water quality conditions would not change under Alternative A and state-listed freshwater mussels occurring downstream of the project area in the Potomac River would not be affected.

Cumulative Effects

Other actions have not affected rare, threatened, and endangered species in the project area. No cumulative effects would result when the effects of other actions and Alternative A are combined.

Conclusions

Alternative A would have no effect on rare, threatened, and endangered species and other actions would not contribute cumulative effects. Alternative A would not result in impairment of park rare, threatened, and endangered species resources or values.

4.9.3 Alternative B – Stone Masonry Arches

As noted for Alternative A, except for occasional transient individuals, no federally proposed or listed endangered or threatened species are known to exist in the project impact area. No critical habitat has been designated in the area. Therefore, Alternative B would have no effect on federally proposed or listed species or critical habitat. No Biological Assessment or further Endangered Species Act section 7 consultation with the U.S. Fish and Wildlife Service is required for this action.

Equipment operation, vegetation clearing, grading, and other ground disturbing activities have the potential to affect state-listed plants and suitable habitat that have been documented on or near the project site. White trout lily and star-flowered false Solomon's-seal occur on the fringe of the project area. Resource protection measures listed in Table 2.1 would be implemented to avoid and minimize any impacts to these plants and their habitat. Locations of these plants were identified during surveys conducted by the Maryland Department of Natural Resources, Wildlife and Heritage Service in 2007. In addition, the resource protection measures for these species were developed in consultation with the Maryland Wildlife and Heritage Service staff. While some individual plants or habitat could be inadvertently damaged or destroyed, Alternative B would not affect the viability of state-listed plant populations or the continued existence of state-listed species within or outside the park. Alternative B is expected to result in short-term, minor, adverse effects on individual state-listed plants and/or their habitat.

Records also exist for two rare mussels downstream from the project site in the Potomac River. The brook floater (*Alasmidonta varicosa*) is a state-listed endangered species and the squawfoot (*Strophitus undulatus*) is a species with "in need of conservation" state status. Freshwater mussels such as these require fish hosts for part of their life cycle and are filter feeders. Therefore, maintaining water quality is crucial to their continued existence.

As discussed above in Sections 4.4.3 and 4.8.3, instream work and ground disturbances would result in short-term, minor, adverse effects to surface water quality in the form of localized increases in turbidity, total suspended solids, nutrient loading, and pH. These effects would be limited to Catoctin Creek. Any changes in water quality of the Potomac River are expected to be negligible based on its large dilution capacity. The surface water resource protection measures and permitting processes described in Section 4.4.3 would also serve to protect the brook floater and squawfoot from indirect effects of changing water quality. Therefore, Alternative B would have no effect on the brook floater and squawfoot.

Cumulative Effects

Other actions have not affected rare, threatened, and endangered species in the project area. When effects of other actions and Alternative B are combined, no cumulative effects to federally listed species, the brook floater, or squawfoot would occur. The cumulative potential to adversely affect state-listed plants and their habitat would remain the same.

Conclusions

Alternative B would have no effect on federally listed species, the brook floater (state-listed endangered), or squawfoot (state status in need of conservation). Resource protection measures developed in consultation with the Maryland Wildlife and Heritage Service would be implemented to avoid and minimize impacts to the state-listed white trout lily and star-flowered Solomon's-seal. While some individual plants or habitat could be inadvertently damaged or destroyed, Alternative B would not affect the viability of state-listed plant populations or the continued existence of state-listed species within or outside the park. Alternative B is expected to result in short-term, minor, adverse effects on individual state-listed plants and/or their habitat. Other actions would not contribute to cumulative effects. Alternative B would not result in impairment of park rare, threatened, or endangered species resources or values.

4.9.4 Alternative C – Reinforced Concrete Arches

The types, locations, and sizes of ground and instream disturbance for Alternative C would be the same as Alternative B. Therefore, the analysis of rare, threatened, and endangered species impacts presented in Section 4.9.3 is applicable to this alternative. Alternative C would have no effect on federally listed species, the brook floater (state-listed endangered), or squawfoot (state status in need of conservation). Resource protection measures developed in consultation with the Maryland Wildlife and Heritage Service would be implemented to avoid and minimize impacts to the state-listed white trout lily and star-flowered Solomon's-seal. While some individual plants or habitat could be inadvertently damaged or destroyed, Alternative C would not affect the viability of state-listed plant populations or the continued existence of state-listed species within or outside the park. Alternative C is expected to result in short-term, minor, adverse effects on individual state-listed plants and/or their habitat.

Cumulative Effects

Similar to Alternative B, when effects of other actions and Alternative C are combined, no cumulative effects to federally listed species, the brook floater, or squawfoot would occur. The cumulative potential to adversely affect state-listed plant would remain the same.

Conclusions

Alternative C would have no effect on federally listed species, the brook floater (state-listed endangered), or squawfoot (state status in need of conservation). Resource protection measures developed in consultation with the Maryland Wildlife and Heritage Service would be implemented to avoid and minimize impacts to the state-listed white trout lily and star-flowered Solomon's-seal. While some individual plants or habitat could be inadvertently damaged or destroyed, Alternative C would not affect the viability of state-listed plant populations or the continued existence of state-listed species within or outside the park. Alternative C is expected to result in short-term, minor, adverse effects on individual state-listed plants and/or their habitat. Other actions would not contribute to cumulative effects. Alternative C would not result in impairment of park rare, threatened, or endangered species resources or values.

4.10 CULTURAL RESOURCES

4.10.1 Impact Threshold Definitions

Regulations for implementing the National Environmental Policy Act and Section 106 of the National Historic Preservation Act require that the effects of proposed actions on important cultural resources be analyzed. However, definitions for assessing effects on cultural resources are different for each act. Both sets of definitions are used in this EA to comply with the requirements of both acts. Three Section 106 determinations of effect characterize the severity or intensity of impacts on National Register-listed or -eligible cultural resources.

- A determination of no historic properties affected means that either there are no historic properties present or there are historic properties present but the undertaking would have no effect on them (36 CFR 800.4(d)(1)).
- A determination of no adverse effect means an effect would occur, but the effect would not meet the criteria of an adverse effect; that is, it would not diminish the characteristics of the cultural resource that qualify it for inclusion in the National Register (36 CFR 800.5(b)).
- An adverse effect would occur whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion in the National Register. For example, this could include diminishing the integrity (or the extent to which a resource retains its historic appearance) of its location, design, setting, materials, workmanship, feeling, or association. Adverse effects also include reasonably foreseeable effects caused by the alternatives that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5(a) (1)).

Archeological Resources

Impact threshold definitions used in the National Environmental Policy Act analysis for archeological resources are as follows:

- Negligible - The action would result in an impact at the lowest levels of detection, barely measurable, with no perceptible consequences, either adverse

or beneficial, to archeological resources. For purposes of Section 106, the determination would be no historic properties affected.

- Minor adverse - The action would impact one or more archeological sites with modest data potential and no significant ties to a living community's cultural identity. The site disturbance would be confined to a small area with little, if any, loss of important information potential. For purposes of Section 106, the determination of effect would be no adverse effect.
- Minor beneficial - The action would result in preservation of a site in its natural state. For purposes of Section 106, the determination of effect would be no adverse effect.
- Moderate adverse - The action would impact one or more archeological sites with good data potential and possible ties to a living community's cultural identity. Site disturbance would be noticeable. For purposes of Section 106, the determination of effect would be adverse effect.
- Moderate beneficial - The action would noticeably enhance the protection or preservation of one or more archeological sites that are listed or eligible for listing in the National Register of Historic Places. For purposes of Section 106, the determination of effect would be no adverse effect.
- Major adverse - The action would impact one or more archeological sites or districts listed in, or eligible for the National Register and/or having possible ties to a living community's cultural identity, resulting in loss of site or district integrity. Site disturbance or resource degradation would be highly visible. For purposes of Section 106, the determination of effect would be adverse effect.
- Major beneficial - The action would substantially enhance the ability to protect and interpret important archeological resources and would foster conditions under which archeological resources and modern society can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations. For purposes of Section 106, the determination of effect would be no adverse effect.

Cultural Landscape

Impact threshold definitions used in the National Environmental Policy Act analysis for the cultural landscape are as follows:

- Negligible - The action would be barely perceptible and would not affect cultural landscape resource conditions. For purposes of Section 106, the determination would be no historic properties affected.
- Minor adverse - The action would affect patterns, features, and/or vegetation in the cultural landscape but would not diminish the overall integrity of the landscape. For purposes of Section 106, the determination of effect would be no adverse effect.
- Minor beneficial - The action would help maintain existing landscape patterns and features in accordance with *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes* (NPS 1995a). For purposes of Section 106, the determination of effect would be no adverse effect.
- Moderate adverse - The action would alter one or more patterns or character-defining features of the cultural landscape. Although the landscape would still be eligible for the National Register, its overall integrity would be diminished. For purposes of Section 106, the determination of effect would be adverse effect.
- Moderate beneficial - The action would enhance the cultural landscape in accordance with *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes* (NPS 1995a). For purposes of Section 106, the determination of effect would be no adverse effect.
- Major adverse - The action would alter patterns or features of the cultural landscape, seriously diminishing the overall integrity of the resource to the point where its National Register eligibility may be in question. For purposes of Section 106, the determination of effect would be adverse effect.
- Major beneficial - The action would actively improve the cultural landscape in accordance with *The Secretary of the Interior's Standards for the Treatment of*

Historic Properties with Guidelines for the Treatment of Cultural Landscapes (NPS 1995a). For purposes of Section 106, the determination of effect would be no adverse effect.

Architectural Resources

Impact threshold definitions used in the National Environmental Policy Act analysis for the architectural resources are as follows:

- Negligible - The action would not have the potential to cause effects on historic structures, buildings, or districts that would alter any of the characteristics that would qualify the resource for inclusion in or eligibility for the National Register of Historic Places. For purposes of Section 106, the determination would be no historic properties affected.
- Minor adverse - The action would affect one or more features of a structure, building, or district that is eligible for or listed in the National Register, but it would neither alter its character-defining features nor diminish the overall integrity of the property. For purposes of Section 106, the determination of effect would be no adverse effect.
- Minor beneficial - The action would maintain and improve the character-defining features of a National Register-eligible or -listed structure, building, or district in accordance with *The Secretary of the Interior's Standards for the Treatment of Historic Properties* (NPS 1995b). For purposes of Section 106, the determination of effect would be no adverse effect.
- Moderate adverse - The action would alter one or more character-defining features of the structure, building, or district. While the overall integrity of the resource would be diminished, the property would retain its National Register eligibility. For purposes of Section 106, the determination of effect would be adverse effect.
- Moderate beneficial - Positive actions would be taken to preserve and noticeably enhance character-defining elements of a structure, building, or district in accordance with *The Secretary of the Interior's Standards for the Treatment of*

Historic Properties (NPS 1995b). For purposes of Section 106, the determination of effect would be no adverse effect.

- Major adverse - The action would alter character-defining features of the structure, building, or district, seriously diminishing the overall integrity of the resource to the point where its National Register eligibility may be in question. For purposes of Section 106, the determination of effect would be adverse effect.
- Major beneficial - The action would enhance the character-defining features of a structure or a building that represents important components of the nation's historic heritage and would foster conditions under which these cultural foundations of the nation and modern society could exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations. The Section 106 determination of effect would be no adverse effect.

Impact duration definitions used in the National Environmental Policy Act analysis for the cultural resources are as follows:

- Short-term adverse - Short-term effects on the cultural landscape would occur only while the action is being implemented.
- Long-term adverse - Most effects on National Register-eligible cultural resources in C&O Canal would be long-term because cultural resources are nonrenewable.
- Short-term beneficial - Effects would occur only during and shortly after (i.e., less than a year from) a specified action or treatment.
- Long-term beneficial - Effects would persist well beyond (i.e., more than a year after) the duration of a specified action or treatment.

4.10.2 Alternative A – No Action – Continue Current Maintenance

Archeological Resources

The Catoctin Aqueduct would not be restored under the Alternative A and additional disturbance of the ground or archeological resources would not occur in the project area. Archeological resources would continue to be managed in accordance with Sections 106 and 110 of the NHPA and Director's Order #28: Cultural Resource Management (NPS 1998). Alternative A would not affect archeological resources.

Cultural Landscape

Routine and emergency maintenance of the Catoctin Aqueduct ruins would continue under Alternative A, but no major actions would be taken to stabilize, rehabilitate, restore, or reconstruct the structure. Continuation of the existing conditions would perpetuate the degradation of the Catoctin Aqueduct, a character-defining feature of the cultural landscape, resulting in declining integrity of the cultural landscape. Eventually, further collapse of the remaining structure is possible. In addition, existing features that degrade the cultural landscape (e.g., Bailey bridge and pedestrian footbridge abutments) would not be removed under Alternative A. The physical integrity of a character-defining feature of the C&O Canal cultural landscape would be diminished if this alternative were implemented, but the overall integrity of the C&O Canal cultural landscape would not be diminished to the point where its National Register eligibility would be in question. Consequently, Alternative A would result in moderate, long-term, adverse effects to the C&O Canal cultural landscape, but the effects would be localized.

Architectural Resources

As discussed above under cultural landscape, continuation of the existing conditions would perpetuate the degradation of the Catoctin Aqueduct, a contributing element of the C&O Canal Historic District. While maintenance and emergency repair work accomplished under Alternative A would have short-term, minor, beneficial effects, further collapse of the structure is possible over the long-term. The physical integrity of the Catoctin Aqueduct would diminish under Alternative A and existing visual impacts associated with the modern Bailey bridge and pedestrian footbridge abutments would remain. Alternative A would result in long-term, moderate, adverse effects to architectural resources, but the effects would be localized.

Historic Material

The stones that were recovered following the 1973 collapse of the Catoctin Aqueduct would continue to be protected *in situ* under Alternative A. These architectural artifacts would continue to be managed in accordance with Sections 106 and 110 of the NHPA. Alternative A would not affect historic materials.

Cumulative Effects

The inventory of Catoctin Aqueduct stones completed by the NPS in late 2006 resulted in long-term, minor, beneficial effects to historic materials by recording detailed information for the recovered stones. Restoration of the Monocacy Aqueduct resulted in long-term, moderate, beneficial effects to the cultural landscape and architectural resources. The overall effect of Alternative A on cultural resources would be long-term, moderate, and adverse because the Catoctin Aqueduct would continue to deteriorate. When the effects of other actions and Alternative A are combined, the cumulative effects would be long-term, minor, and adverse.

Conclusions

Alternative A would have no affect on archeological resources or historic materials. While maintenance and emergency repair work accomplished on the Catoctin Aqueduct under Alternative A would have minor, short-term beneficial effects, further collapse of the structure is possible over the long-term. The physical integrity of the Catoctin Aqueduct would diminish under Alternative A and existing visual impacts associated with the modern Bailey bridge and pedestrian footbridge abutments would remain. Consequently, Alternative A would result in moderate, long-term, adverse effects to the C&O Canal cultural landscape and architectural resources. When the effects of other actions and Alternative A are combined, the cumulative effects would be long-term, minor, and adverse. Alternative A would not result in impairment of park cultural resources or values.

4.10.3 Alternative B – Stone Masonry Arches

Archeological Resources

Based on previous archeological investigations and past ground disturbance, it is unlikely that intact prehistoric or historic archeological deposits exist in the project area of disturbance. Only one prehistoric site (18FR33), a Woodland or possible Terminal Archaic occupation, occurs adjacent to the project area. Currently, the site has not been evaluated to determine NRHP eligibility. This site would not be affected by any ground disturbing activities, but the potential for access to the site and vandalism (i.e., removal or disturbance of artifacts through surface collecting resulting in a loss of provenience and site integrity) could increase during restoration activities. Work crews would be educated in the importance of archeological resources and cautioned regarding the illegality of collecting resources in the park.

While the archeological potential within the project area is low, ground disturbing activities could impact previously unidentified archeological resources. Impacts to unidentified archeological resources would be avoided by implementing the best management practices outlined in Table 2.1. Alternative B would result in long-term, negligible, adverse effects to archeological resources and the effects would be localized.

Cultural Landscape

Alternative B includes several actions that would preserve and noticeably enhance the Catoctin Aqueduct and canal prism, which are character-defining features of the C&O Canal cultural landscape. These actions would result in long-term, moderate, beneficial effects to the cultural landscape and include the following:

- Restoration of the Catoctin Aqueduct similar to its original design.
- Removal of the existing modern Bailey bridge, the western abutment of the former pedestrian bridge, and the water diversion berms in the canal prism on both sides of the aqueduct. These actions would enhance the cultural landscape by removing degrading features that were constructed after canal operations ceased.

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- Selective vegetation clearing within the canal prism approximately 300 feet east and west of the aqueduct and subsequent revegetation with grass. The canal prism along this portion of the C&O Canal lacks permanent water and contains natural forest vegetation that has grown since canal operations ceased. This vegetation currently obscures the visual continuity of the aqueduct and canal prism, which makes it difficult to interpret the aqueduct's unique crooked approach. The proposed selective vegetation clearing would aid in interpretation of the "crooked aqueduct" and would result in conditions that more closely resemble the historic landscape, but would not fully restore historic vegetation patterns.

Construction of the permanent transitional ramps leading from the towpath to the canal and aqueduct prisms would also change the cultural landscape. These transitional ramps would be similar to the ramps at many of the other aqueducts in the park and are necessary to allow park maintenance vehicles, emergency vehicles, bicyclists, and equestrians access to the aqueduct prism so they can cross Catoctin Creek following removal of the Bailey bridge. Construction of these ramps would alter the canal prism, but would not diminish this character-defining feature's integrity relative to baseline conditions. Construction of the ramps would result in long-term, minor, adverse effects to the cultural landscape.

The presence of scaffolding, construction equipment, and barges needed to facilitate restoration of the Catoctin Aqueduct would temporarily disrupt the visual integrity of the cultural landscape. Visual intrusions to the cultural landscape would also be created by the presence of staging areas and from the construction of the temporary access causeway east of Culvert #79. Visual intrusions to the cultural landscape would be short-term, occurring for only the duration of the restoration activities, and would result in minor, adverse, localized effects.

Architectural Resources

Under Alternative B, the Catoctin Aqueduct would be restored by reconstructing the center and west arches using stone masonry similar to the original construction. Original stones recovered following collapse of the aqueduct would be used to the extent possible, including on the undersides of the arches. An internal, structural concrete saddle would be installed above both arches to rectify an inherent structural weakness in the center arch. The

saddle would alter the historic design only slightly by increasing the height of the aqueduct prism by one foot. This would result in a one-foot reduction in the height of the towpath and berm, as measured from the top of the prism. This change in external appearance would slightly diminish the historic integrity of the Catoctin Aqueduct, but would not be noticed by most visitors. Overall, character-defining elements of the structure would be preserved and noticeably enhanced. The restoration would be accomplished in accordance with *The Secretary of the Interior's Standards for the Treatment of Historic Properties* and would result in long-term, moderate, beneficial effects to architectural resources.

The wastewei crossing under the towpath at Milepost 51.05 would not be affected by Alternative B; however, the canal prism, towpath, and Culvert #79 would be affected. A temporary equipment access causeway would be constructed in the canal prism between the wastewei and Culvert #79, which carries Sugartree Branch under the canal prism and towpath at Milepost 51.09. Construction equipment would cross the temporary causeway and access the aqueduct via the towpath, crossing over Culvert #79 in the process. The causeway would be removed and the area restored upon completion of the project, and the resource protection measures outline in Table 2.1 would be implemented to minimize impacts of the causeway. Heavy construction equipment has the potential to adversely affect Culvert #79 through crushing or vibration. In addition, the equipment could create tire ruts in the towpath, particularly during wet conditions. Resource protection measures (Table 2.1) to avoid and minimize potential impacts to the towpath and Culvert #79 would include placing and compacting gravel on the towpath's surface prior to access; enforcing established weight restrictions (12 tons); escorting heavy equipment and limiting speeds to 10 miles per hour; and restoring the towpath's surface following construction. Access by equipment exceeding the 12 ton limit would be evaluated on a case-by-case basis by the park engineer and protective steel plates would be placed over Culvert #79, as needed. The equipment access issues discussed above would not result in long-term alteration of character-defining features and would not diminish the overall integrity of the canal prism, towpath, or Culvert #79. The adverse effects of equipment access under Alternative B would short-term, minor, and localized.

As discussed above for the cultural landscape, the existing Bailey bridge, the west abutment of the former pedestrian bridge, and the existing water diversion berms within the canal prism would be removed under Alternative B. Selective vegetation clearing would also occur within the canal prism. These actions would result in long-term, minor to moderate, beneficial effects to architectural resources. Construction of the transitional ramps leading

from the towpath to the canal and aqueduct prisms would result in long-term, minor, adverse effects to architectural resources. Overall, Alternative B would result in long-term, moderate, beneficial effects to architectural resources in the project area because the Catoctin Aqueduct would be restored.

Historic Material

Stone recovered following the 1973 collapse of the Catoctin Aqueduct, including barrel arch-stones, would be used in the restoration to the maximum extent possible under Alternative B. It is anticipated that a majority of the recovered stone would be used. Any unused stone would remain in the Catoctin Aqueduct project area to retain its contextual integrity. These architectural artifacts would continue to be protected and managed in accordance with Sections 106 and 110 of the NHPA. Alternative B would result in negligible effects on historic materials.

Cumulative Effects

The inventory of Catoctin Aqueduct stones completed by the NPS in late 2006 resulted in long-term, minor, beneficial effects to historic materials by recording detailed information for the recovered stones. Restoration of the Monocacy Aqueduct resulted in long-term, moderate, beneficial effects to the cultural landscape and architectural resources. The overall effect of Alternative B on cultural resources would be long-term, moderate, and beneficial because the Catoctin Aqueduct would be restored. When the effects of other actions and Alternative B are combined, the cumulative, long-term benefits would remain moderate, but they would be magnified relative to Alternative B alone. In addition, the cumulative benefits would be realized over a larger portion of the park.

Conclusions

Alternative B would result in both adverse and beneficial effects to cultural resources. The effects on archeology would be long-term, negligible, adverse, and localized. All of the short- and long-term adverse effects on the cultural landscape and architectural resources would be minor and localized. The overall integrity of the cultural landscape and architectural resources would not be diminished. Restoration of the Catoctin Aqueduct, removal of the Bailey bridge, and clearing vegetation in the canal prism would noticeably enhance the cultural

landscape and architectural resources, resulting in long-term, moderate, beneficial effects to these resources. When the effects of other actions and Alternative B are combined, the cumulative, long-term benefits would remain moderate, but they would be magnified relative to Alternative B alone. In addition, the cumulative benefits would be realized over a larger portion of the park. Alternative B would not result in impairment of park cultural resources and values.

As provided for in the implementing regulations for Section 106 of the National Historic Preservation Act, the NPS has complied with the requirements for using the National Environmental Policy Act process to achieve Section 106 compliance. The State Historic Preservation Officer at the Maryland Historical Trust has been formally notified about the project and will be forwarded a copy of the Draft EA for review and comment. After applying the criteria specified in the Advisory Council on Historic Preservation implementing regulations, the NPS finds that implementation of Alternative B would result in a finding of no adverse effect to historic properties. This finding is considered preliminary, pending State Historic Preservation Officer concurrence.

4.10.4 Alternative C – Reinforced Concrete Arches

Archeological Resources

The location, type, and level of ground disturbance that would occur under Alternative C would be the same as Alternative B. Therefore, the analysis of archeological impacts presented in Section 4.10.3 is applicable to this alternative. Alternative C would result in long-term, negligible, adverse effects to archeological resources and the effects would be localized.

Cultural Landscape

Changes to the cultural landscape that would occur under Alternative C would be the same as Alternative B. Therefore, the analysis of cultural landscape impacts presented in Section 4.10.3 is applicable to this alternative. All of the short- and long-term adverse effects on the cultural landscape would be minor and localized. The overall integrity of the cultural landscape would not be diminished. Restoration of the Catoctin Aqueduct, removal of the Bailey bridge, and clearing vegetation in the canal prism would noticeably enhance the cultural landscape, resulting in long-term, moderate, beneficial effects.

Architectural Resources

Changes to architectural resources that would occur under Alternative C would be very similar to Alternative B. Therefore, the analysis of architectural resources impacts presented in Section 4.10.3 is applicable to this alternative. The primary difference between Alternatives B and C would be the materials and methods used in aqueduct restoration. Original stones recovered following collapse of the aqueduct would be used to the extent possible under Alternative C, but the number of stone used would be fewer than Alternative B.

Alternative C would involve restoring the center and west arches of the Catoctin Aqueduct by constructing self-supporting, reinforced concrete arches in the original shape. The concrete arches would be faced on the sides with stones matching the extant span, while the undersides of the arches would be textured with a form-liner and stained to give the appearance of a stone arch. The geometry of the restored aqueduct would be the same as the original structure under Alternative C. However, the textured concrete undersides of the arches, which would be visible from limited areas, would not match the original stone masonry construction. This change in external appearance would slightly diminish the historic integrity of the Catoctin Aqueduct, but would not be visible from the towpath and would not be noticed by most visitors. Overall, character-defining elements of the structure would be preserved and noticeably enhanced. The restoration would be accomplished in accordance with *The Secretary of the Interior's Standards for the Treatment of Historic Properties* and would result in long-term, moderate, beneficial effects to architectural resources.

Historic Material

Similar to Alternative B, recovered stone would be used in the restoration to the maximum extent possible under Alternative C. No barrel arch-stones would be used in Alternative C because the undersides of the arches would consist of concrete treated to give the appearance of stone. Consequently, fewer stones would be used. All unused stone would remain in the Catoctin Aqueduct project area to retain its contextual integrity. These architectural artifacts would continue to be protected and managed in accordance with Sections 106 and 110 of the NHPA. Alternative C would result in negligible effects on historic materials.

Cumulative Effects

Similar to Alternative B, when the effects of other actions and Alternative C are combined, the cumulative, long-term benefits would remain moderate, but they would be magnified relative to Alternative C alone. In addition, the cumulative benefits would be realized over a larger portion of the park.

Conclusions

Alternative C would result in both adverse and beneficial effects to cultural resources. The effects on archeology would be long-term, negligible, adverse, and localized. All of the short- and long-term adverse effects on the cultural landscape and architectural resources would be minor and localized. The overall integrity of the cultural landscape and architectural resources would not be diminished. Restoration of the Catoctin Aqueduct, removal of the Bailey bridge, and clearing vegetation in the canal prism would noticeably enhance the cultural landscape and architectural resources, resulting in long-term, moderate, beneficial effects to these resources. When the effects of other actions and Alternative C are combined, the cumulative, long-term benefits would remain moderate, but they would be magnified relative to Alternative C alone. In addition, the cumulative benefits would be realized over a larger portion of the park. Alternative C would not result in impairment of park cultural resources and values.

As provided for in the implementing regulations for Section 106 of the National Historic Preservation Act, the NPS has complied with the requirements for using the National Environmental Policy Act process to achieve Section 106 compliance. The State Historic Preservation Officer at the Maryland Historical Trust has been formally notified about the project and will be forwarded a copy of the Draft EA for review and comment. After applying the criteria specified in the Advisory Council on Historic Preservation implementing regulations, the NPS finds that implementation of Alternative C would result in a finding of no adverse effect to historic properties. This finding is considered preliminary, pending State Historic Preservation Officer concurrence.

4.11 VISITOR USE AND EXPERIENCE

4.11.1 Impact Threshold Definitions

The impact threshold definitions for visitor use and experience are as follows:

- Negligible – No noticeable change in visitor use or experience or in the defined indicators of visitor satisfaction or behavior.
- Minor - Changes in visitor use and/or experience would be detectable, although the changes would be small. The visitor would be aware of the effects associated with the alternative, but the changes would not appreciably alter critical characteristics of the visitor experience or levels of park use.
- Moderate - Changes in critical characteristics of the park experience would be readily apparent, or the number of visitors engaging in an activity, or in the use of the park would be substantially altered. Visitor satisfaction would change as a result of the alternative.
- Major - Changes in multiple critical characteristics of the desired experience would be readily apparent. Participation in desired experiences or in park visitation would be considerably changed, and would result in substantial changes in the defined indicators of visitor satisfaction or behavior.
- Short-term - Effects on visitor use and/or experience typically would persist for less than one year or only while the action is being implemented.
- Long-term - Effects on visitor use and/or experience would extend beyond one year or well beyond implementation.

4.11.2 Alternative A – No Action – Continue Current Maintenance

Normal trends in park visitation would not change under Alternative A. Factors that currently detract from visitor experience (e.g., diminished historic integrity of the Catoctin Aqueduct, presence of the metal Bailey bridge, and other visual intrusions to the cultural landscape) would remain. Alternative A would result in long-term, minor, adverse effects on visitor experience because opportunities to interpret the canal's history would continue to be missed on a localized basis.

Cumulative Effects

If authorized, the Catoctin Power right-of-way could result in minor, short- and long-term, adverse effects to visitor use and experience. Restoration of the Monocacy Aqueduct had long-term, moderate, beneficial effects on visitor use and experience in the form of better opportunities to interpret the C&O Canal's history. The adverse effects of Alternative A are offset somewhat by the beneficial effects of the Monocacy Aqueduct restoration because the two aqueducts are located within 10 miles of each other. Visitors have the opportunity to enjoy and interpret a fully restored aqueduct in this part of the park. In addition, occasional use of the Lander Lock House as an interpretive center, which is manned by volunteers from the local area, resulted in long-term, minor benefits to visitor experience. Nonetheless, the localized adverse effects of Alternative A would remain and the cumulative adverse effect would be long-term and minor.

Conclusions

Alternative A would result in long-term, minor, adverse effects on visitor experience because opportunities to interpret the canal's history would continue to be missed on a localized basis. The adverse effects of Alternative A are offset somewhat by the beneficial effects of the Monocacy Aqueduct restoration and occasional use of the Lander Lock House as an interpretive center, but the cumulative, adverse effects on visitor use and experience would remain long-term, minor, and localized.

4.11.3 Alternative B – Stone Masonry Arches

The presence of scaffolding, construction equipment, fencing, staging areas, and temporary access roads during the restoration activities would diminish the experience of visitors that are seeking solitude in a natural setting. Temporary towpath closures during the restoration work would delay users. Necessary towpath closures would be limited to short intervals (5 to 30 minutes) and visitors would be notified of the restoration work through signage, public announcements, and other means to minimize impacts. Some users might elect to avoid the area while restoration activities are ongoing. Disruptions to visitor use and diminished visitor experience would be short-term and localized, occurring for only the duration of the restoration activities, and would result in minor, adverse effects.

Following completion of the restoration project, visitors would have improved opportunities to interpret the C&O Canal's history, which is considered a critical characteristic of the desired visitor experience. The historic integrity of the Catoctin Aqueduct would be restored, the cultural landscape enhanced, and visual intrusions removed. Continuity of the towpath and a safe crossing of Catoctin Creek would be provided via the restored aqueduct. Improvements to the pedestrian bridge abutment on the east bank of Catoctin Creek would provide visitors new opportunities for safely viewing the structure from an upstream vantage point.

The number visitors coming to the park to specifically view, study, and interpret the Catoctin Aqueduct is expected to increase and the potential exists for a small number (i.e., a few per year) of organized tour groups to visit the aqueduct. Some of these groups might choose to access the park via tour buses at the Lander access. While the roads leading to the Lander access and the available parking at the Lander access are not ideally designed to accommodate buses, they appear adequate for the anticipated small number of buses. Buses would need to park and turn around in the upper parking area and would not be able access the lower parking area via the wooden bridge that crosses the towpath. Bus operators would be responsible for understanding the space limitations and to plan accordingly. Any commercially operated tours would be required to obtain a Commercial Use Authorization from the NPS.

Overall visitation rates and patterns would continue to be determined by factors unrelated to the Catoctin Aqueduct (e.g., season, weather, day of the week, and Potomac River flow conditions). While the NPS does not collect visitor use statistics for the Lander access or Catoctin Aqueduct, no perceptible increase in overall visitation rates would be expected. Visitor use in this area would remain low density and the Short-term Remote Zone management objective of finding solitude in a natural setting would not be compromised. Overall, Alternative B would result in long-term, moderate, beneficial effects to visitor use and experience. The benefits would be localized.

Cumulative Effects

If authorized, the Catoctin Power right-of-way could result in minor, short- and long-term, adverse effects to visitor use and experience. The short-term effects would be a cumulative issue only if the right-of-way construction and Catoctin Aqueduct restoration schedules overlap. Restoration of the Monocacy Aqueduct had long-term, beneficial effects on

visitor use and experience in the form of better opportunities to interpret the C&O Canal's history. Given the proximity of the two aqueducts (less than 10 miles apart), completion of the Catoctin Aqueduct restoration would give visitors the opportunity to enjoy and interpret two of the park's important, restored historic structures in a single day. In addition, occasional use of the Lander Lock House as an interpretive center, which is manned by volunteers from the local area, resulted in long-term, minor benefits to visitor experience. When the effects of other actions and Alternative B are combined, the cumulative, long-term benefits would remain moderate, but they would be magnified relative to Alternative B alone. In addition, the cumulative benefits would be realized over a larger portion of the park.

Conclusions

Under Alternative B, disruptions to visitor use and diminished visitor experience would be short-term and localized, occurring for only the duration of the restoration activities, and would result in minor, adverse effects. Following completion of the restoration project, visitors would have improved opportunities to interpret the C&O Canal's history, which is considered a critical characteristic of the desired visitor experience. Overall, Alternative B would result in long-term, moderate, beneficial effects to visitor use and experience. When the effects of other actions and Alternative B are combined, the cumulative, long-term benefits would remain moderate, but they would be magnified relative to Alternative B alone. In addition, the cumulative benefits would be realized over a larger portion of the park.

4.11.4 Alternative C – Reinforced Concrete Arches

Changes to visitor use and experience that would occur under Alternative C would be very similar to Alternative B. Therefore, the analysis of visitor use and experience impacts presented in Section 4.11.3 is applicable to this alternative. Disruptions to visitor use and diminished visitor experience would be short-term, occurring for only the duration of the restoration activities, and would result in minor, localized, adverse effects. The duration of restoration activities under Alternative C would be a few months shorter than Alternative B, resulting in a corresponding decrease in the duration of the temporary adverse effects. Overall, Alternative B would result in long-term, moderate, beneficial effects to visitor use and experience. The benefits would be localized.

Cumulative Effects

As discussed above for Alternative B, when the effects of other actions and Alternative C are combined, the cumulative, long-term benefits would remain moderate, but they would be magnified relative to Alternative C alone. In addition, the cumulative benefits would be realized over a larger portion of the park.

Conclusions

Under Alternative C, disruptions to visitor use and diminished visitor experience would be short-term and localized, occurring for only the duration of the restoration activities, and would result in minor, adverse effects. Following completion of the restoration project, visitors would have improved opportunities to interpret the C&O Canal's history, which is considered a critical characteristic of the desired visitor experience. Overall, Alternative C would result in long-term, moderate, beneficial effects to visitor use and experience. When the effects of other actions and Alternative C are combined, the cumulative, long-term benefits would remain moderate, but they would be magnified relative to Alternative C alone. In addition, the cumulative benefits would be realized over a larger portion of the park.

4.12 PARK OPERATIONS

4.12.1 Impact Threshold Definitions

The impact threshold definitions for park operations are as follows:

- Negligible - Effects on park operations would not be noticeable or measurable outside normal variability.
- Minor - Effects would be measurable but would not appreciably change park operations. Effects would be noticed by park staff, but probably would not be noted by visitors.
- Moderate - The effects would be readily apparent and would result in a substantial change in park operations in a manner that would be noticeable to staff and visitors.

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- Major - The effects would be readily apparent and would result in a substantial change in park operations in a manner that would be noticeable to staff and visitors as markedly different from existing operations.
 - Short-term - Effects would occur only during and shortly after a specified action or treatment.
 - Long-term - Effects would persist well beyond the duration of a specified action or treatment.

4.12.2 Alternative A – No Action – Continue Current Maintenance

Under Alternative A, the NPS would continue routine park operations at and in the immediate vicinity of the Catoctin Aqueduct, including towpath maintenance; grass cutting and tree/vegetation maintenance around the aqueduct; inspections of the aqueduct ruins and Bailey bridge; and maintenance of the Bailey bridge, including cyclic painting and replacement deck boards. The Catoctin Aqueduct's remaining east arch, piers, and wing walls would continue to be susceptible to further deterioration and collapse, but no major actions would be taken to preserve the structure. Acute deterioration issues would frequently arise; causing NPS to reactively expend human and fiscal resources to implement superficial stabilization efforts on a reoccurring basis. Such efforts would not be considered sustainable management could detract human and fiscal resources from other park operations. Consequently, Alternative A would result in long-term, minor, adverse effects to park operations.

Cumulative Effects

Restoration of the Monocacy Aqueduct had a long-term, minor, beneficial effect on park operations because acute deterioration of the structure no longer needs to be addressed on a reoccurring basis. When the effects of other actions and Alternative A are combined, the cumulative, effects to park operations are negligible.

Conclusions

Under Alternative A, a reoccurring need to address acute deterioration issues at the Catoctin Aqueduct would exist and could detract human and fiscal resources from other park operations. Alternative A would result in long-term, minor, adverse effects to park operations.

When the effects of other actions and Alternative B are combined, the cumulative, effects to park operations are negligible.

4.12.3 Alternative B – Stone Masonry Arches

A majority of the funding for the Catoctin Aqueduct restoration would be raised by an external cooperative partnership, which would also provide various forms of in-kind support. The physical restoration/construction work would be conducted by specialized firms under contract to NPS. These factors greatly reduce the overall effect on park operations. Nonetheless, a substantial, short-term (approximately three year), commitment of NPS human and fiscal resources would be required for coordination, oversight, and implementation of the planning, design, and construction processes for the Catoctin Aqueduct restoration. Accomplishing these functions would detract human and fiscal resources from other park operations, such that Alternative B would result in short-term, minor, adverse, effects to park operations.

Alternative B would include establishing approximately one additional acre of grass in the canal prism on either side of the aqueduct, constructing transitional ramps from the towpath to the aqueduct prism, and modifying the pedestrian bridge abutment on the east bank of Catoctin Creek into a viewing platform. These actions would increase long-term maintenance requirements. As discussed in Section 4.5.3, water surface elevations and local areas subjected to flooding would increase during the 100-year storm event. Therefore, requirements for debris removal, flood preparedness, and flood damage repair could increase. These increases in maintenance requirements would have a long-term, minor, adverse effect on park operations. However, the NPS would no longer need to address acute deterioration of the Catoctin Aqueduct ruins on a reoccurring basis or maintain the Bailey bridge. These decreases in maintenance requirements would have a long-term, minor, beneficial effect on park operations. When these adverse and beneficial effects are considered together, Alternative B would have a long-term, negligible effect on park operations from changes in maintenance requirements.

The load rating of the restored aqueduct would be higher than that of the existing Bailey bridge. This would allow heavier park maintenance vehicles to cross Catoctin Creek, provide NPS staff greater flexibility in planning maintenance operations, and provide long-term, minor, beneficial effects to park operations.

Cumulative Effects

Restoration of the Monocacy Aqueduct had a long-term, minor, beneficial effect on park operations because acute deterioration of the structure no longer needs to be addressed on a reoccurring basis. When the effects of other actions and Alternative B are combined, the cumulative, long-term effects to park operations are negligible.

Conclusions

Alternative B would result in short-term, minor, adverse effects to park operations based on the substantial commitment of human resources required for coordination, oversight, and implementation of the planning, design, and construction processes for the Catoctin Aqueduct restoration. Changes in long-term maintenance requirements would result in minor, adverse and minor, beneficial effects. When these adverse and beneficial effects are considered together, Alternative B would have a long-term, negligible effect on park operations. When the effects of other actions and Alternative B are combined, the cumulative, long-term effects to park operations are negligible.

4.12.4 Alternative C – Reinforced Concrete Arches

Changes to park operations that would occur under Alternative C would be very similar to Alternative B. Therefore, the analysis of park operations impacts presented in Section 4.12.3 is applicable to this alternative. Alternative C would result in short-term, minor, adverse effects to park operations based on the substantial commitment of human resources required for coordination, oversight, and implementation of the planning, design, and construction processes for the Catoctin Aqueduct restoration. The duration of restoration activities under Alternative C would be a few months shorter than Alternative B, resulting in a corresponding decrease in the level of effort associated with construction oversight. Changes in long-term maintenance requirements would result in minor, adverse and minor, beneficial effects. When these adverse and beneficial effects are considered together, Alternative C would have a long-term, negligible effect on park operations. The construction materials and methods used for Alternative C would differ slightly from Alternative B, but this would not affect the overall level of effort associated with long-term maintenance or sustainability of the structure.

Cumulative Effects

As discussed above for Alternative B, when the effects of other actions and Alternative C are combined, the cumulative, long-term effects to park operations are negligible.

Conclusions

Alternative C would result in short-term, minor, adverse effects to park operations based on the substantial commitment of human resources required for coordination, oversight, and implementation of the planning, design, and construction processes for the Catoctin Aqueduct restoration. Changes in long-term maintenance requirements would result in minor, adverse and minor, beneficial effects. When these adverse and beneficial effects are considered together, Alternative C would have a long-term, negligible effect on park operations. When the effects of other actions and Alternative C are combined, the cumulative, long-term effects to park operations are negligible.

4.13 PUBLIC HEALTH AND SAFETY

4.13.1 Impact Threshold Definitions

The impact threshold definitions for public health and safety are as follows:

- Negligible - The effects on employee and/or visitor health or safety would not be measurable.
- Minor - Effects on employee and/or visitor health and safety would be detectable; however, they would not produce an appreciable change.
- Moderate - Effects would be readily apparent, and would result in noticeable effects on employee and/or visitor health and safety. Changes in rates or severity of injury could be measured.
- Major - Effects would be swiftly apparent and would result in substantial, noticeable effects on employee and/or visitor health and safety, and could lead to employee or visitor mortality.

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- Short-term - Effects would occur only during and shortly after a specified action or treatment.
 - Long-term - Effects would persist well beyond the duration of a specified action or treatment.

4.13.2 Alternative A – No Action – Continue Current Maintenance

The Catoctin Aqueduct would not be restored under Alternative A and portions of the aqueduct ruins would continue to be unstable. While park policies prohibit direct visitor access to historic ruins, unauthorized access to unstable portions of the aqueduct ruins is a safety risk and risks could increase with continued deterioration. Alternative A would result in long-term, minor, adverse effects to public health and safety. The effects would be localized.

Cumulative Effects

Other actions have not affected public health and safety in the project area. When the effects of other actions and Alternative A are combined, the cumulative, long-term, adverse effects to public health and safety remain minor.

Conclusions

Alternative A would result in long-term, minor, adverse effects to public health and safety because unauthorized access to unstable portions of the aqueduct ruins is a safety risk and risks could increase with continued deterioration. When the effects of other actions and Alternative A are combined, the cumulative, long-term, adverse effects to public health and safety remain minor.

4.13.3 Alternative B – Stone Masonry Arches

Alternative B includes appropriate protective measures (Table 2.1) to avoid injury to visitors using this portion of the park and towpath during construction. Visitor access to work areas would be restricted during restoration using fencing and signage, as appropriate. Flagmen would escort heavy equipment along the towpath and speeds would be limited to 10

miles per hour. Therefore, adverse effects to public health and safety during construction would be short-term, negligible, and localized.

Restoration of the Catoctin Aqueduct would eliminate current safety risks associated with unstable portions of the aqueduct ruins. The restored aqueduct would also provide a safe crossing over Catoctin Creek for towpath users and park maintenance, law enforcement, and emergency vehicles. Alternative B would result in long-term, minor, beneficial effects to public health and safety.

Cumulative Effects

Other actions have not affected public health and safety in the project area. When the effects of other actions and Alternative B are combined, the cumulative, long-term, beneficial effects to public health and safety remain minor.

Conclusions

Short-term, adverse effects of Alternative B to public health and safety would be negligible and localized because appropriate protective measures would be implemented during construction. Restoration of the Catoctin Aqueduct would eliminate current safety risks associated with unstable portions of the aqueduct ruins and would result in long-term, minor, beneficial effects to public health and safety. When the effects of other actions and Alternative B are combined, the cumulative, long-term, beneficial effects to public health and safety remain minor.

4.13.4 Alternative C – Reinforced Concrete Arches

Public health and safety conditions that would occur under Alternative C would be very similar to Alternative B. Therefore, the analysis of public health and safety impacts presented in Section 4.13.3 is applicable to this alternative. Short-term, adverse effects of Alternative C to public health and safety would be negligible and localized because appropriate protective measures would be implemented during construction. The duration of construction activities under Alternative C would be a few months shorter than Alternative B, resulting in a corresponding decrease in the duration of potential construction safety risks. Alternative C

would eliminate current safety risks associated with unstable portions of the aqueduct ruins and would result in long-term, minor, beneficial effects to public health and safety.

Cumulative Effects

Similar to Alternative B, when the effects of other actions and Alternative C are combined, the cumulative, long-term, beneficial effects to public health and safety remain minor.

Conclusions

Short-term, adverse effects of Alternative C to public health and safety would be negligible and localized because appropriate protective measures would be implemented during construction. Restoration of the Catoctin Aqueduct would eliminate current safety risks associated with unstable portions of the aqueduct ruins and would result in long-term, minor, beneficial effects to public health and safety. When the effects of other actions and Alternative C are combined, the cumulative, long-term, beneficial effects to public health and safety remain minor.

4.14 SOCIOECONOMIC ENVIRONMENT

4.14.1 Impact Threshold Definitions

The impact threshold definitions for socioeconomic environment are as follows:

- Negligible - Little or no detectable change in local economic activity, employment, or the structure of primary local industries. Slight changes in spending patterns might occur at local businesses.
- Minor - Small but measurable changes in economic activity, employment, or the structure of primary local industries. Measurable changes in spending patterns would occur at local businesses.
- Moderate - Readily apparent and widespread changes in economic activity, employment, or the structure of primary local industries in the communities

nearest the park. The effects would be detectable in the economy of Frederick County.

- Major - Readily apparent and widespread changes in economic activity, employment, or the structure of primary industries in Frederick County.
- Short-term - Effects would primarily exist during active implementation of the action and could continue up to one year following implementation.
- Long-term - Effects would continue more than one year following implementation.

4.14.2 Alternative A – No Action – Continue Current Maintenance

Continuation of current maintenance would not affect park visitation rates, tourism, or economic indicators. Alternative A would have no effect on the socioeconomic environment.

Cumulative Effects

Restoration of the Monocacy Aqueduct might have increased park visitation and spending at local businesses slightly, and likely had a long-term, negligible, beneficial effect on the socioeconomic environment. When the effects of other actions and Alternative A are combined, the cumulative, long-term, beneficial effects to the socioeconomic environment would be negligible.

Conclusions

Alternative A would have no effect on the socioeconomic environment. When the effects of other actions and Alternative A are combined, the cumulative, long-term, beneficial effects to the socioeconomic environment would be negligible.

4.14.3 Alternative B – Stone Masonry Arches

Restoration of the Catoctin Aqueduct has the potential to increase tourism. The number visitors coming to the park to specifically view, study, and interpret the Catoctin Aqueduct is expected to increase and the potential exists for a small number (i.e., a few per year) of organized tour groups to visit the aqueduct. Historic sites and museums are among Frederick

County's top tourist stops. Organizations such as the Tourism Council of Frederick County, Inc. and the Frederick Historic Sites Consortium (a program of the Tourism Council) are expected to actively promote the restored Catoctin Aqueduct as one of many cultural sites of interest in the county. However, no perceptible increase in overall park visitation rates would be expected. Slight increases in spending at local business could occur, but measurable changes in local economic activity, employment, or structure of primary industries are not expected. Alternative B would have long-term, negligible, beneficial effects on the socioeconomic environment.

Cumulative Effects

Restoration of the Monocacy Aqueduct might have increased park visitation and spending at local businesses slightly, and likely had a long-term, negligible, beneficial effect on the socioeconomic environment. Restoration of the Catoctin Aqueduct would provide additional incentive for people to visit the area. When the effects of other actions and Alternative B are combined, the cumulative, long-term, beneficial effects to the socioeconomic environment would be negligible to minor.

Conclusions

Alternative B has the potential to increase tourism and spending at local business slightly, but measurable changes in local economic activity, employment, or structure of primary industries are not expected. Alternative B would have long-term, negligible, beneficial effects on the socioeconomic environment. When the effects of other actions and Alternative B are combined, the cumulative, long-term, beneficial effects to the socioeconomic environment would be negligible to minor.

4.14.4 Alternative C – Reinforced Concrete Arches

Park visitation and socioeconomic conditions that would occur under Alternative C would be the same as Alternative B. Therefore, the analysis of socioeconomic impacts presented in Section 4.14.3 is applicable to this alternative. Slight increases in spending at local business could occur, but measurable changes in local economic activity, employment, or structure of primary industries are not expected. Alternative C would have long-term, negligible, beneficial effects on the socioeconomic environment.

Cumulative Effects

Similar to Alternative B, when the effects of other actions and Alternative C are combined, the cumulative, long-term, beneficial effects to the socioeconomic environment would be negligible to minor.

Conclusions

Alternative C has the potential to increase tourism and spending at local business slightly, but measurable changes in local economic activity, employment, or structure of primary industries are not expected. Alternative C would have long-term, negligible, beneficial effects on the socioeconomic environment. When the effects of other actions and Alternative C are combined, the cumulative, long-term, beneficial effects to the socioeconomic environment would be negligible to minor.