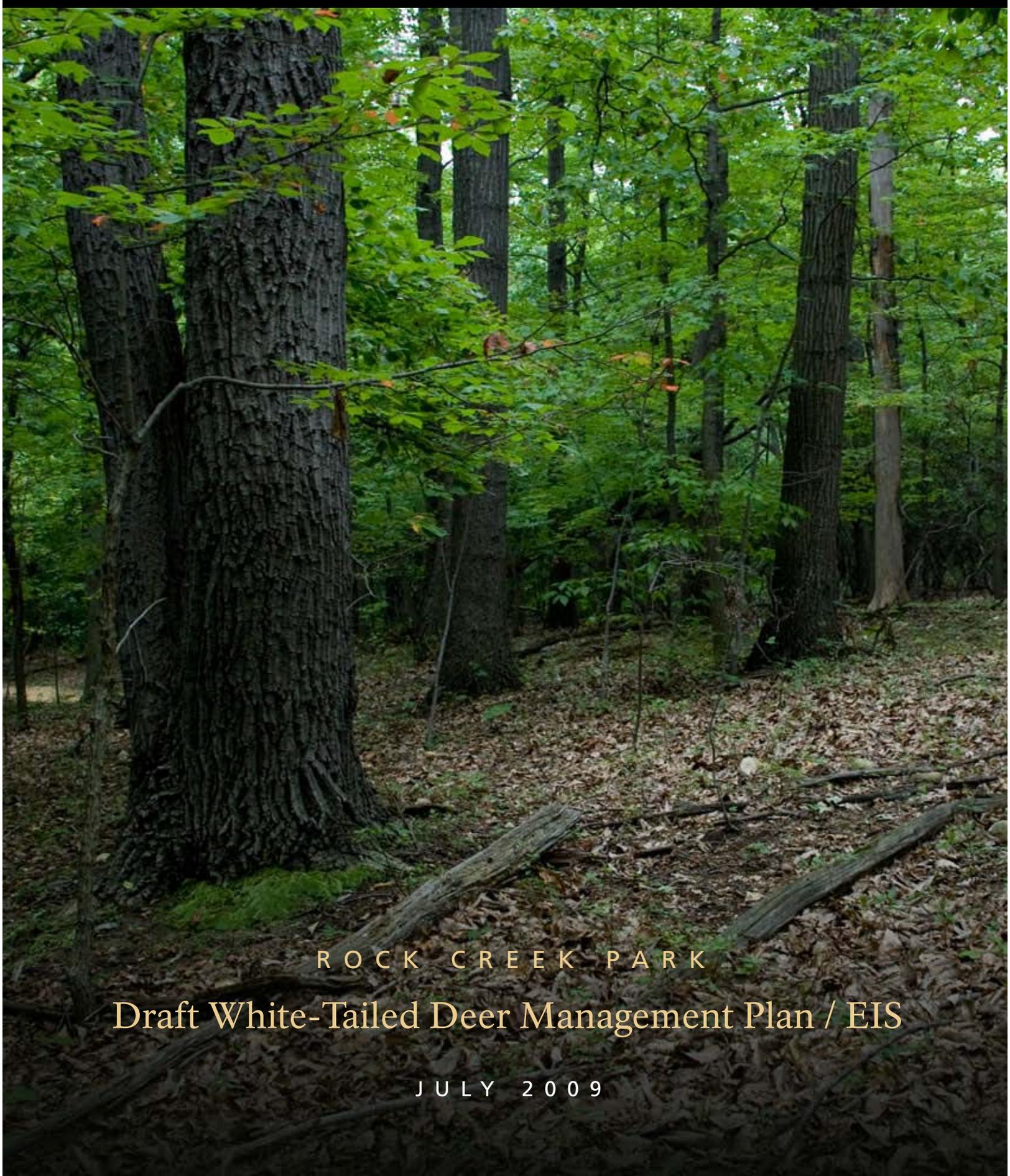


Rock Creek Park

Draft White-Tailed Deer  
Management Plan / Environmental Impact Statement

National Park Service  
U.S. Department of the Interior



ROCK CREEK PARK

Draft White-Tailed Deer Management Plan / EIS

JULY 2009



**UNITED STATES DEPARTMENT OF THE INTERIOR – NATIONAL PARK SERVICE**  
**DRAFT WHITE-TAILED DEER MANAGEMENT PLAN ENVIRONMENTAL IMPACT STATEMENT**  
**ROCK CREEK PARK, WASHINGTON, DC**

Lead Agency: National Park Service (NPS), U.S. Department of the Interior

This *Draft White-tailed Deer Management Plan/Environmental Impact Statement* describes four alternatives for the management of deer at Rock Creek Park, as well as the environment that would be affected by the alternatives and the environmental consequences of implementing these alternatives.

The purpose of this action is to develop a white-tailed deer management strategy that supports long-term protection, preservation, and restoration of native vegetation and other natural and cultural resources in Rock Creek Park. Action is needed at this time to address the potential of deer becoming the dominant force in the park's ecosystem, and adversely impacting native vegetation and other wildlife; a decline in tree seedlings caused by excessive deer browsing and the ability of the forest to regenerate in Rock Creek Park; excessive deer browsing impacts on the existing shrubs and herbaceous species; and deer impacts on the character of the park's cultural landscapes. White-tailed deer herds have increased substantially within and around Rock Creek Park in recent years, and results of vegetation monitoring have documented the adverse effects of the growing herd size on forest regeneration.

Under alternative A (no action), the existing deer management plan of monitoring, data management, research, and use of protective caging and repellents in landscaped areas would continue; no new deer management actions would be taken. Under alternative B, several non-lethal actions, such as large-scale exclosures (large fenced areas), and reproductive control of does via sterilization and an acceptable reproductive control agent when feasible would be taken to protect forest seedlings, promote forest regeneration, and gradually reduce deer numbers in the park. Under alternative C, direct reduction of the deer herd would be achieved by sharpshooting and by capture and euthanasia of individual deer in certain circumstances where sharpshooting would not be appropriate. Alternative D (preferred alternative) would combine elements from alternatives B and C: sharpshooting and capture/euthanasia would be used initially to quickly reduce the deer herd numbers, followed by population maintenance via reproductive control methods if these are available and feasible; if not, sharpshooting would be used as a default option for maintenance.

The potential environmental consequences of the alternatives are addressed for vegetation; soils and water quality; wetlands and floodplains; wildlife and wildlife habitat (including deer); rare, unique, threatened or endangered species; cultural landscapes; soundscapes; visitor use and experience; visitor and employee safety; socioeconomics; and park management and operations. Under alternative A, no action would be taken to reverse the expected long-term continued growth in the deer population, and damage to vegetation would likely continue. The analysis indicates that impairment to vegetation, wildlife habitat, and certain rare plant species could result in the long term if alternative A was implemented.

The *Draft White-tailed Deer Management Plan/ Environmental Impact Statement* is available for public and agency review and comment beginning when the U.S. Environmental Protection Agency Notice of Availability is published in the Federal Register. If you wish to comment on the document, you may mail comments to the name and address listed below or you may post them electronically at <http://parkplanning.nps.gov/rocr>. Before including your address, telephone number, electronic mail address, or other personal identifying information in your comments, you should be aware that your entire comment (including your personal identifying information) may be made publicly available at any time. While you can ask us in your comments to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. After public review, this document will then be revised in response to public comments. A final version of this document will then be released, and a 30-day no-action period will follow. Following the 30-day period, the alternative or actions constituting the approved plan will be documented in a record of decision that will be signed by the Regional Director of the National Capital Region. For further information regarding this document, please contact:

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National Park Service  
U.S. Department of the Interior



Rock Creek Park  
District of Columbia

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**ROCK CREEK PARK**  
**DRAFT DEER MANAGEMENT PLAN AND**  
**ENVIRONMENTAL IMPACT STATEMENT**

July 2009



# SUMMARY

## PURPOSE OF AND NEED FOR ACTION

The purpose of this action is to develop a white-tailed deer (*Odocoileus virginianus*) management strategy that supports long-term protection, preservation, and restoration of native vegetation and other natural and cultural resources in Rock Creek Park. White-tailed deer herds have increased substantially within and around Rock Creek Park in recent years. In 2007, sampling indicated 82 deer per square mile in the park, and results of vegetation monitoring in recent years have documented the adverse effects of the growing herd size on forest regeneration.

The deer population in Rock Creek Park has continued to grow and have adverse effects on the park's vegetation; therefore, action is needed at this time to address:

- The potential of deer becoming the dominant force in the park's ecosystem, and adversely impacting native vegetation and other wildlife.
- A decline in tree seedlings caused by excessive deer browsing and the ability of the forest to regenerate in Rock Creek Park.
- Excessive deer browsing impacts on the existing shrubs and herbaceous species.
- Deer impacts on the character of the park's cultural landscapes.
- Opportunities to coordinate with other jurisdictional entities currently implementing deer management actions beneficial to the protection of park resource and values.

## OBJECTIVES IN TAKING ACTION

Objectives define what must be achieved for an action to be considered a success. The following objectives relative to deer management at Rock Creek Park were developed for this plan, based on the park's enabling legislation, mandates, and direction in other planning documents, as well as service-wide objectives, management policies, and the Organic Act.

### VEGETATION

- Develop and implement informed, scientifically-based vegetation impact levels and corresponding measures of deer population density that would serve as a threshold for taking prescribed management actions within the park.
- Protect the natural abundance, distribution, and diversity of native plant species within the applicable park units by reducing excessive deer browsing, trampling, and nonnative seed dispersal.
- Maintain, restore, and promote a mix of native plant species and reduce the spread of nonnative plant species through effective deer management.

### WILDLIFE AND WILDLIFE HABITAT

- Allow for a white-tailed deer population within the park while protecting other park resources.
- Protect the natural abundance, distribution, and diversity of native animal species within the park by reducing excessive deer browsing, trampling, and nonnative seed dispersal.
- Protect lower canopy, shrub, and ground nesting bird habitat from adverse effects of deer browsing.

## THREATENED, ENDANGERED, AND SPECIES OF SPECIAL CONCERN

- Protect habitat of rare plant and animal species from adverse effects of deer, such as excessive deer browsing, trampling, and nonnative seed dispersal.

## CULTURAL RESOURCES

- Protect the integrity, variety, and character of the cultural landscapes by reducing excessive deer browsing, trampling, and nonnative seed dispersal.

## VISITOR USE AND EXPERIENCE

- Share information with the public regarding the deer population and the forest regeneration process and diversity, including the role of deer as part of a functioning park ecosystem, not the primary driving force within it.
- Initiate cooperative efforts to address deer effects on the park and surrounding communities.

## PARK MANAGEMENT AND OPERATIONS

- Share information with park staff and other regional parks regarding the deer population and management strategies.

## WHITE-TAILED DEER AT ROCK CREEK PARK

Although relatively rare at the turn of the twentieth century, white-tailed deer populations in the District of Columbia metropolitan area have rebounded during recent years. Deer thrive on food and shelter available in the “edge” habitat conditions created by suburban development. In addition, fragmentation of the landscape and the increase in developed areas have reduced suitable hunting opportunities. This is particularly true in Maryland’s growing suburban areas, some of which are adjacent to the District of Columbia.

Although there are no historic records before 1960 of the deer population specific to Rock Creek Park, deer herds have increased substantially within and around Rock Creek Park in recent years. Park observation records show four sightings of deer in Reservation 339 of Rock Creek Park in the 1960s. Deer sightings increased to 19 by the 1970s, and in 1984, the first recorded deer sighting in Glover-Archbold Park occurred. In the late 1980s (1987–1989) there were 39 deer sightings. By the early 1990s, deer sightings were so prevalent that observation cards were no longer completed. In 2007, sampling indicated 82 deer per square mile in the park, and results of vegetation monitoring in recent years have documented the effects of the growing herd size.

- The increasing numbers of white-tailed deer within the park are resulting in a substantial effect on the park ecosystem due to the deer’s heavy browsing of vegetation. Studies being conducted by the park indicate that deer are having adverse effects on shrub cover, tree seedling regeneration, and herbaceous cover, which affect habitat quality for other wildlife within the park that are dependent on this vegetation for food, shelter, and cover.

## ALTERNATIVES CONSIDERED

The alternatives under consideration include a required “no action” alternative and three action alternatives that were developed by an interdisciplinary planning team and through feedback from the public and scientific community during the planning process. The three action alternatives would meet, to a large degree, the objectives for this plan and also the purpose of and need for action. The alternatives are described below.

- **Alternative A: No Action** — Current deer management actions and policies would continue under alternative A, including monitoring deer density and relative numbers, monitoring

vegetation, data management, and opportunity for research. Protective caging and limited use of deer repellents may also be used to protect rare plants in natural areas and small areas in landscaped and cultural areas. Current educational and interpretive measures, as well as inter-jurisdictional communication, would continue. No new actions would occur to reduce the effects of deer overbrowsing.

- ***Alternative B: Combined Non-Lethal Actions*** — Alternative B would include all actions described under alternative A, but would also incorporate several non-lethal actions to protect forest seedlings, promote forest regeneration, and gradually reduce deer numbers in the park. The additional actions would include the construction of large-scale deer exclosures (large fenced areas) and reproductive control of does via sterilization and an acceptable reproductive control agent when feasible. Reproductive control implementation may require construction of temporary holding areas to house captured deer prior to treatment.
- ***Alternative C: Combined Lethal Actions*** — Alternative C would include all actions described under alternative A, but would also incorporate two lethal deer management actions to reduce the herd size. The additional actions would include reduction of the deer herd by either sharpshooting or by implementing capture and euthanasia of individual deer, to be used in limited circumstances where sharpshooting may not be appropriate.
- ***Alternative D: Combined Lethal and Non-Lethal Actions*** — Alternative D would include all actions described under alternative A, but would also include a combination of certain additional lethal and non-lethal actions from alternatives B and C to reduce deer herd numbers. The lethal actions would include both sharpshooting and capture/euthanasia and would be taken initially to quickly reduce the deer herd numbers. Population maintenance would be conducted via reproductive control methods if these are available and feasible; if not, sharpshooting would be used as a default option for maintenance.

## **ENVIRONMENTAL CONSEQUENCES**

The summary of environmental consequences considers the actions being proposed and the cumulative impacts to resources from occurrences inside and outside the park. The potential environmental consequences of the actions are addressed for vegetation; soils and water quality; wetlands and floodplains; wildlife and wildlife habitat (including deer); rare, unique, threatened or endangered species; cultural landscapes; soundscapes; visitor use and experience; visitor and employee safety; socioeconomics; and park management and operations.

**SUMMARY OF ENVIRONMENTAL CONSEQUENCES**

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Vegetation	<p><i>Direct/Indirect Impact:</i> The impacts of large numbers of deer browsing on a very large percentage of the park's woody and herbaceous vegetation and consequently limiting natural regeneration would be adverse, long term, and major.</p>	<p><i>Direct/Indirect Impact:</i> Since the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to woody and herbaceous vegetation would be adverse, long term, and major.</p>	<p><i>Direct/Indirect Impact:</i> Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through direct reduction would result in beneficial, long-term impacts. Over time as natural forest regeneration occurred, adverse, long-term, major impacts that could be expected if the deer herd continued unchecked would be reduced to minor levels.</p>	<p><i>Direct/Indirect Impact:</i> Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through the use of reproductive control (and direct reduction if needed) would result in beneficial, long-term impacts. Over time as natural forest regeneration occurred, adverse, long-term, major impacts would be reduced to minor levels.</p>
	<p><i>Cumulative Impact:</i> Would result in adverse, long-term, major cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in long-term, moderate to major adverse cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in beneficial, long-term cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in beneficial, long-term cumulative impacts.</p>
	<p><i>Potential for Impairment:</i> Current conditions in the park indicate severe adverse impacts on vegetation resources. Under alternative A it is expected that impairment of vegetation resources would occur over the long term.</p>	<p><i>Potential for Impairment:</i> It is not expected that impairment of vegetation resources would occur under this alternative.</p>	<p><i>Potential for Impairment:</i> No impairment of vegetation resources would occur under this alternative.</p>	<p><i>Potential for Impairment:</i> No impairment of vegetation resources would occur under this alternative.</p>
Soils and Water Quality	<p><i>Direct/Indirect Impact:</i> Soil erosion and sedimentation due to loss of vegetation from increased deer browsing could result in adverse long-term, negligible to minor impacts on soils and water quality.</p>	<p><i>Direct/Indirect Impact:</i> If deer displaced by the fenced enclosures concentrated in other areas of the park, resulting in increased loss of vegetation in those areas and a potential increase in soil erosion, adverse, long-term, minor impacts to soils and water quality could occur. Impacts would gradually shift to beneficial in the long term.</p>	<p><i>Direct/Indirect Impact:</i> Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on soils and water quality.</p>	<p><i>Direct/Indirect Impact:</i> Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on soils and water quality.</p>

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	<p><i>Cumulative Impact:</i> Would result in adverse, long-term, minor cumulative impacts on soil and water quality.</p> <p><i>Potential for Impairment:</i> No impairment of soil or water resources would occur under this alternative.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, long term, and minor cumulative impacts.</p> <p><i>Potential for Impairment:</i> No impairment of soil or water resources would occur under this alternative.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, long term, and minor cumulative impacts.</p> <p><i>Potential for Impairment:</i> No impairment of soil or water resources would occur under this alternative.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, long term, and minor cumulative impacts.</p> <p><i>Potential for Impairment:</i> No impairment of soil or water resources would occur under this alternative.</p>
Wetlands and Floodplains	<p><i>Direct/Indirect Impact:</i> Loss of vegetation from increased deer browsing, disturbance to small wetland areas and vernal pools and changes in species composition would result in adverse, long-term, moderate impacts on wetlands and floodplains.</p>	<p><i>Direct/Indirect Impact:</i> Use of exclosures to protect many of the park's forested wetlands would gradually result in beneficial long-term impacts to wetlands, although continued long-term minor to moderate adverse impacts would be expected in areas that are not fenced and in smaller wetland areas and seeps. Beneficial long-term impacts would also result from decreased vegetation loss. Construction of exclosures within the 100-year floodplain could result in short-term, minor adverse impacts on the floodplain.</p>	<p><i>Direct/Indirect Impact:</i> Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on wetlands and floodplains.</p>	<p><i>Direct/Indirect Impact:</i> Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on wetlands and floodplains.</p>
	<p><i>Cumulative Impact:</i> Would result in adverse, long-term, moderate impacts on wetlands and floodplains.</p> <p><i>Potential for Impairment:</i> No impairment of wetlands of floodplains would occur under this alternative.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, long-term, moderate impacts on wetlands and floodplains.</p> <p><i>Potential for Impairment:</i> No impairment of wetlands or floodplains would occur under this alternative.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, long term, minor to moderate cumulative impacts due mainly to past actions.</p> <p><i>Potential for Impairment:</i> No impairment of wetlands or floodplains would occur under this alternative.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, long term, minor to moderate cumulative impacts due mainly to past actions.</p> <p><i>Potential for Impairment:</i> No impairment of wetlands or floodplains would occur under this alternative.</p>

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
White-tailed Deer	<p><i>Direct/Indirect Impact:</i> Excessive deer browsing that would degrade habitat and limit food sources would result in long-term, moderate adverse impacts.</p>	<p><i>Direct/Indirect Impact:</i> Because the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to deer habitat, and in turn deer, would be adverse, long term, and moderate as a result of habitat degradation and loss of food sources. There could also be long-term, major adverse impacts to individual deer from the physiological, biological, and behavioral effects associated with the use of reproductive control; however, long-term impacts to the population would be minor to moderate because the adverse effects would be offset over time by the benefits of population reduction.</p>	<p><i>Direct/Indirect Impact:</i> The relatively rapid reduction of the deer herd and the resultant regeneration of forage would result in beneficial effects on deer herd health and would reduce adverse impacts to negligible or minor levels over the long term.</p>	<p><i>Direct/Indirect Impact:</i> Enhancing natural forest regeneration by quickly reducing deer browsing pressure would result in beneficial, long-term impacts to deer and deer habitat. Over time as natural forest regeneration occurred, adverse, long-term, major impacts would be reduced to negligible to minor levels. If reproductive controls are used, there could also be long-term, major adverse impacts to individual deer from the physiological, biological, and behavioral effects associated with the use of reproductive control; however, long-term impacts to the population would be minor to moderate because the adverse effects would be offset over time by the benefits of population reduction.</p>
	<p><i>Cumulative Impact:</i> Would result in adverse, long-term, moderate cumulative impacts.</p> <p><i>Potential for Impairment:</i> Although impacts to deer under alternative A could be severe, they would not approach the level of impairment over the long term.</p>	<p><i>Cumulative Impact:</i> Would result in long-term, moderate adverse cumulative impacts.</p> <p><i>Potential for Impairment:</i> It is not expected that impairment of the white-tailed deer herd in Rock Creek Park would occur under this alternative.</p>	<p><i>Cumulative Impact:</i> Would result in long-term, beneficial, cumulative impacts on deer herd health.</p> <p><i>Potential for Impairment:</i> No impairment of the white-tailed deer population would occur under this alternative.</p>	<p><i>Cumulative Impact:</i> Would result in beneficial, long-term cumulative impacts.</p> <p><i>Potential for Impairment:</i> No impairment of the white-tailed deer population would occur under this alternative.</p>
Other Wildlife and Wildlife Habitat	<p><i>Direct/Indirect Impact:</i> A continued large deer population and related browsing, resulting in decreased plant diversity, increased invasive exotic plants, and reduced forest regeneration would result in adverse effects on other wildlife. A</p>	<p><i>Direct/Indirect Impact:</i> Construction of large, fenced enclosures over the life of the plan would protect some habitat; however, the remaining habitat would continue to be subject to a high degree of deer browsing.</p>	<p><i>Direct/Indirect Impact:</i> Rapid reductions in deer numbers in the park, thereby reducing deer browsing pressure on woody and herbaceous vegetation and allowing increased abundance and diversity of other wildlife that</p>	<p><i>Direct/Indirect Impact:</i> Rapid reductions in deer numbers in the park, thereby reducing deer browsing pressure on woody and herbaceous vegetation and allowing increased abundance and diversity of other wildlife that</p>

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	<p>few predator species would benefit from a large deer population and an open understory; however, the impacts of large numbers of deer browsing on vegetation would adversely affect a large percentage of habitats for other wildlife (e.g., ground-nesting birds, frogs, snakes, and turtles), resulting in adverse, long-term, and negligible to potentially major impacts, depending on the species.</p> <p><i>Cumulative Impact:</i> Would result in both adverse and beneficial impacts, with adverse, long-term, major cumulative impacts.</p>	<p>adversely impacting both ground and shrub layer habitat for many other species of wildlife until reproductive controls took effect and reduced the deer population. A few species would tend to benefit from a large deer population and an open understory but overall, impacts to other wildlife would be adverse, long term, and negligible to potentially major, depending on the species.</p> <p><i>Cumulative Impact:</i> Would result in both adverse and beneficial impacts, with overall adverse, long term, moderate to major cumulative impacts.</p> <p><i>Potential for Impairment:</i> It is not expected that impairment of other wildlife species or habitat would occur under this alternative.</p>	<p>depend on understory vegetation would result in beneficial long term impacts. Adverse, long-term impacts would be reduced to negligible or minor levels over time.</p> <p><i>Cumulative Impact:</i> Would result in long-term, beneficial, cumulative impacts.</p> <p><i>Potential for Impairment:</i> No impairment of the white-tailed deer population would occur under this alternative.</p>	<p>depend on understory vegetation would result in beneficial long term impacts. Adverse, long-term impacts would be reduced to negligible or minor levels over time.</p> <p><i>Cumulative Impact:</i> Would result in beneficial, long-term cumulative impacts.</p> <p><i>Potential for Impairment:</i> No impairment of the white-tailed deer population would occur under this alternative.</p>
Rare, Unique, Threatened, or Endangered Species	<p><i>Potential for Impairment:</i> As explained in "Vegetation" above, alternative A would not reverse the expected long-term continued growth in the deer population, and wildlife habitat would likely continue to be degraded. Although not all wildlife species would be affected to the same extent, impairment of those wildlife species that depend on the presence of ground cover and understory vegetation that are heavily browsed by deer could occur under this alternative over the long term.</p> <p><i>Direct/Indirect Impact:</i> Impacts to rare, unique, threatened, or endangered species under alternative A would be both beneficial and adverse. Adverse</p>	<p><i>Direct/Indirect Impact:</i> Adverse impacts to the federally listed Hay's Spring amphipod could be long term and negligible to minor. Impacts to species listed or</p>	<p><i>Direct/Indirect Impact:</i> The reduced deer density would minimize potential impacts on the habitat for the Hay's Spring amphipod, resulting in long-term,</p>	<p><i>Direct/Indirect Impact:</i> The reduced deer density would minimize potential impacts on the habitat for the Hay's Spring amphipod, resulting in long-term, beneficial</p>

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	<p>impacts to the federally listed Hay's Spring amphipod (<i>Stygobromus hayi</i>) could be long term and negligible to minor. Beneficial impacts to state-listed plants would result from establishing caging around known individual plants and around newly discovered plants in the park. Overall, there would be adverse, long-term, negligible to major impacts to rare, unique, threatened, or endangered species, from excessive deer browsing and the associated habitat degradation that could result in lack of food or cover for such species.</p>	<p>considered special status species by Maryland and the District of Columbia would be adverse, long term, and moderate to major, until reproductive controls on the park deer herd were effective. The placement and maintenance of large exclosures would include many species listed or considered special status species by Maryland and the District of Columbia, resulting in beneficial, long-term impacts. However, adverse, long-term, negligible to moderate impacts due to deer browsing would continue outside the exclosures.</p>	<p>beneficial effects that would reduce adverse impacts to negligible. Impacts on species listed or considered special status species by Maryland and the District of Columbia, as well as their habitat, would be beneficial and long term as a result of rapid reductions in deer numbers in the park that would reduce deer browsing pressure on woody and herbaceous vegetation. A few predators that use deer as a food source could be adversely affected by a lower deer density, as could scavengers that feed on deer carcasses, but this alternative could also increase the availability of other prey. Adverse, long-term impacts would be reduced to negligible or minor levels over time.</p>	<p>effects that would reduce adverse impacts to negligible. Impacts on species listed or considered special status species by Maryland and the District of Columbia, as well as their habitat, would be beneficial and long term as a result of rapid reductions in deer numbers in the park that would reduce deer browsing pressure on woody and herbaceous vegetation. Adverse, long-term impacts would be reduced to negligible or minor levels over time. A few predators and scavengers that use deer and their carcasses as a food source could be adversely affected by a lower deer density or denser understory conditions, but this alternative could also increase the availability of other prey. Adverse, long-term impacts would be reduced to negligible or minor levels over time.</p>
	<p><i>Cumulative Impact:</i> Would result in both adverse and beneficial impacts, with overall long-term, minor to major, adverse cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in both beneficial and adverse impacts.</p>	<p><i>Cumulative Impact:</i> Would result in long-term, beneficial, cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in long-term, beneficial, cumulative impacts.</p>
	<p><i>Potential for Impairment:</i> Impairment under alternative A would be possible for some of the state-listed plants that are palatable to deer, as well as habitat for rare, unique, threatened, or endangered species, because alternative A would not reverse the expected long-term continued growth in the deer population and</p>	<p><i>Potential for Impairment:</i> It is not expected that impairment of state-listed plants, as well as habitat for rare, unique, threatened, or endangered species, would occur over the long term.</p>	<p><i>Potential for Impairment:</i> No impairment of rare, unique, threatened, or endangered species would occur under this alternative.</p>	<p><i>Potential for Impairment:</i> No impairment of rare, unique, threatened, or endangered species would occur under this alternative.</p>

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	damage to vegetation would likely continue, as described under "Vegetation" above. Therefore, it is expected that impairment of certain state-listed plants could occur over the long term.			
Cultural Landscapes	<i>Direct/Indirect Impact:</i> The use of small cages and repellents to protect landscape plantings, new restoration plantings, or rare plant species at specified areas could result in beneficial, long-term, minor impacts to these parts of the park's vegetation. However, continued growth of the deer population and the associated ongoing decline in the abundance and diversity of the native plant communities and cultural plantings would result in an adverse, long-term, minor to moderate impact to the park's cultural landscapes.	<i>Direct/Indirect Impact:</i> Constructing enclosures over the life of this plan would preserve some vegetation that is part of the cultural landscapes of the park. However, presence of the enclosures would result in long-term minor to moderate adverse impacts to the cultural landscapes in which they are located, and remaining vegetation within the park would continue to be adversely affected by deer browsing over the long term until reproductive controls became effective and the population decreased. Since the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to cultural landscapes would be adverse, long term, and minor to moderate.	<i>Direct/Indirect Impact:</i> Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through direct reduction would result in beneficial, long-term impacts.	<i>Direct/Indirect Impact:</i> Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through direct reduction would result in beneficial, long-term impacts.
	<i>Cumulative Impact:</i> Would result in adverse, long-term, minor to moderate cumulative impacts.	<i>Cumulative Impact:</i> Would result in long-term, moderate adverse cumulative impacts.	<i>Cumulative Impact:</i> Would result in beneficial, long-term cumulative impacts.	<i>Cumulative Impact:</i> Would result in beneficial, long-term cumulative impacts.
	<i>Potential for Impairment:</i> No impairment of cultural landscapes would occur under this alternative.	<i>Potential for Impairment:</i> No impairment of cultural landscapes would occur under this alternative.	<i>Potential for Impairment:</i> No impairment of cultural landscapes would occur under this alternative.	<i>Potential for Impairment:</i> No impairment of cultural landscapes would occur under this alternative.
Soundscapes	<i>Direct/Indirect Impact:</i> Actions taken to protect plants and monitor the deer population and park	<i>Direct/Indirect Impact:</i> Intermittent construction of enclosures and reproductive control activities	<i>Direct/Indirect Impact:</i> Sharpshooting would result in adverse impacts, primarily affecting	<i>Direct/Indirect Impact:</i> Sharpshooting would result in adverse impacts, primarily affecting

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	<p>vegetation would result in an adverse, short-term, negligible adverse impact on soundscapes.</p>	<p>would result in short term, negligible to minor, adverse impacts Individual construction and reproductive control activities would be short term, but would continue indefinitely into the future, resulting in both short- and long-term, negligible to minor, adverse impacts.</p>	<p>nearby residents. Perception of the intensity of the impacts would vary depending on several factors, including timing, attenuation levels, and distance from the source, resulting in minor to moderate impacts to individuals experiencing the sound.</p>	<p>nearby residents. Perception of the intensity of the impacts would vary depending on several factors, including timing, attenuation levels, and distance from the source, resulting in minor to moderate impacts to individuals experiencing the sound.</p>
	<p><i>Cumulative Impact:</i> Would result in cumulative impacts ranging from minor to moderate and adverse depending on the source, due to the variety and abundance of noise sources that already exist around and within the park.</p>	<p><i>Cumulative Impact:</i> Would result in cumulative impacts ranging from minor to moderate and adverse depending on the source, due to the variety and abundance of noise sources that already exist around and within the park.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, short and long term, and minor to moderate cumulative impacts. However, these impacts would be expected to decrease in the long term, as deer populations in all affected areas decrease and the need for direct reduction decreases as well.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, short and long term, and minor to moderate cumulative impacts. However, these impacts would be expected to decrease in the long term, as deer populations in all affected areas decrease and the need for direct reduction decreases as well.</p>
	<p><i>Potential for Impairment:</i> No impairment of the park's soundscapes would occur under this alternative.</p>	<p><i>Potential for Impairment:</i> No impairment of the park's soundscapes would occur under this alternative.</p>	<p><i>Potential for Impairment:</i> No impairment of the park's soundscapes would occur under this alternative.</p>	<p><i>Potential for Impairment:</i> No impairment of the park's soundscapes would occur under this alternative.</p>
Visitor Use and Experience	<p><i>Direct/Indirect Impact:</i> Impacts to visitor use and experience would be both beneficial and adverse to those visitors who maybe primarily interested in viewing deer (beneficial in that there would be more deer to see, adverse in that the appearance of the herd could be poor). However, overall impacts related to a decreased ability to view scenery and other wildlife would be long term, minor to moderate and adverse.</p>	<p><i>Direct/Indirect Impact:</i> Visitors would experience adverse, short-term impacts primarily due to aesthetics and closures of certain areas of the park, as well as a slight increase in occasional noise levels. These impacts would be offset by the educational and interpretive information, which would reduce adverse impacts to minor. Short-term impacts would eventually give way to beneficial, long-term impacts as the need for deer population declined, and the deer population declined, resulting in a restored forest ecosystem</p>	<p><i>Direct/Indirect Impact:</i> Adverse, short-term impacts that could occur if visitors were exposed to management actions would be offset by educational and interpretive information, resulting in negligible adverse impacts. Beneficial impacts would occur in the long term, as the forest regenerated and visitors could see increased plant and animal diversity, and enjoy enhanced scenery. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such impact would</p>	<p><i>Direct/Indirect Impact:</i> Adverse, short-term impacts that could occur if visitors were exposed to management actions would be offset by educational and interpretive information, resulting in negligible adverse impacts. Beneficial impacts would occur in the long term, as the forest regenerated and visitors could see increased plant and animal diversity, and enjoy enhanced scenery. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such impact would</p>

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
		throughout the park. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such an impact would be negligible to minor, as opportunities to view deer would still exist.	be negligible to minor, as opportunities to view deer would still exist.	be negligible to minor, as opportunities to view deer would still exist.
	<i>Cumulative Impact:</i> Would result in both adverse and beneficial (depending on an individual visitor's goals) impacts. Overall cumulative impacts would be long term, minor to moderate and adverse.	<i>Cumulative Impact:</i> Would result in mostly beneficial and long term cumulative impacts due to the effects of combined forest regeneration activities.	<i>Cumulative Impact:</i> Would result in cumulative impacts that would be primarily beneficial and long term.	<i>Cumulative Impact:</i> Would result in cumulative impacts that would be primarily beneficial and long term.
Visitor Safety	<i>Direct/Indirect Impact:</i> Because it is expected that no discernible effects to visitor safety would result from deer management actions, but vehicle collisions would continue, adverse, long-term, negligible to moderate adverse impacts could occur.	<i>Direct/Indirect Impact:</i> Adverse impacts to visitors would be short and long term and negligible from deer management, although the continued presence of a large number of deer over the life of the plan would continue to contribute to vehicle deer collisions on park roads and result in minor to moderate adverse impacts.	<i>Direct/Indirect Impact:</i> The extent of safety measures would result in adverse, short- and long-term, negligible to minor impacts, as it is expected that no discernible effects to visitor safety would occur from deer management actions and the possibility of deer-vehicle collisions would be diminished.	<i>Direct/Indirect Impact:</i> The extent of safety measures that would be used and locating activities away from park boundaries would result in adverse, short- and long-term, negligible impacts. The possibility of deer-vehicle collisions would be greatly diminished.
	<i>Cumulative Impact:</i> Would result in adverse, long term, and minor cumulative impacts.	<i>Cumulative Impact:</i> Would result in adverse, long term, and minor cumulative impacts.	<i>Cumulative Impact:</i> Would result in adverse, long term, and negligible to minor cumulative impacts.	<i>Cumulative Impact:</i> Would result in adverse, long term, and negligible to minor cumulative impacts.
Employee Safety	<i>Direct/Indirect Impact:</i> Because it is expected that no discernible effects to employee safety would occur as a result of deer management actions, impacts would be adverse, long term, and negligible.	<i>Direct/Indirect Impact:</i> Adverse impacts to government employees would be short and long term and negligible to minor.	<i>Direct/Indirect Impact:</i> Adverse, short- and long-term, negligible to minor impacts would occur.	<i>Direct/Indirect Impact:</i> Adverse, short- and long-term, negligible to minor impacts would occur.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Socio-economic Resources	<p><i>Cumulative Impact:</i> Would result in adverse, long term, and negligible cumulative impacts.</p> <p><i>Direct/Indirect Impact:</i> The continued high numbers of deer and likely long-term increase in the deer population in Rock Creek Park would result in additional damage to landscaping in the surrounding areas and could result in varying impacts, ranging from minor to moderate and adverse.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, long term, and negligible cumulative impacts.</p> <p><i>Direct/Indirect Impact:</i> Reproductive controls (if successful) would allow for only a gradual reduction in the number of deer, and there could be some displacement of deer from the park due to exclosures. The net effect on surrounding property could result in slightly greater damage to landscaping, the impacts of which would be long term and moderate.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, long term, and negligible cumulative impacts.</p> <p><i>Direct/Indirect Impact:</i> The reduction of the existing deer populations in both the short and long term could result in fewer deer leaving the park and browsing landscaping on adjacent lands, with long-term beneficial effects that would reduce adverse impacts to negligible or minor levels.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, long term, and negligible to minor cumulative impacts.</p> <p><i>Direct/Indirect Impact:</i> The reduction of the existing deer populations in both the short and long term could result in fewer deer leaving the park and browsing landscaping on adjacent lands, with long-term beneficial effects that would reduce adverse impacts to negligible or minor levels.</p>
Park Management and Operations	<p><i>Cumulative Impact:</i> Would result in adverse, long term, and minor to moderate cumulative impacts.</p> <p><i>Direct/Indirect Impact:</i> Long-term demands on park staff and funding for managing the deer herd and protecting other park resources would result in adverse, long term, and minor to moderate impacts.</p>	<p><i>Cumulative Impact:</i> Would result in moderate adverse long-term cumulative impacts.</p> <p><i>Direct/Indirect Impact:</i> Installing and maintaining large exclosures and implementing and monitoring reproductive controls would result in long-term, moderate adverse impacts.</p>	<p><i>Cumulative Impact:</i> Would result in long-term minor cumulative adverse impacts.</p> <p><i>Direct/Indirect Impact:</i> The need for additional staff time for monitoring and coordinating activities under alternative C would result in adverse, moderate impacts initially, reduced to minor over time.</p>	<p><i>Cumulative Impact:</i> Would result in long-term minor cumulative adverse impacts.</p> <p><i>Direct/Indirect Impact:</i> The need for additional staff time for monitoring and coordinating activities under alternative C would result in adverse, moderate impacts initially, reduced to minor over time.</p>

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## PURPOSE OF AND NEED FOR ACTION

The “Purpose of and Need for Action” chapter explains what this plan intends to accomplish and why the National Park Service (NPS) is taking action at this time. This Draft White-Tailed Deer Management Plan and Environmental Impact Statement (plan/EIS) presents three action alternatives for managing white-tailed deer (*Odocoileus virginianus*), and assesses the impacts that could result from continuation of the current management framework (alternative A) or implementation of any of the action alternatives. Upon conclusion of the plan and decision-making process, the alternative that is selected will become the white-tailed deer management plan for Rock Creek Park, which will guide future actions for a period of 15 years. Brief summaries of both purpose and need are presented here, but more information is available in the “Park Background” section of this chapter.

### PURPOSE OF THE PLAN / ENVIRONMENTAL IMPACT STATEMENT

The purpose of this plan/EIS is to develop a white-tailed deer management strategy that supports long-term protection, preservation, and restoration of native vegetation and other natural and cultural resources in Rock Creek Park.

### NEED FOR ACTION

Although relatively rare at the turn of the twentieth century, white-tailed deer populations in the District of Columbia metropolitan area have rebounded during recent years. Deer thrive on food and shelter available in the “edge” habitat conditions created by suburban development. In addition, fragmentation of the landscape and the increase in developed areas have reduced suitable hunting opportunities. This is particularly true in Maryland’s growing suburban areas, some of which are adjacent to the District of Columbia (MD DNR 1998).

Although there are no historic records before 1960 of the deer population specific to Rock Creek Park, deer herds have increased substantially within and around Rock Creek Park in recent years. Park observation records show four sightings of deer in Reservation 339 of Rock Creek Park in the 1960s. Deer sightings increased to 19 by the 1970s, and in 1984, the first recorded deer sighting in Glover-Archbold Park occurred. In the late 1980s (1987–1989) there were 39 deer sightings. By the early 1990s, deer sightings were so prevalent that observation cards were no longer completed. In 2007, sampling indicated 82 deer per square mile in the park, and results of vegetation monitoring in recent years have documented the effects of the growing herd size.

The deer population in Rock Creek Park has continued to grow and have adverse effects on the park’s vegetation; therefore, action is needed at this time to address:

- The potential of deer becoming the dominant force in the park’s ecosystem, and adversely impacting native vegetation and other wildlife.
- A decline in tree seedlings caused by excessive deer browsing and the ability of the forest to regenerate in Rock Creek Park.
- Excessive deer browsing impacts on the existing shrubs and herbaceous species.

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*The purpose of this plan/EIS is to develop a white-tailed deer management strategy that supports long-term protection, preservation, and restoration of native vegetation and other natural and cultural resources in Rock Creek Park.*

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## *Purpose of and Need for Action*

- Deer impacts on the character of the park's cultural landscapes.
- Opportunities to coordinate with other jurisdictional entities currently implementing deer management actions beneficial to the protection of park resource and values.

## **OBJECTIVES IN TAKING ACTION**

Objectives define what must be achieved for an action to be considered a success. Alternatives selected for detailed analysis must meet all objectives to a large degree and must also resolve the purpose of and need for action. Using the park's enabling legislation, mandates, and direction in other planning documents, as well as service-wide objectives, management policies, and the Organic Act, park staff identified the following objectives relative to deer management at Rock Creek Park:

### **VEGETATION**

- Develop and implement informed, scientifically-based vegetation impact levels and corresponding measures of deer population density that would serve as a threshold for taking prescribed management actions within the park.
- Protect the natural abundance, distribution, and diversity of native plant species within the applicable park units by reducing excessive deer browsing, trampling, and nonnative seed dispersal.
- Maintain, restore, and promote a mix of native plant species and reduce the spread of nonnative plant species through effective deer management.

### **WILDLIFE AND WILDLIFE HABITAT**

- Allow for a white-tailed deer population within the park while protecting other park resources.
- Protect the natural abundance, distribution, and diversity of native animal species within the park by reducing excessive deer browsing, trampling, and nonnative seed dispersal.
- Protect lower canopy, shrub, and ground nesting bird habitat from adverse effects of deer browsing.

### **THREATENED, ENDANGERED, AND SPECIES OF SPECIAL CONCERN**

- Protect habitat of rare plant and animal species from adverse effects of deer, such as excessive deer browsing, trampling, and nonnative seed dispersal.

### **CULTURAL RESOURCES**

- Protect the integrity, variety, and character of the cultural landscapes by reducing excessive deer browsing, trampling, and nonnative seed dispersal.

### **VISITOR USE AND EXPERIENCE**

- Share information with the public regarding the deer population and the forest regeneration process and diversity, including the role of deer as part of a functioning park ecosystem, not the primary driving force within it.
- Initiate cooperative efforts to address deer effects on the park and surrounding communities.

### **PARK MANAGEMENT AND OPERATIONS**

- Share information with park staff and other regional parks regarding the deer population and management strategies.

## PROJECT SITE LOCATION

Part of the national park system, Rock Creek Park is composed of 99 separate units, known as reservations, located in the District of Columbia and bordered by Montgomery County, Maryland (see figure 1). The focus of the analysis is to develop management strategies for the white-tailed deer population in and around the 99 units administered by Rock Creek Park. Although all units were considered, those units that have the available land to support a deer population, provide travel corridors between viable habitats, and/or where deer are currently known to occur, are emphasized in this plan. Table 1 lists all administered units of Rock Creek Park, including the main unit, Reservation 339 (which is also called “Rock Creek Park,” but as a separate unit) and its tributary extension units and other reservations that are part of the overall NPS-administered park. Reservations that are not specifically addressed in the plan are highlighted in gray. Triangle parks, traffic circles, and most parks less than one acre in size were removed from site specific evaluation. Park units less than one acre in size that are not highlighted in gray are included in the study area because of their proximity to Reservation 339 and their potential as a wildlife corridor to that reservation.

1

**TABLE 1. ROCK CREEK PARK NAMED ADMINISTERED UNITS**

Unit Name	Reservation Number	Approx. Acreage	Enabling Legislation
Rock Creek Park and tributary park extensions	339	1,822	26 Stat 492 September 27, 1890
Pinehurst Parkway	545		Purchased by National Capital Planning Commission April 30, 1926 and Capper-Cramton Act, transfer from District of Columbia
Klingle Valley	356, 635, 563		
Soapstone Valley Park	402		
Normanstone Parkway	514		
North Portal Parkway	433		
Beach Parkway	432		
Rock Creek and Potomac Parkway	360	171	
Fort Circle Parks			Capper-Cramton Act, May 29, 1930
Fort Reno	470, 515, 542	62	
Fort Stevens	358, 494, 499	24	
Battery Kemble	521, 530	57	
Fort Bayard	359	4	
Fort Slocum	435	18	
Fort Totten	497, 544, 451	129	
Fort Bunker Hill	443	6	
Potomac Palisades Parkway – Key Bridge to Chain Bridge, NW	404 Section 3	232	Capper-Cramton Act, May 29, 1930 Transfer of jurisdiction from District of Columbia
Barnard Hill	520, 528	29	Capper-Cramton Act, May 29, 1930
Dumbarton Oaks Park	637	27	Deeded to government from private donors
Meridian Hill Park	327	12	36 Stat 1310 March 4, 1911
Montrose Park	324	16	1911 District appropriations act provision (36 Stat 1005), transfer of jurisdiction from District of Columbia or other
Glover-Archbold Park, Glover Parkway & Children’s Playground	351 (A–K), 450 (A–B), 451, 641	287	Land donations, authorized June 6, 1924 (43 Stat 464) and February 25, 1925 (43 Stat 978)

Purpose of and Need for Action

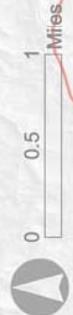
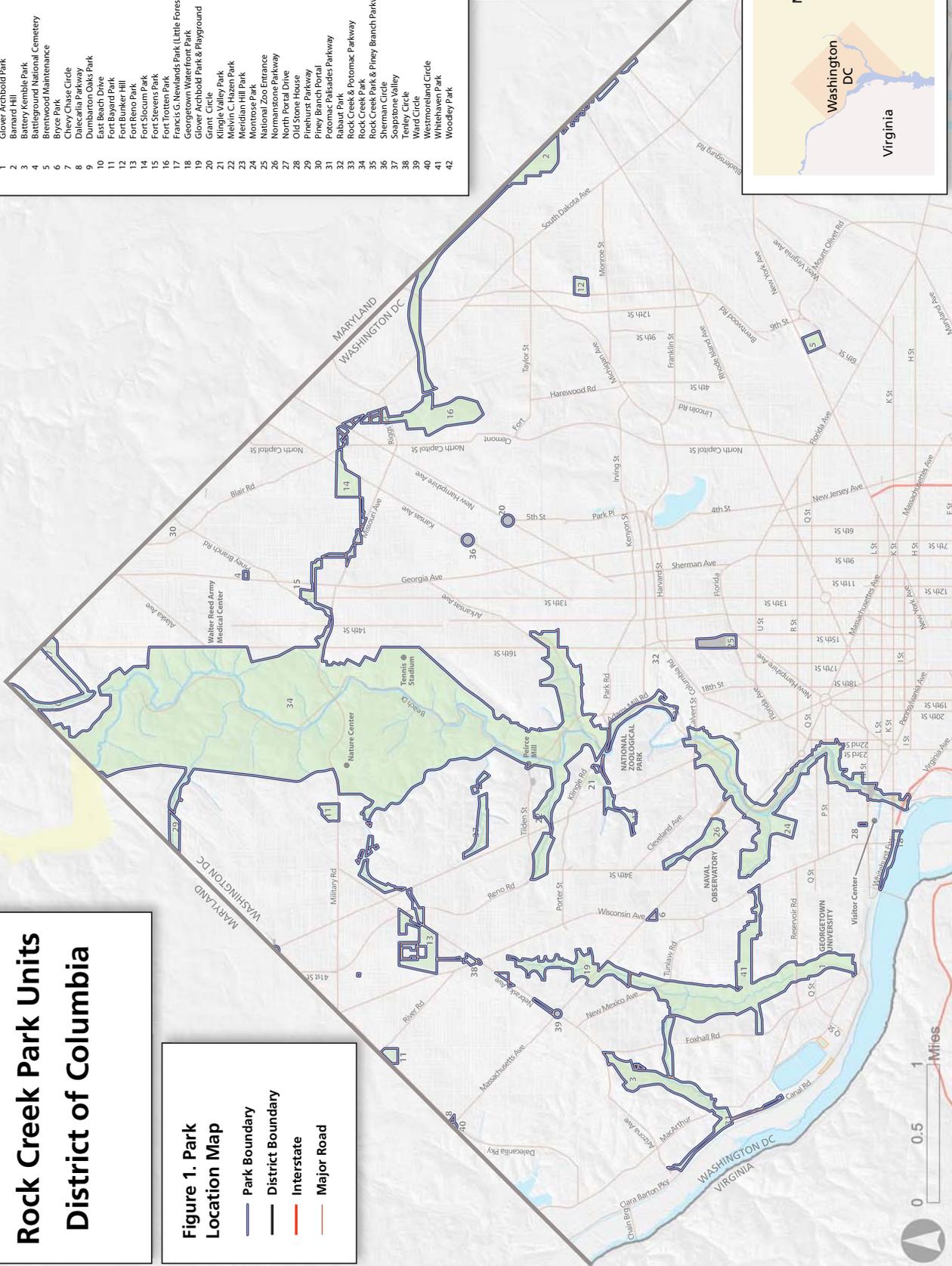
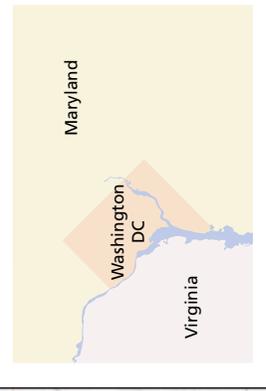
Unit Name	Reservation Number	Approx. Acreage	Enabling Legislation
Triangle Parks (irregular parcels) [note: Triangle Parks, located throughout the city, are not shown on figures 1 or 2]	302-303, 303B, 309 (A-B, G), 312 (A, I), 313B, 330 (B-C), 345-346, 397, 436, 438, 447-448, 468, 565, 573, 587, 614, 643, 667, 686	5.07	Transfer of jurisdiction from District of Columbia or other
Traffic Circles Grant Circle Chevy Chase Circle Sherman Circle Tenley Circle Westmoreland Circle Ward Circle	303A 312 335A 369 398, 399 559 572	0.16 1.84 0.71 2.32 0.16 0.76 0.69	Transfer of jurisdiction from District of Columbia or other
Curb Parking – Ashmeade PI between Connecticut Ave & Kalorama Rd NW, Jenifer & 41 <sup>st</sup> Sts at Belt Rd NW, Western Ave & Patterson St NW	303D, 326C, 335, 361	0.44	Transfer of jurisdiction from District of Columbia or other
Center Parking – Tilden St & Linnean Ave NW, Rock Creek Dr between Edgevale Terr & Normanstone Dr NW	308A, 338	1.20	Transfer of jurisdiction from District of Columbia or other
Rabaut Park	309C	0.57	Transfer of jurisdiction from District of Columbia or other
Whitehaven Parkway	357	51.25	--
National Zoological Park Entrance – Harvard St NW	516	1.0	Capper-Cramton Act, May 29, 1930
Park – Garfield St, between Fulton St & Foxhall Rd NW	529	14.0	Capper-Cramton Act, May 29, 1930
Piney Branch Portal	531	0.77	Transfer of jurisdiction from District of Columbia or other
Park – north side of National Zoological Park & Adams Mill Rd NW	563	1.77	Transfer of jurisdiction from District of Columbia or other U.S. agency
Battleground National Cemetery	568	1	Transfer from U.S. agencies
Melvin C. Hazen Park	630	43	Capper-Cramton Act, May 29, 1930
Woodley Park	635	3	Capper-Cramton Act, May 29, 1930 and transfer from District of Columbia or other
Francis G. Newlands Park (Little Forest)	668	9	Dedication/donation from private party
Park – Pennsylvania Ave btw 28 <sup>th</sup> & M Sts NW	691	0.07	Transfer of jurisdiction from District of Columbia or other
Old Stone House	693	0.42	Purchased by USDI, NPS, or NCR, legislation approved September 25, 1950
Bryce Park	700	0.58	Capper-Cramton Act, May 29, 1930

# Rock Creek Park Units District of Columbia

**Figure 1. Park  
Location Map**

-  Park Boundary
-  District Boundary
-  Interstate
-  Major Road

Map Name	Reservation #
1 Glover Archbold Park	351,450
2 Barnard Hill	520,528
3 Battery Kemble Park	521,530
4 Battleground National Cemetery	568
5 Brentwood Maintenance	
6 Bryce Park	700
7 Chey Chase Circle	335A
8 Dumbarton Oaks Park	637
9 Dumbarton Oaks Park	482
10 East Beach Drive	359
11 Fort Bayard Park	443
12 Fort Bunker Hill	470,515,542
13 Fort Reno Park	435
14 Fort Slocum Park	358,494,499
15 Fort Stevens Park	497,544,451
16 Fort Totten Park	668
17 Francis C. Newlands Park (Little Forest)	
18 Georgetown Veterans Park	451,641
19 Glover Archbold Park & Playground	312
20 Grant Circle	312
21 Kingie Valley Park	356,635,663
22 Melvin C. Hazen Park	630
23 Meridian Hill Park	327
24 Montrose Park	324
25 National Zoo Entrance	516
26 Normanstone Parkway	514
27 North Portia Drive	433
28 Old Stone House	693
29 Piney Branch Park	531
30 Piney Branch Park	531
31 Potomac Palisades Parkway	404
32 Rabaut Park	309C
33 Rock Creek & Potomac Parkway	360
34 Rock Creek Park	339
35 Rock Creek Park & Piney Branch Parkway	339,531
36 Sherman Circle	369
37 Soapstone Valley	402
38 Tenley Circle	396,399
39 Ward Circle	522
40 Woodland Circle	567
41 Whitehaven Park	327
42 Woodley Park	635





## PARK BACKGROUND

### HISTORY OF ROCK CREEK PARK

The 1890 legislation establishing Rock Creek Park reserved land in the District of Columbia for the purpose of creating a “public park and pleasure ground for the benefit and enjoyment of the people of the United States.” These urban allocations of land provided to the local residents and visitors fresh air, waterways, meadows, and serenity that were considered the antidote to the stress of daily work and the congestion of the city. However, Rock Creek Park was also linked to the burgeoning conservation movement within the United States. Congress emphasized the preservation of the park’s natural resources and landscape scenery in the enabling legislation, stating “regulations shall provide for the preservation from injury or spoliation of all timber, animals or curiosities within said park, and their retention in their natural condition, as nearly as possible” (Bushong 1990).

As previously noted, Rock Creek Park is an administrative unit of the national park system consisting of 99 separate units, known as reservations, located entirely within the northwest and northeast quadrants of the District of Columbia. Residential and commercial areas of Washington, D.C. and Maryland surround all of the park units. Over 1,100 homes and apartments abut the park units along 72 miles of the park boundary (NPS 2005a). The largest of the 99 reservations, Rock Creek Park (Reservation 339), was established by Congress on September 27, 1890, and consists of 1,754 acres of Rock Creek and the surrounding valley from the Maryland state line south to the National Zoological Park (see figure 2). Beyond Reservation 339, Rock Creek administers areas such as the Rock Creek and Potomac Parkway (Reservation 360), Glover-Archbold Park (Reservations 351 and 450), and the Fort Circle Parks to name a few. These units have different purposes, ranging from highly designed cultural landscapes to natural forested areas. Throughout this document, references to Rock Creek Park or the park include all administered units; descriptions of specific units are referenced as such.



*The 1890 legislation establishing Rock Creek Park reserved land in the District of Columbia for the purpose of creating a “public park and pleasure ground for the benefit and enjoyment of the people of the United States.”*

## 1 OVERVIEW OF THE PARK'S ECOSYSTEM

Deciduous woods cover most of the park's total acreage. While there are six forest communities in the park, over half of the park is an American beech (*Fagus grandifolia*)/white oak (*Quercus alba*) forest (Nature Conservancy 1998). Several species of oak (*Quercus* spp.), hickory (*Carya* spp.), tulip poplar (*Liriodendron tulipifera*), and American beech predominate the slopes and ridges. Elm (*Ulmus* spp.), sycamore (*Platanus occidentalis*), ash (*Fraxinus* spp.), box elder (*Acer negundo*) and tulip poplar are common in the occasional floodplain areas along stream channels. Remnant coniferous trees are spread throughout the park as single trees or small groves. An inventory of the park's vegetation has documented approximately 700 species of vascular plants. Thirty-one rare or uncommon plants listed by Maryland and Virginia are found in the park. Approximately 15 meadow areas, measuring from 0.3 to 4 acres in size, are scattered among the park units (NPS 2005a).

Wildlife studies throughout the park have identified 36 species of mammals, 181 species of birds, and 19 species of reptiles and amphibians that are present or probably present in the park (NPS unpublished data-NPSpecies 2008b). Species in the park include white-tailed deer, red (*Vulpes vulpes*) and gray (*Urocyon cinereoargenteus*) fox, raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), gray squirrel (*Sciurus carolinensis*), beaver (*Castor canadensis*), chipmunk (*Tamias striatus*), southern flying squirrel (*Glaucomys volans*), coyote (*Canis latrans*), great horned owl (*Bubo virginianus*), barred owl (*Strix varia*), red shouldered hawk (*Buteo lineatus*), eastern box turtle (*Terrepenne carolina*), spotted salamander (*Ambystoma maculatum*), and black rat snake (*Elaphe obsoleta*) (NPS 2005a). One endangered species is found in freshwater springs within the park, the Hay's Spring amphipod (*Stygobromus hayi*).

The increasing numbers of white-tailed deer within the park are resulting in a substantial effect on the park ecosystem due to the deer's heavy browsing of vegetation. Studies being conducted by the park indicate that deer are having adverse effects on shrub cover, tree seedling regeneration, and herbaceous cover, which affect habitat quality for other wildlife within the park that are dependent on this vegetation for food, shelter, and cover (see "Vegetation Impacts section, below).

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*Herbaceous plants are non-woody plants, including grasses, wildflowers, and sedges and rushes (grass-like plants).*

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### PURPOSE AND SIGNIFICANCE OF ROCK CREEK PARK UNITS

All units of the national park system are formed for a specific purpose and to preserve significant resources or values for the enjoyment of future generations. The purpose and significance identify uses and values that individual NPS plans should support.

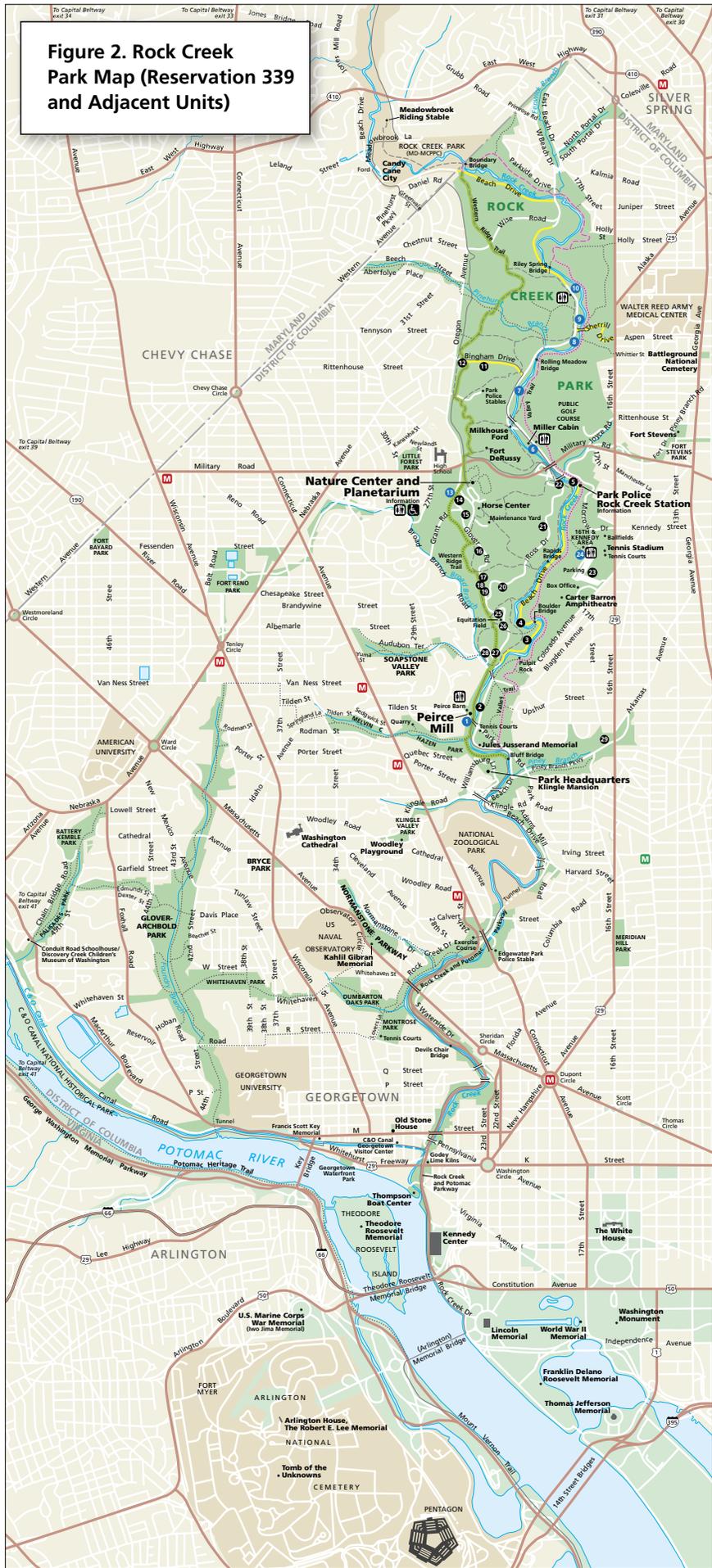
The following provides background on the purpose and significance of three large units managed by Rock Creek Park: Rock Creek Park (Reservation 339), Rock Creek and Potomac Parkway, and the Fort Circle Parks. Information on purpose and significance were taken from the enabling legislation and general management plan (GMP) language.

#### **Rock Creek Park and Associated Tributary Parks (Reservation 339) and the Rock Creek and Potomac Parkway (Reservation 360)**

**Establishment**—Congress established Rock Creek Park, one of the first national park areas, on September 27, 1890 as a unique natural park containing significant historic and archeological resources, and providing a variety of recreational opportunities for visitors and residents of the District of Columbia metropolitan area (Pub. L. 51-297, 26 Stat. 482).

Rock Creek Park is linked to the Potomac River and the monuments in downtown Washington, D.C. by the Rock Creek and Potomac Parkway. Congress established the parkway through the Public Buildings Act of March 4, 1913. The parkway corridor is managed contiguously with Rock Creek Park.

**Figure 2. Rock Creek Park Map (Reservation 339 and Adjacent Units)**



North

0 0.5 1 Kilometer  
0 0.5 1 Mile

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**Purpose**—The 1890 enabling legislation for Rock Creek Park states:

- The area is to be “perpetually dedicated and set apart as a public park or pleasure ground for the benefit and enjoyment of the people of the United States.”
- The park is to “provide for the preservation from injury or spoliation of all timber, animals, or curiosities within said park, and their retention in their natural condition, as nearly as possible.”

Based on NPS’s interpretation of this legislation, as presented in the Rock Creek Park and the Rock Creek and Potomac Parkway General Management Plan, Rock Creek Park exists to:

- Preserve and perpetuate for this and future generations the ecological resources of the Rock Creek valley within the park in as natural a condition as possible, the archeological and historic resources in the park, and the scenic beauty of the park.
- Provide opportunities for the public to experience, understand, and appreciate the park in a manner appropriate to the preservation of its natural and cultural resources.
- Provide opportunities for recreation appropriate to the park’s natural and cultural resources. The purpose of the tributary parks adjacent to Rock Creek Park includes the preservation of forests and natural scenery in and around the District of Columbia (NPS 2005a).

Rock Creek and Potomac Parkway exists to connect Rock Creek Park and the National Zoological Park to Potomac Park with a scenic road; and prevent pollution and obstruction of Rock Creek.

**Significance**—Park significance statements capture the essence of the park’s importance to the nation’s natural and cultural heritage. Understanding park significance helps managers make decisions that preserve the resources and values necessary to the park’s purpose. The following significance statements, as detailed in the Rock Creek Park and the Rock Creek and Potomac Parkway General Management Plan (NPS 2005a), recognize the important features of the park.

- Rock Creek Park is one of the oldest and largest naturally managed urban parks in the United States. The park and parkway contains approximately 2,100 acres of valuable plant and wildlife habitat, providing protection for a variety of native species within a heavily urbanized area.
- Rock Creek Park encompasses a rugged stream valley of exceptional scenic beauty with forested, natural landscapes and intimate natural details, in contrast to the surrounding cityscape of Washington, D.C.
- Rock Creek Park’s forests and open spaces help define the character of the nation’s capital.
- Rock Creek valley was important in the early history of the region and in the development of the nation’s capital. The park’s cultural resources are among the few tangible remains of the area’s past.
- Rock Creek Park is an oasis for urban dwellers, offering respite from the bustle of the city.
- Rock Creek Park is a historic designed landscape incorporating early twentieth century picturesque and rustic features designed to enhance the visitors’ experience of the naturalistic park scenery.
- Located in the heart of a densely populated cosmopolitan area, Rock Creek Park serves as an ambassador for the national park idea, providing outstanding opportunities for education, interpretation, and recreation to foster stewardship of natural and cultural resources.

The following significance statement recognizes the important features of the parkway: The Rock Creek and Potomac Parkway provides a scenic gateway to the city’s downtown area, known as the monumental core.

**Fort Circle Parks (Battery Kemble, Fort Bayard, Fort Reno, Fort DeRussy, Fort Stevens, Fort Slocum, Fort Totten, and Fort Bunker Hill)**

**Establishment**—The monies used by the NPS to acquire the Fort Circle Parks were appropriated by the Capper-Cramton Act of 1930. This act appropriated funds for the further acquisition of “...such lands in the District of Columbia as are necessary and desirable for the suitable development of the National Capital Park, parkway, and playground system...”

**Purpose**—The Fort Circle Park Final Management Plan / Environmental Assessment (NPS 2004b) states that the purpose of the Fort Circle Parks is to:

- Preserve and interpret historical resources related to the Civil War defenses of Washington.
- Conserve this linkage or urban green space that contributes to the natural character and scenic values of the nation’s capital.
- Provide recreational opportunities compatible with historic and natural resource values.
- Protect the forests and natural scenery and prevent the pollution of park waterways.

**Significance**—The *Fort Circle Parks Final Management Plan/Environmental Assessment* (NPS 2004b) states that the significance of the Fort Circle Parks is as follows:

- The park sites contain remains of the defense sites (e.g., forts, batteries, rifle trenches) that effectively deterred the invasion of the nation’s capital during the Civil War.
- The Fort Circle Parks include the remains of forts that were engaged in the Battle of Fort Stevens in July 1864 – the only Civil War battle in the District of Columbia and the only time a sitting U.S. president has come under enemy fire in warfare.
- The pattern (greenbelt) of public space of Fort Circle Parks represents an element of one of the earliest urban planning efforts for public recreation in the United States. Today it enhances the aesthetics of the capital city and the quality of life for its citizens.
- The Fort Circle Parks preserve significant natural features, including substantial acreage of mature native hardwood forests, geologic and aquatic resources, and a diversity of important habitat for indigenous flora and fauna that are unusual in an urban setting and that contribute to the uniqueness of the nation’s capital.

**AUTHORITY TO MANAGE DEER**

The NPS has broad authority to manage wildlife and other natural resources within the boundaries of units of the national park system. See, generally, 16 U.S.C. 1 (NPS “shall promote and regulate the use of Federal areas known as national parks...by such mean and measures as conform with the fundamental purpose of the parks...to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations”). In defining this discretion, the 10th Circuit Court of Appeals overturned a district court decision, holding in part that the NPS “need not wait until the damage through overbrowsing has taken its toll on park plant life ... before taking preventative action” *New Mexico State Game Commission v. Udall*, 410 F.2d 1197, 1201 (10th Cir. 1969). This discretion has been reinforced over time. In *United States v. Moore*, 640 F.Supp. 164, 166 (S.D. W.VA. 1986) the court found that Congress had given the Secretary great discretion in regulating and controlling wildlife within the national park system. This discretion is further defined by NPS management policy.

*NPS Management Policies 2006*, section 4.4.2, states that “[w]henver possible, natural processes will be relied upon to maintain native plant and animal species and influence natural fluctuations in populations of these species. The Service may intervene to manage populations or individuals of native species only when such intervention will not cause unacceptable impacts to the populations of the species or to other

components and processes of the ecosystems that support them.” In addition, the policy restricts management to times when certain conditions exist. One such condition is when “a population occurs in an unnaturally high or low concentration as a result of human influences (such as loss of seasonal habitat, the extirpation of predators, the creation of highly productive habitat through agriculture or urban landscapes), and it is not possible to mitigate the effects of the human influences.”

However, as part of any animal population management action, the NPS is required to follow an established planning process, including provisions for public review and comment. NPS policies also require that parks “assess the results of managing plant and animal populations by conducting follow-up monitoring or other studies to determine the impacts of the management methods on nontargeted and targeted components of the ecosystem” section 4.4.2. This strategy is described in this plan including specific thresholds for taking action and end points on management actions.

## SCIENTIFIC BACKGROUND: DEER AND VEGETATION MANAGEMENT

### DEER MANAGEMENT ISSUES AND RESEARCH OVERVIEW

The focus of the analysis is to develop deer management methods and strategies for Rock Creek Park in cooperation with local, state, and regional entities, as well as other federal agencies. A science team consisting of scientists and other specialists from a variety of state and federal government organizations has helped define components of the planning process. The team evaluated scientific literature and research on the topic of deer management; established a monitoring protocol for park deer populations and other park resources; and recommended resource thresholds at which deer management strategies would be implemented. Monitoring protocols and impact thresholds are a component of all action alternatives evaluated in analysis, helping to ensure that the deer population at the park does not jeopardize the ecological integrity of the park.

### Regional Landscape-level Changes

Before European settlement of North America, white-tailed deer populations are estimated to have been between 23 and 24 million, or about 8 to 11 deer per square mile (McCabe and McCabe 1984). Deer herds throughout the eastern United States were heavily exploited after the arrival of Europeans around 1600. By 1790, deer populations were low wherever Europeans had settled. However, since the early 1900s, as a result of low mortality rates due to a lack of predators and increased availability of food and habitat, the deer population has continued to increase. Today the deer density in many areas of the eastern United States exceeds 100 deer per square mile (Porter 1991), and researchers have established that such high deer densities have negative impacts on plant and animal species (Alverson 1988; Anderson 1994; Augustine and Frelich 1998; deCalesta 1994; McShea 2000; McShea and Rappole 2000).

Improved habitat conditions resulting in increased reproduction, coupled with low mortality rates, have resulted in deer numbers that have grown to an estimated current population in excess of 234,000 animals in Maryland (MD DNR 2006–2007). Deer thrive on habitat conditions created by suburban development. New roads, housing, and related enterprises fragment forests and farms, and create “edge” habitats that provide plenty of food and ample shelter for deer. Fragmentation of the landscape and the increase in residential development have also reduced suitable hunting opportunities, particularly in



*White-tailed deer in Rock Creek Park*

## *Purpose of and Need for Action*

Maryland's growing suburban areas, some of which are adjacent to the District of Columbia and Rock Creek Park (MD DNR 1998). Although data exist for the District of Columbia near Rock Creek Park, the observations are too general and inconclusive (S. Bates, pers. comm. 2008d). However, because deer populations can and do cross these political boundaries, and because there are many similarities in regional landscape level changes and conditions, it is reasonable to assume that the District of Columbia and Rock Creek Park face the same issues as the neighboring Maryland suburbs.

### **Documentation of Deer Damage at Rock Creek Park**

As in other eastern national parks, today the white-tailed deer at Rock Creek Park have no significant natural predators and virtually no hunting. The park provides an island of habitat in an urban environment, where there is no hunting per 36 Code of Federal Regulations (CFR) 2.2. Coupled with the lack of natural predation within the park, the combination of these factors has facilitated the growth of the deer population at Rock Creek Park.

Occasional sightings of deer in Rock Creek Park emerged in the 1960s, and continued sporadically throughout the 1970s. The deer population continued to increase, and in 1984, the first deer sighting in



*Deer have browsed a considerable amount of the understory at Rock Creek Park*

Glover-Archbold Park was recorded. By 1990, deer sightings were common throughout Rock Creek Park (K. Ferebee, pers. comm. 2005).

In an effort to determine the extent of deer-related impacts at Rock Creek Park, park staff have conducted a number of monitoring studies to document the size of the park's deer population, as well as plant growth in the understory of the forest. Generally, the data collected indicate that deer are having adverse effects on shrub cover, tree seedling regeneration, and understory plant densities. The following summarizes the surveys performed at the park to date and their results.

### **Population and Ecological Characteristics of White-tailed Deer at Rock Creek Park**

Observed deer trends and density at Rock Creek Park has been estimated through roadside spotlight surveys, Distance Sampling, limited Forward Looking Infrared Surveys (FLIR), and roadkill reports. Deer monitoring and research started in Rock Creek Park when deer were first spotted in the 1960s. From the 1960s to the early 1990s, deer observation cards were collected to document sightings. By the early 1990s, deer sightings were so prevalent that observation cards were no longer completed. Until the early 1990s, observation cards served as the only method for tracking deer in Rock Creek Park.

#### **Roadkill Reports (1989–present)**

Rock Creek Park staff have been recording dead animals found in the park since the early 1980s. In 1989, the first deer struck and killed by a vehicle in the park was recorded. Data collected included sex, age, and the presence or absence of parasites. The park now records road-killed deer in a Geographic Information

System (GIS) layer. Areas of high numbers of road-killed deer include Military Road, Oregon Avenue, Beach Drive and Rock Creek and Potomac Parkway.

**Radio Telemetry Surveys (2001–present)**

The park performs limited radio telemetry studies. Beginning in 2002, park staff have collared five deer (does) with a radio transmitter, recording their movements. Data collected from the telemetry surveys are used to estimate the area used by each deer and the percentage of time that each deer is inside or outside of the park. The survey data show that the area used by each deer ranges from about 31 to 260 acres, and that the percentage of time spent outside the park is quite variable, ranging from about 5 to 42% (K. Ferebee, pers. comm. 2008d). Results of this limited research indicate that deer typically move about 0.25 miles outside the park boundary (K. Ferebee, pers. comm. 2008i).

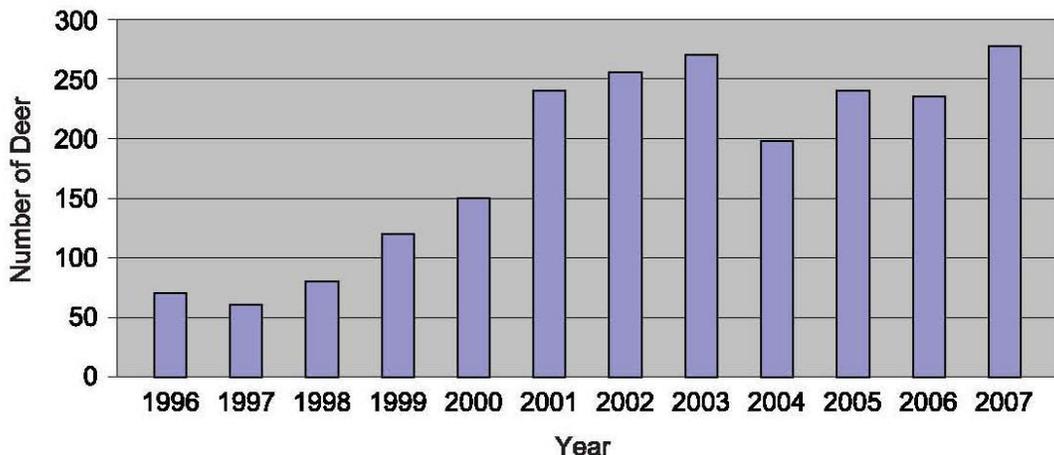
**Spotlight Surveys (1996–present)**

Since 1996, park staff have conducted annual spotlight surveys to monitor trends in the deer population at Rock Creek Park. The surveys are conducted the same time each year over a four-night period, following the same 22-mile route covering the majority of Rock Creek Park (Reservation 339). The deer counts are based on visual sightings and eye shine from a spotlight. Where possible, sex and age determinations are recorded. The spotlight surveys are not based on any specific scientific protocols and provide population trends only, suggesting abundance levels in the area immediately adjacent to the vehicle route. Their usefulness is limited, since population densities cannot be calculated using this method (K. Ferebee, pers. comm. 2008c). As shown in figure 3, spotlight surveys indicate that the number of deer observed cumulatively over all four nights along the route increased steadily from 1997 to 2003, with a decrease in 2004, followed by some rebound in 2005–2007 (NPS 2005c; K. Ferebee, pers. comm. 2006, 2007a, b).



*Conducting spotlight surveys at Rock Creek Park*

**FIGURE 3. SPOTLIGHT COUNTS, 1996–2007**



### Forward Looking Infrared Surveys (1997–1999)

In March 1997, the park used FLIR, a nighttime survey conducted from a helicopter to estimate the total number of deer in the park. In the first two years of the survey, the main reservation of Rock Creek Park (Reservation 339), Glover-Archbold Park, and Battery Kemble Park were surveyed. In 1999 (year 3 of the survey), only Rock Creek Park was surveyed, to allow a more intensive survey in one location to attempt to obtain more accurate results. In Rock Creek Park the survey results were as follows: 1997, 87 deer; 1998, 80 deer; and 1999, 90 deer in the park. The company conducting the survey stated the results were 75% accurate or better; however, due to unacceptable error rate, the park did not use FLIR after 1999.

### Distance Sampling (2000–present)

In 2000, Dr. Brian Underwood of the U.S. Geological Survey taught Distance Sampling, which accurately estimates animal population density, to the National Capital Region natural resource personnel. Trained Rock Creek Park staff conducted the first Distance Sampling in November 2000, estimating 62 deer per square mile within the park. Since 2000, Distance Sampling is repeated annually over three to four consecutive nights (table 2). In 2004, 75 deer per square mile were surveyed, a decrease from 98 deer per square mile in 2003 (NPS 2005d). The densities surveyed in 2005 and 2006, respectively, were 52 and 58 deer per square mile (K. Ferebee, pers. comm. 2007b). Current (2007) density is estimated at 82 deer per square mile (K. Ferebee, pers. comm. 2008a).

TABLE 2. DISTANCE SAMPLING RESULTS IN ROCK CREEK PARK

Year	Deer per Square Mile (density)	Standard Error of the Mean (±)
2000	62	11.6
2001	63	6.9
2002	60	8.0
2003	98	17.3
2004	75	7.8
2005	52	6.9
2006	58	8.9
2007	82	10.21

Source: K. Ferebee pers comm. 2007b, 2008f

### Effects of White-tailed Deer on Vegetation Structure and Diversity at Rock Creek Park

In addition to determining abundance and distribution of deer at Rock Creek Park, the park is also conducting studies to determine the impacts of deer on other natural resources. Studies conducted to date include long-term monitoring of unfenced vegetation plots and studies of paired plots (fenced and unfenced) to assess the effects of deer browsing on forest vegetation.

## Vegetation Impacts

### Long-term Vegetation Plots

In 1990, 27 long-term vegetation monitoring plots (20 meters × 20 meters [66 feet × 66 feet], unfenced plots) were placed in three geographic regions in the park—north, central, and south—to ensure that all areas would be adequately sampled. Plots were placed randomly within each region to capture general changes in vegetation over time. There were not many deer documented in the park in 1990, providing a good baseline of vegetation characteristics. Data from these long-term unfenced plots, read every four years (1991, 1995, 1999, 2003, 2007), indicate that in 1991,  $3.1 \pm 0.9\%$  of the stems were browsed compared to  $31.1 \pm 2.9\%$  in 2003. During this time, the shrub cover decreased from  $54.63 \pm 5.9\%$  in 1991 to  $14.92 \pm 2.2\%$  in 2003. Tree seedlings decreased significantly from 1991 across all other years measured (Hatfield 2005). Preliminary 2007 data analysis (Hatfield 2008) show that all tree seedling counts generally declined since 1991 and that counts for all height classes were near zero in 2007. The data collected from these monitoring plots indicate that the mean seedling stocking rates (or tree seedling weighted measure, see appendix A) declined significantly from 1991 to 2007, with a stocking rate of  $2.26 \pm 0.32\%$  in 2007, significantly below the 67% stocking rate recommended for regeneration (Hatfield 2008; Stout 1999 appendix A). Additional information including the most recent results of long-term monitoring can be found in the “Vegetation” section of the “Affected Environment” chapter.

### Paired Plots

In 2000, 20 paired plots (one plot fenced, one plot unfenced, located next to each other in similar vegetation conditions) were established in Rock Creek Park proper and Glover-Archbold Park. From 2001 to 2004, the paired plots showed that plant cover outside the fenced plots was substantially less when compared to plant cover inside the fenced plots over the study period. Specifically, the mean percentages of plant cover for nonnative, native, herbaceous, and woody plants were 2 to 3 times less in the paired unfenced plots than in the paired fenced plots (Rossell et al. 2007). These impacts can be directly attributed to deer browsing and indicate deer are affecting the integrity of the understory structure and species composition, diminishing the value of habitat for other wildlife. While there is some understory vegetation and the browse line is not prominent at Rock Creek Park, trends indicate that an unmanaged deer population could lead to these problems, which are currently being faced by similar eastern national parks such as Catoctin Mountain Park, Maryland.



*Understory growth in a fenced plot*

### Current Deer Management at Rock Creek Park and in Surrounding Jurisdictions

Rock Creek Park currently has no formal deer management plan, but does undertake numerous deer management activities. In addition to the deer population and vegetation monitoring described in previous sections, other deer management activities currently undertaken by Rock Creek Park include assisting D.C. Animal Control with injured animals (e.g., darting animals, euthanizing injured animals), responding to neighbors’ questions about the deer population (e.g., how to keep deer out of yards, preventing browsing of landscaping vegetation), and disseminating information about the deer population. These

actions constitute this plan's "no action" alternative, and details about current management actions are described in this document in "Chapter 2: Alternatives" under alternative A.

### **District of Columbia – Fisheries and Wildlife**

Although there is not a formal deer management plan in the District of Columbia, issues associated with an overabundance of deer still exist. As issues arise, they are addressed mainly by two District government agencies: the Department of Health and the Department of the Environment. The Department of Environment's Fisheries and Wildlife Division has four major components: the Aquatic and Wildlife Education Branch, the Fisheries Research and Management Branch, the Grant Coordination and Licensure Branch, and the Wildlife Management and Research Branch. Collectively these branches monitor the District's aquatic and wildlife resources. Although not currently engaged in deer management activities, the Fisheries and Wildlife Division has recently hired several wildlife biologists and is beginning to establish an inventory and monitoring program.

The majority of deer related actions in the city are undertaken by the District of Columbia Department of Health (DCDOH). The DCDOH, through a contract with the Washington Humane Society, provides animal control and animal disease prevention services and assists the public with animal-related problems. Services offered by this agency include, but are not limited to, animal disease control, rabies suspect control, stray animal control, dangerous dog control, licensing, enforcement, sterilization, and adoption. Specific activities that may relate to this deer management effort include conducting disease surveillance, enforcement of animal control laws, and disposal of animals by redemption to owner, release to the wild, humane intravenous euthanasia; providing education via pamphlets and classroom visits, and assisting District of Columbia agencies, such as the Metropolitan Police Department, as requested (DCDOH n.d.).

### **Maryland National Capital Park and Planning Commission – Montgomery County Division**

In addition to the District of Columbia, Rock Creek Park shares a border with Montgomery County, Maryland. Along this border, the NPS Rock Creek Park transitions into the Maryland National Capital Park and Planning Commission (M-NCPPC)-managed Rock Creek Park, a portion of the 33,000-acre county park system. Montgomery County and the NPS have concurrent jurisdiction over Rock Creek (the waterway). Montgomery County has been actively addressing deer overabundance since 1995.

Citizen complaints about the effects of deer, including deer/vehicle collisions and damage to landscape vegetation, began to increase in the county around 1992. At that time, the county established a task force to determine if deer overabundance was a problem and, if so, to discuss solutions for addressing it. The efforts of the task force focused on information relative to conflicts between deer and people in the county and resulted in the April 1994 *Report of the Task Force to Study White-Tailed Deer Management*. The report included a recommendation to the county council to establish a working group to prepare a comprehensive deer management plan. This working group is still active today.



*White-tailed deer near the road at Rock Creek Park*

As a result of the working group efforts, in 1995 the *Comprehensive Management Plan for White-tailed Deer in Montgomery County, Maryland* was published. This plan recognized that the type and extent of deer-human conflicts varies throughout the county and addresses

deer from a variety of standpoints including public safety issues (collisions), economic issues (agricultural interests, agricultural preserves), and the maintenance and protection of natural areas. The goal of the deer management plan in Montgomery County is to address the effects of deer. The plan does not provide a density goal to be reached (Montgomery County 1995a).

To develop the plan, the county collected and centralized data on the deer and their impacts so that these data could be used as a foundation for management decisions. Data collected during the initial stages included information on deer/vehicle collisions that was later incorporated into a geographic information system to identify hot spots and target areas, effects on agricultural lands and residential properties, and effects on natural areas. Part of the data collection involved vegetation monitoring where a number of plots were established throughout the county in upland and stream valley parks. The study, concluded in 1999, indicated that county forests experienced degradation, but it did not show to what extent increasing deer densities were responsible.

In 1990, the county placed one set of paired unfenced and fenced plots (20 meters × 20 meters [66 feet × 66 feet]) in each of nine parks (Storm and Ross 1992). The plots were arbitrarily placed in the county parks and there was no replication. Data from the paired plots showed an average loss of 65% of species to deer browsing. A qualitative assessment of 1995–2001 paired plot data concluded that (1) deer impacts are reducing height, number, and species diversity of seedlings within county parks, (2) understory density has been dramatically reduced, and (3) the effects appear greatest in parks with higher densities of deer (Montgomery County 2002). In 1995, the *Inventory of Rare, Threatened, and Endangered Plant Populations and Significant Habitats on Selected Park Lands of M-NCPPC in Montgomery County, Maryland* stated:

Every park surveyed during this project had an overpopulation of deer. The severity of this problem varies from one park to another, but it represents a considerable threat to the native vegetation in every park (Montgomery County 1995b).

The county studied a variety of deer management methods, and in 1996 in areas where immediate attention was required, managed deer hunts were implemented. The first managed hunt occurred in northern Montgomery County on a 400-acre agricultural history farm park. The hunt was considered a success based on several factors: it was completed safely with no injuries or accidents; the deer population was reduced to the desired goal; and impacts to the surrounding communities (landscape and crop damages) were reduced. Managed hunts have continued throughout the county and the program has been expanded since its implementation (W. Hamilton pers. comm. 2008).

The county also considered the use of repellents/scare devices, fencing/physical exclusion, habitat management, supplemental feeding, restoration of predators, modifying legal harvest, agricultural depredation permits, direct reduction through sharpshooting or special or managed hunts, contraception, and trapping and removal/relocation. Although all were considered, not all of these methods have been or will be implemented.

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*Depredation means  
damage or loss.*

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One method implemented throughout the county is sharpshooting. When sharpshooting activities occur, a notification is posted at the entrance of the park stating that the park is closed to the public from sunset to sunrise. M-NCPPC Park Police officers perform the sharpshooting, removing deer for approximately five hours per night. Deer are processed and donated to the Capital Area Food Bank. The county notes that, while this method is effective, the administration and logistics are difficult. The county estimates the cost of sharpshooting at \$150 per animal, which includes approximately \$50 for deer processing for donation and the rest for ammunition, staffing, and other needs. The other form of direct reduction, special or managed hunts, involves taking land previously closed to hunting and holding a managed hunt under

strict guidelines for limited duration. To participate in the hunts, hunters must pass special training and marksmanship tests.

The county has considered contraception and has worked with the Humane Society of the United States and the National Institute of Standards and Technology (NIST) to implement a study in Wheaton Regional Park. However, the Wheaton Regional Park site was determined inappropriate for such an effort as policy in the State of Maryland prefers an enclosed population for research studies.

As part of the Comprehensive Management Plan (1995), the Montgomery County Deer Management Work Group annually reviews deer impact data and creates a list of recommendations for the upcoming year. In fiscal year 2003, this report stated that the management options implemented over the previous six years appeared to be having an effect. The report also stated that, in areas where managed hunts had been held (Little Bennett Regional Park, the Agricultural History Farm Park, and Seneca Creek State Park), the number of deer/vehicle collisions had been reduced and remained at lower levels. The fiscal year 2003 study also identified 19 “hot spots” for deer impacts and listed a combination of lethal and non-lethal methods at each site to manage the deer population (Montgomery County 2002).

Deer removals are not currently taking place in Maryland’s lower Rock Creek Park. The M-NCPPC has been addressing other areas within the county that have higher concentrations of deer. The park is currently on a list of areas to be managed for deer, but specific management actions have not yet been implemented. The M-NCPPC continues to express interest in working together with Rock Creek Park to coordinate management efforts (K. Ferebee, pers. comm. 2008h).

#### **Comprehensive Management Plan for White-tailed Deer in Montgomery County (1995, updated 2004)**

The M-NCPPC, which oversees the Montgomery County Department of Park and Planning, created a comprehensive management plan for white-tailed deer on the premise that deer are an important and valued part of the county’s natural heritage; however, deer are an opportunistic species that can, in the absence of checks and balances, become abundant enough to conflict with human interests. The plan, developed to be open-ended and adaptable, acknowledges that deer-human conflicts vary and one single management prescription may not be appropriate. The *Comprehensive Management Plan for White-tailed Deer in Montgomery County* establishes goals and objectives for managing deer in the county, develops a plan of action for each of the problem issues identified, and sets a timetable for implementation of these actions. The management plan is composed of four components:

Part I addresses the collection, centralization, and use of accurate data on white-tailed deer and their effects on Montgomery County, and forms the foundation on which sound management decisions must be based.

Part II outlines the implementation of a comprehensive public awareness and public education program to better inform citizens about deer-human conflicts and how to prevent them.

Part III describes the various management alternatives that are available to reduce the deer effects and outlines the implementation of population management alternatives to reduce deer populations in areas where this is deemed necessary.

Part IV outlines the current status of the plan’s implementation and the work program for the current fiscal year—this component of the plan is updated annually.

## Other Deer Management Efforts

### Deer Management Efforts within the National Park Service

Other national park units have been involved in deer management planning efforts. Gettysburg National Military Park and Eisenhower National Historic Site completed a *White-tailed Deer Management Plan and Environmental Impact Statement* in 1995, and approved management strategies are now being implemented. Deer management planning and environmental review efforts are also being undertaken at Indiana Dunes National Lakeshore, Catoctin Mountain Park in Maryland, Cuyahoga Valley National Park in Ohio, and Valley Forge National Historical Park in Pennsylvania and are in various stages of completion.

### Deer Management by State and Other Federal Agencies

The Wildlife Services program of the Animal and Plant Health Inspection Service (APHIS), within the U.S. Department of Agriculture (USDA), has been involved in the evaluation and/or implementation of a number of deer management plans on federal properties in the eastern United States. USDA-ARS Beltsville Agricultural Research Center has been conducting managed deer hunts since 1995. Average annual removal of deer is 200 to 400 (Mike Dudley, USDA-ARS biological science technician, pers. comm. June 10, 2008, reported in S. Bates pers. comm. 2008c). Studies conducted for the states of New Jersey and Virginia concluded that direct reduction of the deer population was the preferred alternative (USDA 2000a, 2000b). In Pennsylvania the resulting management plan included a wide range of management options to assist landowners with damage control (USDA 2003).

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*Direct Reduction —  
Lethal removal of  
deer; includes both  
sharpshooting and  
capture/euthanasia.*

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The Mason Neck National Wildlife Refuge (NWR), located in northeastern Virginia, has been conducting managed deer hunts since 1989. The refuge is managed as part of the Potomac River NWR Complex, which includes Mason Neck, Occoquan Bay, and Featherstone NWRs. The Occoquan Bay NWR also initiated its first managed deer hunt in 2002. The managed hunts at both NWRs are in response to overabundance of white-tailed deer. The purpose of these hunting programs is to improve the quality of the habitat and protect the nesting habitat for bald eagles (*Haliaeetus leucocephalus*) at Mason Neck and migratory bird species at Occoquan Bay. The Refuge hunting program facilitates this goal by reducing the local deer herd through removal of a higher percentage of females and young deer (USFWS et al. 2005a, 2005b, 2005c).

The Maryland Department of Natural Resources has issued two permits to conduct reproductive control studies, one to the USDA Wildlife Services for research on the effectiveness of GonaCon® immunocontraceptive vaccine (GCIV) on female white-tailed deer in the White Oaks Federal Research Center in White Oak, Maryland, and the second to the Humane Society of the United States to test the effectiveness of different forms of porcine zona pellucida (PZP) on female white-tailed deer in the National Institute of Standards and Technologies (NIST) site in Gaithersburg, Maryland. APHIS has been conducting the research at the White Oak site, which is about 1 square mile in size and has a fenced perimeter that is relatively impermeable to deer. In 2004, female deer were individually darted with an immobilization drug and then treated with a Gonadotropin Releasing Hormone (GnRH) vaccine, GonaCon®. GnRH needs to be injected 8 to 10 weeks prior to rutting. This product has shown 0 to 4 years of effectiveness without boosters in some studies. Twenty-five does were treated and 15 does were marked as a control group. Each doe received a radio collar and ear tags to mark the animals. During the spring following initial treatment, 11 out of 15 control animals had fawns, where only 3 out of the 25 treated does gave birth. In the second year at White Oak, more than half (54%) of the treated does gave

birth (K. Sullivan, Maryland State Director, USDA-Wildlife Services, Wildlife Society Meeting presentation, 9/20/2007, as reported by S. Bates, pers. comm. 2008b). These numbers give some sense of the current effectiveness of this product, which is discussed in more detail in “Chapter 2: Alternatives.”

The NIST site and the NPS Fire Island National Seashore are using PZP in contraceptive control research studies. SpayVac®, a vaccine containing PZP, does not need a booster, but is no longer available on the market. PZP is not currently registered with the Food and Drug Administration (FDA), and the FDA is trying to transfer registration responsibility to the Environmental Protection Agency. Registration for non-research use may be available in five or more years.

Other local governments or local institutions have also completed studies to develop deer management plans, including Fairfax County, Virginia, and Montgomery County, Maryland. The Fairfax County plan incorporates a combination of hunting and sharpshooting to manage the deer population (Fairfax County 2003). The Montgomery County plan includes a comprehensive management approach incorporating education, lethal means (sharpshooting, hunting), and non-lethal means (fencing, repellents) (Montgomery County 2004). The National Conservation Training Center in Shepherdstown, West Virginia, has a deer management plan that relies on managed hunts for deer management.

## **Other Vegetation Management Issues**

### **Role of Invasive Exotic Plant Species**

Invasive nonnative plants (exotics) seriously threaten the integrity of native habitats, including eastern deciduous forests, by aggressively displacing and killing native plants, reducing native habitats, and reducing forest regeneration (Bratton 1982). The exotics problem is particularly acute in urban parklands where the extensive edges and frequent human disturbances enhance opportunities for aggressive exotic plants to become established (NPS 2004a).

Rock Creek Park, within the city of Washington, D.C., is one of the largest natural, urban forests within the United States. The park is comprised of 2,980 acres of mostly natural forest with 72 miles of boundary and more than 1,000 adjacent neighbors. This boundary (edge) interfaces the forest with streets and other urban landscape components, especially numerous landscaped private properties. Of the 41 most aggressive exotics, 40 are horticultural plants (NPS 2004a).



*Deer enclosure/fenced plot at edge of forest overrun by invasive plants. The plot was discarded because the number of nonnative plants biased the data.*

Ornamental vines like Asiatic bittersweet (*Celastrus orbiculatus*), porcelain berry (*Ampelopsis brevipedunculata*), and English ivy (*Hedera helix*) kill trees along the edges of forest openings. Multiflora rose (*Rosa multiflora*) forms occasional dense thickets that out-compete native shrubs and ground covers. Herbaceous invaders like lesser celandine (*Ranunculus ficaria*) and Japanese stiltgrass (*Microstegium vimineum*) blanket the floodplain, crowding out native herbaceous species and, in some cases, changing soil chemistry to make it harder for native plants to recover. Most invasive plants get started and thrive in open, disturbed areas where there is ample space and light. However, several of the most aggressive invaders [Asiatic bittersweet, English ivy, burning bush (*Euonymus alatus*), privet (*Ligustrum* spp.), viburnums (*Viburnum* spp.), Japanese barberry (*Berberis thunbergii*), garlic mustard (*Alliaria petiolata*),

lesser celandine, and Japanese stiltgrass] also penetrate undisturbed forest interiors, reducing light levels to the forest floor, limiting regeneration, and displacing native shrubs and saplings (NPS 2004a).

Between the late 1970s and 1995, park staff implemented various pilot programs to document the spread of exotics and find treatments for the most obvious threats (Fleming, 1978-1995, unpublished data). Under the direction of Richard Hammerschlag, research scientist at USGS-Biological Resources Discipline, a research project was initiated in 1996 to determine the environmentally safest and most effective chemical means of controlling Asiatic bittersweet and porcelain berry, as well as other woody exotics (Salmons 2000). At the same time, park staff have implemented an exotics management program using this information. Efforts have thus far been directed at extending the areas treated during the research. Research plots were positioned in the densest areas of Asiatic bittersweet and porcelain berry and at the upstream end of Rock Creek. Starting at these heavily infested areas allowed staff to remove the seed source for many woody vines in the Rock Creek floodplains. These floodplains also contain ephemeral ponds, an important wildlife habitat. The park has started to prioritize work and identify what criteria will be used to assist park managers in implementation. In addition, some parts of the park have not been as thoroughly surveyed as the Rock Creek watershed, where the research has been conducted. The invasive exotic management plan will be updated as the park learns more about exotics and the resources they threaten within the park (NPS 2004a).

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*Anthracnose — Any of several plant diseases caused by certain fungi and characterized by dead spots on the leaves, twigs, or fruits.*

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### Role of Pests and Disease

In addition to exotic plants, Rock Creek’s forests are susceptible to pests, such as insects and disease, as described below.

- Chestnut Blight—A fungus (*Cryphonectria [Endothia] parasitica*) was accidentally introduced into New York City in the early 1900s from trees imported from Asia, destroying its new host, the American chestnut (*Castanea dentata*), throughout its range from Maine to Alabama.
- Dogwood Anthracnose—Native dogwood trees (*Cornus florida*) have succumbed to the dogwood anthracnose, a disease caused by the fungus (*Discula destructiva*), which attacks flowering dogwood trees.



*Female gypsy moth*

- Gypsy Moth—Gypsy moths (*Lymantria dispar*), target a number of tree species found in the park including chestnut oak (*Quercus prinus*), white oak, red oak (*Q. rubra*), black oak (*Q. velutina*), scarlet oak (*Q. coccinea*), American beech, and various hickories. Gypsy moth caterpillars feed on the leaves of these hardwood trees and can cause complete defoliation of a tree. This affects the vigor and general health of forests and shade trees, leading to tree death, and subsequently altering wildlife habitat and affecting water quality and quantity. Gypsy moths first appeared in Rock Creek Park in the late 1970s. An integrated pest management plan for the park was developed by the NPS Center for Urban Ecology and the USDA Forest Service in 1983. Direct suppression through aerial application of the biological insecticides *Bacillus thuringiensis* (B.t.) and the gypsy moth specific nucleopolyhedrosis virus (Gypchek®) occurred from 1987 through 1989 (Favre et al. 1993).

- Hemlock Woolly Adelgid—The hemlock woolly adelgid (*Adelges tsugae*) feeds by sucking sap from young needles of eastern hemlock (*Tsuga canadensis*), which causes them to drop

prematurely. Extensive tree death is accompanied by detrimental environmental effects, such as the loss of ecological function, the loss of wildlife habitat (in the northeast United States, 96 bird and 47 mammal species are associated with hemlock forests for some critical component of their life cycle), soil erosion, changes in water quality, loss of aesthetics, and diminished recreational opportunities.

### Role of Fire

Fire is an active and powerful natural force, which has the potential to affect all areas of the park and all facets of park management at various times and to varying degrees. Rock Creek Park's Fire Management Plan (FMP; NPS 2004c) is essentially a fire suppression plan (no prescribed burns are allowed) due to the urban nature of the park. Therefore, vegetation has not been affected or controlled by the use of prescribed fires, and any unplanned fires in the park are immediately suppressed.

### DESIRED CONDITIONS

This section defines the desired conditions for Rock Creek Park, which are connected to this plan's purpose, need, and objectives. Several objectives were factored into the definition of desired conditions: allowing for a deer population within the park while protecting other park resources; protecting the natural abundance, distribution, and diversity of native plant species by reducing excessive deer browsing, trampling, and nonnative seed dispersal; and developing and implementing informed, scientifically-based vegetation impact levels and corresponding measures of deer population density that would serve as a threshold for taking prescribed management actions within the park.

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*This plan/EIS addresses desired conditions for Rock Creek Park, the desired condition of the deer population, and the desired condition of the forest.*

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#### DESIRED DEER POPULATION CONDITION

Deer are a natural part of the ecosystem and play an important role in it. One of the objectives of this plan is to allow for a deer population within the park while protecting other park resources. Therefore, the team needed to consider what a desired deer population condition for Rock Creek Park was to ensure that actions taken under this plan would meet objectives. For this plan, a desired deer population is one that allows the forest to naturally regenerate, while maintaining a deer population within the park. The measure of deer density that would meet this condition is described more in chapter 2.

### DESIRED FOREST CONDITIONS

One of the objectives of this plan is to reduce adverse effects of deer browsing pressure on native plant species, which include the seedlings of forest species. A desired forest condition would be a forest community that has the ability to maintain forest structure (i.e., tree density, size, and age classes), function, species diversity, and natural processes by natural tree replacement. The scientifically-based vegetation impact levels that would serve as a threshold for taking prescribed management actions to meet this desired condition are described more in chapter 2.

### SCOPING PROCESS AND PUBLIC PARTICIPATION

The National Environmental Policy Act (NEPA) regulations require an "early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." To determine the scope and identify significant issues to be analyzed in depth in this plan, internal scoping was conducted with park staff and other parties associated with preparing this document. As a result of this scoping effort (see "Chapter 5: Consultation and Coordination," for

additional information), several issues were identified as requiring further analysis in this plan. These issues represent existing conditions, as well as concerns that might arise during implementation of alternatives.

## ISSUES AND IMPACT TOPICS

The issue statements developed by the interdisciplinary team are presented below. These issues formed the basis for the impact topics discussed in chapters 3 and 4 of this environmental impact statement.

### Vegetation

An overabundance of deer could possibly alter and affect forest regeneration patterns in the park, as well as the diversity of species within the park, by reducing the understory and affecting the natural diversity of dominant tree species. Vegetation monitoring in Rock Creek Park has demonstrated a decline in shrubs and seedlings since 1991. As previously described, from 2001 to 2004, the paired unfenced-fenced plots showed that plant cover outside the fenced plots decreased substantially compared to plant cover inside the fenced plots. These impacts can be directly attributed to deer browsing and indicate deer are affecting the integrity of the understory structure and species composition, diminishing the value of habitat for other wildlife. While there is some understory vegetation and the browse line is not widespread at Rock Creek Park, trends indicate that an unmanaged deer population could lead to these problems, as are currently being faced by similar eastern national parks such as Catoctin Mountain Park in Maryland.

The excessive browsing associated with an overabundance of deer in Rock Creek Park could adversely affect regeneration of vegetation in riparian areas. Riparian areas are important, because of their relatively high biological diversity. The level of deer browsing in these areas that would be associated with an overabundance of deer in Rock Creek Park could prevent regeneration in these areas and negatively affect the riparian areas. Currently, no data exist on deer impacts to riparian areas within the park.

Increased deer activity can promote nonnative species through habitat alteration and seed dispersal. An increase in nonnative species could have a negative impact on the park's native plant communities. Deer activity, such as browsing, trampling, and seed dispersal through waste or attachment to hair, has the potential to increase the number and type of nonnative species within the park (Myers et al. 2004; Vellend 2002; Williams and Ward 2006; Willson 1993). As the number of nonnative species increases, the native species within the park encounter increased competition and are adversely affected.

Deer management activities could result in areas of increased deer use, if bait is used to attract deer to a particular area. This could have a disproportionate impact to vegetation in areas near established bait piles. In addition, fencing that keeps deer away from vegetation results in increased browsing pressure outside of the fenced area, as well as decreased browsing pressure inside the fenced area.

### Soils and Water Quality

Deer overabundance has led to increased deer browsing and a reduction in the understory vegetation in Rock Creek Park, as shown in the data from the long-term and paired vegetation plots. As the understory cover decreases, soils become more susceptible to erosion, which can lead to sedimentation and degradation of the park's water resources. Certain deer management actions can also disturb soils and affect water quality, including construction of fencing, especially in riparian areas that are already impacted by erosion.



*Peirce Mill Dam and fish ladder*

## **Floodplains and Wetlands**

The removal of ground vegetation as a result of overabundance of deer and their activities (i.e., browsing, trampling, creating trails) may increase erosion and stormwater runoff and affect floodplains and wetland habitats. As the deer population increases, the amount of deer browsing and trampling of vegetation increases, thus reducing the amount of ground cover within the forest. As ground cover decreases, stormwater runoff and erosion increase. Water retention in the forest is related to the amount of ground cover. Some of the vegetation in floodplains could be affected, and there could be a degradation of wetland habitat from the increased erosion and sedimentation. Although some impacts to floodplains and wetlands may be attributed to deer activity, there are other factors from both inside and outside the park that also influence floodplains and wetlands, and contribute to the majority of impacts to these resources. Among these factors are land use changes, the large amount of impervious surfaces in Washington, DC, and the loss of ground cover and trampling of vegetation by park users. Also, several of the large exclosures proposed as part of one management alternative would be located within the 100-year floodplain and possibly within wetlands.

## **Wildlife and Wildlife Habitat**

***White-tailed Deer***—Maintaining a healthy, viable deer population, while protecting other park resources within Rock Creek Park, is imperative to this plan. Rock Creek Park has monitored the number and density of the deer population through spotlight counts, FLIR, and Distance Sampling. Survey results indicate an overabundance of deer. Although high deer densities may adversely affect plants and other wildlife species, deer themselves are an important park resource. It is important that this plan maintain a deer population in the park while taking action to reduce adverse effects to the deer population itself.

***Other Wildlife***—At certain levels, deer overabundance adversely affects other wildlife and/or habitat by reducing habitat diversity through activities such as browsing, trampling, and seed dispersal. Studies have linked high deer densities to undesirable effects on other wildlife species, such as migratory birds (deCalesta 1994; McShea 2000; McShea and Rappole 2000). Park staff are concerned that deer may be affecting other species, including breeding birds; however, there are no park-specific data to show that impacts to ground-nesting species have occurred from deer browsing (S. Bates, pers. comm. 2008d).

Changes in water quality from the removal of ground vegetation as a result of overabundance of deer and their activities (i.e., browsing, trampling, creating paths) have the potential to adversely affect unique and important fish habitats located within Rock Creek Park. Issues related to unique or essential fish habitat are similar to those for surface water. As the deer population increases, so does the amount of deer browsing and trampling of vegetation, reducing the amount of ground cover within the forest. As the ground cover decreases, the amount of stormwater runoff and erosion also increases and could degrade water quality, including unique and essential fish habitat. Efforts are currently underway in the park to improve fish habitat. As a part of the Woodrow Wilson Bridge project mitigation, man-made barriers to fish movement in Rock Creek Park have been removed. This project, which began in December 2003, removed or bypassed several man-made barriers that for generations had prevented herring and other migratory fish from returning to primordial spawning areas located upriver. A total of 23 fish barriers were removed or modified in several streams that empty into the Potomac River. In Rock Creek Park, six fish barriers were removed or modified, while two more were removed from the adjacent National Zoological Park. Furthermore, a fish ladder was constructed at the Peirce Mill dam to provide access to the habitat above the dam for migrating fish.

Deer management activities could also impact other wildlife and wildlife habitat. The use of bait piles could provide an additional food source for some species, while fencing could restrict access to certain wildlife habitat. In addition, the presence of increased human activities during specific time periods and associated noise could result in temporary behavior changes and avoidance of management areas.

### Rare, Unique, Threatened, or Endangered Species

The NPS is required under the Endangered Species Act (ESA) to ensure that federally listed species and their designated critical habitats are protected on lands within the agency's jurisdiction. Only one federally listed species, the endangered Hay's Spring amphipod, is known to inhabit the park. The Hay's Spring amphipod was discovered in five groundwater springs in Rock Creek Park in 1998. Another rare species, Kenk's amphipod (*Stygobromus kenki*), also known as the Rock Creek groundwater amphipod, was identified in park springs (NPS 1997a). Kenk's amphipod is not listed under the ESA, and recently the U.S. Fish and Wildlife Service (USFWS) found that the petition for listing did not contain sufficient scientific or commercial information indicating that listing of this species was warranted (USFWS 2007b). In addition, three other *Stygobromus* species of amphipods that are listed by the state of Maryland as rare or uncommon have been located in or near the park (Maryland Department of Natural Resources, Heritage and Biodiversity Conservation Program 2003). Habitat for these species may be vulnerable to impacts from deer overabundance and their related activities (i.e., trampling, browsing, seed dispersal, etc.). If studies can show that surface erosion can lead to impacts on the quality of underground water resources, then the erosion caused by deer could, in turn, affect the amphipod species. Protection of the amphipods will be considered in this deer management plan.

Rare species are also identified by the District of Columbia, Maryland, and Virginia. The Virginia species are not known in the park and it is not likely that they will occur because of the separation from Virginia by the Potomac River, as well as the presence of different habitats. However, there are several plant species that have been or are currently listed as rare by Maryland Department of Natural Resources that, although rare, have been documented in Rock Creek Park. Several animal species with known occurrences in Rock Creek Park are listed as rare or uncommon by Maryland. While the District of Columbia does not provide special protection for listed species, it has identified species of concern, called species of greatest conservation need, within the area in its Wildlife Action Plan (District of Columbia 2006). Because of the habitat value provided by Rock Creek Park, many of these species are found in the park. Habitats preferred by these species generally include springs, seeps, wetlands, and waterways and/or associated moist forested areas. While the NPS is not under any legal obligation to protect state- or locally-listed species, the park enabling legislation supports maintaining these as part of the park's natural heritage, and NPS management policies state that these should be addressed in environmental assessments of proposed actions (NPS 2006). These species have the potential to be impacted by an overabundance of deer as a result of habitat alteration as discussed under soils, water resources, and vegetation.

### Cultural/Historic Resources – Cultural Landscapes

An overabundance of deer and the resulting deer browsing could impact the cultural landscapes within Rock Creek Park. Rock Creek Park consists of many diverse units varying from carefully designed landscapes to natural forested areas. The cultural landscapes at Rock Creek Park reflect the relationship between what is natural and what is man-made. Dumbarton Oaks Park is an example of a designed landscape within the park. Whether natural or designed, an overabundance of deer and the resulting deer browsing can impact the cultural landscape of an area and affect the historic integrity of a given site. Certain deer management activities that result in the construction of fences or the alteration of the landscape could impact designated cultural landscapes.



*Peirce Barn*

## **Soundscapes**

Certain deer management activities may cause disturbance to park soundscapes. The deer management strategies discussed included the use of sharpshooting and/or contraceptives by dart gun. Firearm noise resulting from such management activities could affect park visitors and wildlife. Rock Creek Park is an urban park and, while the park is located in an area of high ambient noise, residents have expressed concern for noises related to firearms, and this concern would be taken into consideration in the creation of a deer management plan. It is unlikely that firearm discharge noise would have a substantial impact due to the likelihood that noise suppression devices for the firearms would be recommended as part of the management activity. These devices would render the noise level to be substantially below typical noise associated with vehicle traffic and recreational activities. Current sources of ambient noise in the park include a variety of visitor uses (e.g., traffic, special events, athletic fields, picnicking, etc.), flight paths over the park including helicopters and military flyovers, landscaping activities both within the park by contractors and on adjoining lands, commuter traffic, emergency service vehicles, and the activities of adjacent property owners (i.e., community events at schools or churches), as well as other noises common to urban areas.

## **Visitor Use and Experience**

The presence or absence of deer in Rock Creek Park could be an important component of the visitor experience for some park users and alteration of the number of deer through a Deer Management Plan would impact this experience. Many visitors come to Rock Creek Park units to enjoy the natural areas. For some park visitors, seeing a deer is an important part of the park experience and for others, deer are an unwelcome intrusion. At one town hall meeting, approximately half of the participants favored deer in the area and the other half looked upon the presence of deer unfavorably. An overabundance of deer may



*Visitors stroll at Rock Creek Park*

also have an indirect impact on other park visitors by altering the habitat of other species (i.e., changing the understory so that there are fewer migratory birds) and changing the visitor experience for those visitors that come to see species within that habitat. Deer have direct impacts on the community gardens that are maintained by park users, most of which have been fenced to protect them from deer browsing.

Deer management activities have been, and will continue to be, affected by the public perception of deer and other wildlife. From 2000–2005, the park received two reports of deer running through plate glass windows at neighboring residences. These few instances of damage to personal property resulting from deer influence the public perception within the community. Likewise, park staff have reported that public outreach indicates that a portion of the District of Columbia community has a general fear of wildlife, including deer.

Proposed deer management activities may require certain areas of the park to be closed to the general public during management activities, affecting visitor use and experience. If deer management activities were to decrease the number of deer in the park, chance sightings by visitors would also decrease. Some visitors to the park may view deer sightings as an integral part of their visit. Deer management actions

may decrease the potential for visitors to observe deer within the park, causing less visitor satisfaction. Conversely, as the number of deer increase, other resources that visitors come to see, such as songbirds, may decrease. Increased deer browse has the potential to impact these other resources and impact the satisfaction of these visitors.

### **Visitor and Employee Health and Safety**

Various health and safety concerns could result from implementation of the alternatives described in this plan/EIS. Health and safety applies to Rock Creek Park visitors, local residents, and Rock Creek Park employees. All deer management activities would need to be conducted in a manner to ensure the safety of park visitors and employees.

The majority of incidents within Rock Creek Park are a result of vehicle accidents. A primary safety issue for visitors and local residents related to this plan involves injuries from deer/vehicle collisions. In past studies, the number of deer/vehicle collisions has been correlated to both traffic volume and greater deer abundance. However, a working group within the D.C. metro region, including Rock Creek Park, found in comparing data from 1995 and 2003 that traffic volumes remained basically the same or decreased somewhat, while deer/vehicle collisions increased (Metropolitan Washington Council of Governments 2006), indicating that the number of deer may be an important factor in the increased number of accidents occurring. Deer/vehicle collisions within the park are most common along Military Road, Oregon Avenue, Beach Drive, and Rock Creek and Potomac Parkway.

### **Socioeconomic Resources**

An overabundance of deer could lead to increased browsing of landscape vegetation on neighboring properties, having a negative economic impact on those landowners. Current Rock Creek Park deer management activities include communicating with neighboring landowners and addressing questions and concerns. Residents contact the park to complain about deer that have entered private property and have eaten their landscaping, causing aesthetic and economic impacts. The park, in turn, provides advice to the landowners regarding landscape plantings that may be less palatable to deer, methods to exclude deer, as well as recommendations on scare devices and repellents. Certain deer management activities would need to be coordinated with neighbors and would affect neighboring landscaping due to a change in the number of deer present in certain areas of the park.

### **Park Management and Operations**

Deer management activities must take into consideration the deer management actions of adjacent municipalities to enhance deer management success within the park. Rock Creek Park is an urban park with multiple jurisdictions as neighbors, including the District of Columbia and Montgomery County, Maryland. The District of Columbia does not actively manage deer, but does assist Rock Creek Park with responding to deer complaints and has hired several wildlife biologists to address potential deer issues. Deer overbrowsing is listed as a threat to terrestrial ecosystems in the DC Wildlife Action Plan, and NPS participated in developing the plan (Pfaffko 2006). Rock Creek Park and the District of Columbia have collaborated on deer management issues in the past, including the Metropolitan Washington Council of Government's Wildlife Vehicle Collision working group, and will continue to work together on deer-related issues in the future.



*Park neighbors*

## *Purpose of and Need for Action*

The adjacent jurisdiction of Montgomery County, Maryland has had an active deer management program since 1995 (Montgomery County 1995a). The county and the District of Columbia have stated they would like to be a partner with the park for deer management efforts.

Deer management activities have the potential to impact staffing levels and the operating budget necessary to conduct park operations. Park management and operations refers to the current staff available to adequately protect and preserve vital park resources and provide for an effective visitor experience. Additional deer management activities undertaken by park staff could affect other areas of park operations.

Park interpretive or educational staff would need to allocate additional time and resources to enhance public awareness and understanding of NPS resource management issues, policies, and mandates, as they pertain to deer management. Implementing deer management activities would require conducting public outreach efforts on the part of park staff.

### **OTHER ISSUES CONSIDERED BUT DISMISSED FROM FURTHER CONSIDERATION**

The following impact topics and/or issues were dismissed from further analysis, as explained below:

- **Geohazards:** A geohazard is an event related to geological features and processes that cause loss of life and severe damage to property and the natural and built environment, such as an earthquake or rock slide. There are no known geohazards within the park that would be affected by the creation or implementation of a white-tailed deer management plan.
- **Prime Farmlands:** There are no designated prime farmland soils in the park.
- **Air Quality:** Potential sources of air quality emissions from the implementation of a white-tailed deer management plan include the use of a few vehicles to carry out the prescribed management activities and possibly firearm discharges. Although Rock Creek Park is located in an area classified by the U.S. Environmental Protection Agency as severe nonattainment for ozone, it was determined that the increase in air emissions from these activities would be extremely minimal and short-term, resulting in only negligible impacts to the regional air quality. Therefore, air quality was dismissed as an issue.
- **Streamflow Characteristics:** The proposed action would not occur in any area or involve management actions that would potentially impact streamflow.
- **Marine or Estuarine Resources:** There are no marine or estuarine resources in any of the Rock Creek Park units.
- **Land Use:** Implementation of a white-tailed deer management plan would not affect how surrounding land is used including occupancy, income, ownership, or type of use. The proposed plan would be consistent with surrounding land uses and would not have an effect.
- **Unique Ecosystems, Biosphere Reserves, and World Heritage Sites:** There are no known biosphere reserves, World Heritage sites, or unique ecosystems listed in the park. Rock Creek Park is part of the Chesapeake Bay Watershed; however, actions related to the deer management plan would not affect the watershed.
- **Museum Collections:** The implementation of a White-tailed Deer Management Plan in Rock Creek Park would mainly occur within the forested areas of the park and would not have any effects on the park's museum collections.
- **Historic Structures:** Although there are historic structures that are listed or eligible for listing in the National Register of Historic Places, there would be no negligible impacts on these structures from implementing, or not implementing, a white-tailed deer management plan in Rock Creek

Park. Designed landscapes, such as Dumbarton Oaks Park, would be addressed under cultural landscapes.

- Archeological Resources: Any impacts to park archeological resources as a result of deer management activities would be negligible. Although digging for fencing or other land disturbance could occur, this would be limited to small areas and would avoid areas of known archeological resources. Monitoring would occur and installations would be halted should any archeological resources be discovered.
- Ethnographic Resources: No ethnographic resources or issues have been identified at Rock Creek Park.
- Impacts to Soils from Construction: Any deer management actions that would involve construction, such as erecting enclosures under alternative B or digging pits for waste and/or carcass disposal in disturbed areas under alternatives C or D, could potentially impact soils. However, it was determined that such impacts would be no more than negligible because of the small area disturbed for fence construction, and because disposal pits would be constructed in previously disturbed locations. Therefore, this issue was dismissed from further analysis.
- Water Quality Effects other than Sedimentation: Although there could be other effects on water quality from deer droppings or from the limited application of repellents, the impacts would be so minor and/or localized that these aspects of water quality were not carried through for detailed analysis, and the analysis was focused on effects from erosion and sedimentation.
- Energy Resources and Resource Conservation: The implementation of a white-tailed deer management plan would not be expected to affect energy resources or resource conservation within the park.
- Environmental Justice: The actions under this plan are not expected to have a disproportionate or significant adverse effect on any low income or minority populations in the area.

## RELATED LAWS, POLICIES, PLANS, AND CONSTRAINTS

### NATIONAL PARK SERVICE ORGANIC ACT

By enacting the NPS Organic Act of 1916, Congress directed the U.S. Department of the Interior and the NPS to manage units of the national park system “to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations” (16 USC 1). The Redwood National Park Expansion Act of 1978 reiterates this mandate by stating that the NPS must conduct its actions in a manner that will ensure no “derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress” (16 USC 1 a-1).

Despite these mandates, the Organic Act and its amendments afford the NPS latitude when making resource decisions that balance visitor use and resource preservation. Through these acts Congress “empowered [the NPS] with the authority to determine what uses of park resources are proper and what proportion of the parks resources are available for each use” (*Bicycle Trails Council of Marin v. Babbitt*, 82 F.3d 1445, 1453 (9th Cir. 1996)).

Courts have consistently interpreted the Organic Act and its amendments to stress resource conservation. *Michigan United Conservation Clubs v. Lujan*, 949 F.2d 202, 206 (6th Cir. 1991) states, “Congress placed specific emphasis on conservation.” The *National Rifle Ass’n of America v. Potter*, 628 F. Supp. 903, 909 (D.D.C. 1986) states, “In the Organic Act Congress speaks of but a single purpose, namely, conservation.” The policy dictates, “when there is a conflict between conserving resources and values and providing for the enjoyment of them, conservation is to be predominant (NPS 2006, sec. 1.4.3).

## *Purpose of and Need for Action*

Because conservation remains predominant, the NPS seeks to avoid or to minimize adverse impacts on park resources and values. However, the NPS has discretion to allow negative impacts when necessary (NPS 2006, sec. 1.4.3).

While some actions and activities cause impacts, the NPS cannot allow an adverse impact that constitutes a resource impairment (NPS 2006, sec. 1.4.4). Actions that impair park resources are prohibited unless a law directly and specifically allows for such actions (16 USC 1 a-1). An action constitutes an impairment when, in the professional judgment of the responsible manager, its impacts “harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values” (NPS 2006, sec. 1.4.5). To determine impairment, the NPS must evaluate “the particular resources and values that would be 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 question and other impacts” (NPS 2006, sec. 1.4.5). Therefore, this plan assesses the effects of the management alternatives on park resources and values, and determines if these effects would cause impairment.

An impact on any park resource or value may constitute an impairment, but an impact would be more likely to constitute an impairment to the extent that it has a major adverse effect on 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
- identified as a goal in the park’s GMP or other relevant NPS planning documents

## **NATIONAL PARK SERVICE MANAGEMENT POLICIES 2006**

Several sections from the NPS *Management Policies 2006* (NPS 2006) are relevant to deer management in Rock Creek Park, as described below.

NPS *Management Policies 2006* instruct park units to maintain as parts of the natural ecosystems of parks all native plants and animals. The NPS achieves this maintenance by “preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur” (NPS 2006, sec. 4.4.1).

Furthermore, the NPS “will adopt park resource preservation, development, and use management strategies that are intended to maintain the natural population fluctuations and processes that influence the dynamics of individual plant and animal populations, groups of plant and animal populations, and migratory animal populations in parks” (NPS 2006, sec. 4.4.1.1).

Whenever the NPS identifies a possible need for reducing the size of a park plant or animal population, the decision will be based on scientifically valid resource information that has been obtained through consultation with technical experts, literature review, inventory, monitoring, or research (NPS 2006, sec. 4.4.2.1). The science team was assembled to complete this task.

Section 4.4.2 of the NPS *Management Policies 2006* also states:

Whenever possible, natural processes will be relied upon to maintain native plant and animal species and influence natural fluctuations in populations of these species. The NPS may intervene to manage individuals or populations of native species only when such intervention will not cause unacceptable impacts to the populations of the species or to other components and processes of the ecosystems that support them. The second is that at least one of the following conditions exists (NPS 2006, sec. 4.4.2):

- Management is necessary

- because a population occurs in unnaturally high or low concentration as a result of human influences (such as loss of seasonal habitat, the extirpation of predators, the creation of highly productive habitat through agriculture or urban landscapes) and it is not possible to mitigate the effects of the human influences
- to protect specific cultural resources
- to protect rare, threatened, or endangered species

Section 4.4.2.1 of the NPS *Management Policies 2006* states:

Where visitor use or other human activities cannot be modified or curtailed, the [NPS] may directly reduce the animal population by using several animal population management techniques, either separately or together. These techniques include relocation, public hunting on lands outside a park or where legislatively authorized within a park, habitat management, predator restoration, reproductive intervention, and destruction of animals by NPS personnel or their authorized agents. Where animal populations are reduced, destroyed animals may be left in natural areas of the park to decompose unless there are human safety concerns regarding attraction of potentially harmful scavengers to populated sites or trails or other human health and sanitary concerns associated with decomposition (NPS 2006, sec. 4.4.2.1).

#### **DIRECTOR'S ORDER 12: CONSERVATION PLANNING, ENVIRONMENTAL IMPACT ANALYSIS, AND DECISION MAKING AND HANDBOOK**

NPS Director's Order 12 and its accompanying handbook (NPS 2001) lay the groundwork for how the NPS complies with the NEPA. Director's Order 12 and the handbook set forth a planning process for incorporating scientific and technical information and establishing a solid administrative record for NPS projects.

NPS Director's Order 12 requires that impacts to park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision makers to understand the implications of those impacts in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists. Director's Order 12 also requires that an analysis of impairment to park resources and values be made as part of the NEPA document.

#### **NATIONAL ENVIRONMENTAL POLICY ACT OF 1969, AS AMENDED**

NEPA section 102(2)(c) requires that an environmental impact statement be prepared for proposed major federal actions that may significantly affect the quality of the human environment.

#### **NATURAL RESOURCES REFERENCE MANUAL, NPS-77 (1991)**

The *Natural Resource Reference Manual 77*, which supersedes the 1991 NPS 77: *Natural Resource Management Guideline*, provides guidance for NPS employees responsible for managing, conserving, and protecting the natural resources found in national park system units.

#### **DIRECTOR'S ORDER 28: CULTURAL RESOURCE MANAGEMENT (2002)**

This Director's Order (NPS 2002b) sets forth the guidelines for management of cultural resources, including cultural landscapes, archeological resources, historic and prehistoric structures, museum objects, and ethnographic resources. This order calls for the NPS to protect and manage cultural resources in its custody through effective research, planning, and stewardship in accordance with the policies and principals contained in the NPS *Management Policies 2006*.

## **OTHER LEGISLATION, COMPLIANCE, AND NATIONAL PARK SERVICE POLICY**

### **Redwood Amendment to the General Authorities Act**

Reasserting the system-wide standard of protection established by Congress in the original Organic Act, the Redwood Amendment stated:

The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the national park system and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress (P.L. 95-250, USC Sec 1a-1).

Congress intended the language of the Redwood Amendment to the General Authorities Act to reiterate the provisions of the Organic Act, not to create a substantively different management standard. The House committee report described the Redwood amendment as a “declaration by Congress” that the promotion and regulation of the national park system is to be consistent with the Organic Act. The Senate committee report stated that under the Redwood amendment, “the Secretary has an absolute duty, which is not to be compromised, to fulfill the mandate of the 1916 Act to take whatever actions and seek whatever relief as will safeguard the units of the national park system.” Although the Organic Act and the General Authorities Act, as amended by the Redwood amendment, use different wording (“unimpaired” and “derogation”) to describe what the NPS must avoid, they define a single standard for the management of the national park system—not two different standards. For simplicity, Management Policies uses “impairment,” not both statutory phrases, to refer to that single standard.

### **Endangered Species Act of 1973, as Amended**

The purpose of the ESA is to conserve “the ecosystems upon which endangered and threatened species depend” and to conserve and recover listed species. Under the law, species may be listed as either “endangered” or “threatened.” Endangered means a species is in danger of extinction; threatened means a species is likely to become endangered. All federal agencies are required to protect listed species and preserve their habitats. The law also requires federal agencies to consult with the USFWS to ensure that the actions they take, including actions chosen under this deer management plan, will not jeopardize listed species.

### **Migratory Bird Treaty Act of 1918**

The Migratory Bird Treaty Act of 1918 implements various treaties and conventions between the United States and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Under this act it is prohibited, unless permitted by regulations, to “pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess...any migratory bird, included in the terms of this Convention...for the protection of migratory birds...or any part, nest, or egg of any such bird” (16 USC 703). Since actions of deer or management actions could affect habitat for or disturb migratory birds, this act was considered in the development of this plan.

### **Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds**

Executive Order 13186 was established on the premise that migratory birds contribute to biological diversity, bring enjoyment to millions of Americans, and are of great ecological and economic value to this country and to other countries. Under this order, federal agencies taking actions that have, or are likely to have, a measurable negative effect on the migratory bird population are directed to develop and implement a Memorandum of Understanding with the USFWS that promotes the conservation of migratory bird populations. This executive order also requires that the environmental analysis of federal

actions required by NPS or other established environmental review processes evaluate the effects of the action and agency plans on migratory birds, with an emphasis on species of concern.

### **National Historic Preservation Act of 1966, as Amended**

Section 106 of the National Historic Preservation Act (NHPA) requires that federal agencies consider the effects of their undertakings on properties listed or potentially eligible for listing in the National Register of Historic Places. All actions affecting the park's cultural resources must comply with this regulation.

### **Historic Sites, Buildings, and Antiquities Act, 1935**

The Historic Sites, Buildings, and Antiquities Act establishes “national policy to preserve for public use historic sites, buildings and objects of national significance.” It gives the Secretary of the Interior broad powers to protect these properties, including the authority to establish and acquire nationally significant historic sites.

### **Federal Noxious Weed Act, 1975**

The Federal Noxious Weed Act (7 USC 2801-2814, January 3, 1975, as amended 1988 and 1994) provides for the control and management of nonindigenous weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health. Since actions of deer or management actions could affect the distribution of noxious weeds through seed dispersal, this act was considered in the development of this plan.

### **Code of Federal Regulations, Title 43**

Title 43 of the *Code of Federal Regulations* (CFR) part 24 describes the four major systems of Federal lands administered by the Department of the Interior. Section 24.4(f) states that “units of the National Park System contain natural, recreation, historic, and cultural values of national significance as designated by Executive and Congressional action.” In describing appropriate activities, it states that “[a]s a general rule, consumptive resource utilization is prohibited.”

In addition, section 24.4 (i) instructs all Federal agencies of the Department of the Interior, among other things, to “[p]repare fish and wildlife management plans in cooperation with State fish and wildlife agencies and other Federal (non-Interior) agencies where appropriate.” It also directs agencies to “[c]onsult with the States and comply with State permit requirements ... except in instances where the Secretary of the Interior determines that such compliance would prevent him from carrying out his statutory responsibilities.”

### **Code of Federal Regulations, Title 36**

Title 36 provides the regulations “for the proper use, management, government, and protection of persons, property, and natural and cultural resources within areas under the jurisdiction of the National Park Service” (36 CFR 1.1(a)). This includes wildlife management, hunting and permits.

### **Executive Order 11990, Protection of Wetlands**

Executive Order 11990 directs federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.

### **Executive Order 11988, Floodplain Management**

This executive order directs federal agencies to avoid, to the extent possible, long- and short-term impacts associated with occupying and modifying floodplains through development, where a practicable alternative exists.

### **Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations**

The NPS must address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities, including planning projects, on minority populations and low-income populations.

### **Executive Order 13112, Invasive Species**

This executive order requires the NPS to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

### **Animal Welfare Act, as Amended (7 USC, 2131-2159)**

The Animal Welfare Act requires that minimum standards of care and treatment be provided for certain animals bred for commercial sale, used in research, transported commercially, or exhibited to the public. Individuals who operate facilities in these categories must provide their animals with adequate care and treatment in the areas of housing, handling, sanitation, nutrition, water, veterinary care, and protection from extreme weather and temperatures. Although federal requirements establish acceptable standards, they are not ideal. Regulated businesses are encouraged to exceed the specified minimum standards. Deer management alternatives that include trapping, euthanasia, or administration of reproductive controls could be regulated by this act.

## **RELATIONSHIP TO OTHER PLANNING DOCUMENTS FOR ROCK CREEK PARK AND ADMINISTERED UNITS**

The following plans for Rock Creek Park need to be considered in the development of this plan.

### **Natural Resources Management Plan (NPS 1996)**

The Natural Resources Management Plan for Rock Creek Park (NPS 1996a) provides specific management objectives for Rock Creek Park based on the park's Statement for Management. The Natural Resources Management Plan will be updated as a Resource Stewardship Strategy when NPS issues guidelines for the updated plan. Although the NPS has not yet adopted the new guidelines for Resource Stewardship strategies, the Resources Management Plan for Rock Creek Park is used as a general guide to past planning efforts until a new resource stewardship strategy is completed. Resource related management objectives in the existing plan require that the park:

- Seek information, through research or other means, on the natural processes of the park's natural areas in order to perpetuate park resources and to enhance opportunities for resource-compatible public use and enjoyment.
- Preserve and perpetuate the park's plant and wildlife resources in as natural a condition as possible, and reduce the adverse effects of human activities and exotic species on the natural environment.
- Identify, protect, and perpetuate the park's historic resources, including mills, Civil War fortifications, and archeological sites.

- Monitor and evaluate current recreational uses of the park lands and redirect these activities in order to reduce adverse impacts.
- Foster understanding and appreciation of the park's natural and cultural values through interpretive and educational programs focusing on Rock Creek's biological, geological, historic, and prehistoric resources.
- Provide for public use and enjoyment of the park through the provisions of varied facilities, services, and programs that are compatible with perpetuating the park's natural and cultural values.
- Establish contact and cooperation with citizens' associations, governmental agencies, and other groups or individuals that surround and have direct effects on or interests in the welfare of the park.

The Natural Resources Management Plan is a strategic planning document and a key element in good management and resource preservation. These management objectives are addressed in a series of project statements which consider natural and cultural resource problems, activities, or issues. The plan does not directly address deer management at the park.

### **Cultural Landscape Reports and Inventories**

The park has completed several cultural landscape reports or inventories that document the history and existing condition of the landscapes and analyze and evaluate the landscape resources. The results and recommendations of these reports were taken into consideration when developing this plan/EIS. These reports include the following:

- Dumbarton Oaks Cultural Landscape Report (NPS 2000a)—The need to document the Dumbarton Oaks Park historic landscape became apparent in 1985 when the NPS recognized that the garden was being managed as a natural, rather than a cultural resource. The landscape report was created to provide guidance for stabilizing existing resources such as focal points and waterway features. This effort led to the 1997 *Preservation Maintenance Plan for Dumbarton Oaks Park*, which details cultural landscape maintenance.
- Peirce Mill Cultural Landscapes Inventory (NPS 2003b)—In 1997, the Peirce Mill landscape was identified as a component landscape of Rock Creek Park (Reservation 339). The landscape is identified as the property owned by Peirce Shoemaker that was transferred to the federal government after the creation of the park in 1890 and is distinctive from the rest of Reservation 339 because of the physical history of the site and the character of the area.
- Linnaean Hill Cultural Landscapes Inventory (NPS 2003a)—In 1997, the Linnaean Hill landscape was identified as a component landscape of Rock Creek Park (Reservation 339). The landscape is the property of Joshua Peirce Klinge that was transferred to the federal government after the creation of the park in 1890 and is distinctive from the rest of Reservation 339 because of the physical history of the site and the character of the area.

### **Draft Long Range Interpretive Plan (NPS 2003)**

The Rock Creek Park Draft Long Range Interpretive Plan (NPS 2003d) provides an assessment of current conditions in the interpretation and educational program for Rock Creek Park, establishes goals for the future direction and development of that program, and establishes priorities necessary to get there.

### **Fort Circle Parks Final Management Plan/Environmental Assessment (NPS 2004)**

The Fort Circle Parks Final Management Plan (NPS 2004b), finalized in September 2004, provides a unifying management concept for significant historic resources associated with the Civil War defenses of

Washington that would allow these resources to be preserved for future generations, and interpreted in a coherent, easily understandable manner. This plan sets forth a series of desired visitor experience and resource condition statements to guide the management of these units for the next 10 to 15 years.

#### **Environmental Commitment Statement (NPS 2004)**

In July 2004, Rock Creek Park issued a statement (NPS 2004f) that summarizes a commitment to manage park resources and the multiple sites in the District of Columbia under park jurisdiction as outlined by the principles and practices described in the Organic Act of 1916, which state “we are to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.”

#### **Draft Invasive Exotic Plant Management Plan (NPS 2004)**

The Draft Invasive Exotic Plant Management Plan (NPS 2004a) describes the principles under which exotic plant management is prioritized and undertaken for all the natural areas within Rock Creek Park. The plan details methods to be used, with the understanding that methods will be adapted as more effective and efficient methods are developed and/or monitoring indicates that current methods are ineffective. NEPA compliance is conducted as needed.

#### **Rock Creek Park and Rock Creek and Potomac Parkway Final General Management Plan/Environmental Impact Statement (2005; Record of Decision 2007)**

The 2005 *Rock Creek Park and Rock Creek and Potomac Parkway Final General Management Plan* (NPS 2005a) is the basic guidance document for the management of these units for the next 10 to 15 years. The purpose of the plan is to specify resource conditions and visitor experiences to be achieved in the park and parkway, and to provide the foundation for decision-making and preparation of more specific resource plans regarding the management of the park and parkway. The 2005 plan is the first comprehensive plan prepared for Rock Creek Park. The central issue for management planning in Rock Creek Park is how to meet the often conflicting purposes of protecting the scenic, natural, and cultural resources of the park, while concurrently providing for appropriate public use of these resources.

The 2005 *Final General Management Plan*, which was finalized in a 2007 Record of Decision, outlines the following desired conditions for Rock Creek Park and the Rock Creek and Potomac Parkway that would be applicable to a deer management plan:

#### **Natural Resource Management Requirements**

- Native species populations that have been severely reduced or extirpated are restored where feasible and sustainable.
- Invasive species are reduced in number and area, or eliminated from natural areas of the park.
- Federal- and District-listed threatened or endangered species and their habitats are protected and sustained.
- Native plant and animal species function in as natural a condition as possible, except where special management considerations are allowable under policy.
- Surface waters and groundwater are protected or restored such that water quality as a minimum meets all applicable District of Columbia water quality standards.

#### **Cultural Resource Management Requirements**

- Archeological sites are protected in an undisturbed condition unless it is determined through formal processes that disturbance or natural deterioration is unavoidable.

### **Visitor Experience and Park Use Requirements**

- Visitor and employee safety and health are protected.
- Visitors have opportunities to enjoy the park in ways that leave park resources unimpaired for future generations.
- Visitors understand and appreciate park values and resources and have the information necessary to adapt to the park's environments.

### **Special Use Management Requirements**

- Resources outside of the park are managed in such a way that the park will be safeguarded.
- The NPS works cooperatively with others to anticipate, avoid, and resolve potential conflicts and address mutual interests.

All alternatives considered for the development of a White-tailed Deer Management Plan were developed within the framework of the park's GMP/EIS.

### **Fire Management Plan (NPS 2004)**

Rock Creek Park's Fire Management Plan (FMP; NPS 2004c) is a component of the overall resources management program. It integrates fire management objectives with other resource management programs. The FMP provides a detailed action program that is consistent with NPS Management Policies 2006 and DO/RM-18 (NPS 1999, 2006), and will assist the park in its efforts to preserve, maintain, and protect natural and cultural resources.

The FMP is essentially a fire suppression plan, due to its urban surroundings. This FMP documents the fire management objectives, operational programs, and research required to effectively manage wildland fire at Rock Creek Park. Implementation of the plan allows all wildfires to be suppressed as safely and as quickly as possible. A prescribed fire program is not included in the FMP because Rock Creek Park is an urban park with 72 miles of boundary lines that would severely limit the use of prescribed fires. Air quality standards and visibility requirements for local air traffic further restrict the use of prescribed fire.

### **Watershed Condition Assessment Program (ongoing)**

During 2006-2014, the Watershed Condition Assessment (WCA) Program plans to fund a comparable natural resource condition assessment for each of the 270 parks in the 32 NPS Vital Signs Monitoring networks. Each assessment gives the receiving park a snapshot-in-time evaluation of current condition status, critical data gaps, and resource condition influences relative to a strategic subset of natural resource attributes and indicators. The assessments also strive to provide a holistic, science-based roll-up and report on overall condition status by park areas of greatest management interest (e.g., by watersheds, habitat/ecosystem types, or management zones). Assessments will help park managers and planners describe and quantify characteristics of Desired Conditions for each park's "fundamental" and "other important" natural resources and values. Rock Creek Park's Draft Watershed Condition Assessment will be completed in 2009 (J. Sherald, pers. comm. 2008).



# ALTERNATIVES

This “Alternatives” chapter describes the various actions that could be implemented for current and future management of white-tailed deer (*Odocoileus virginianus*) in Rock Creek Park. The *National Environmental Policy Act* (NEPA) requires federal agencies to explore a range of reasonable alternatives and to analyze what impacts the alternatives could have on the human environment, which the act defines as the natural and physical environment and the relationship of people with that environment. The analysis of impacts is presented in “Chapter 4: Environmental Consequences” and is summarized in table 12 at the end of this chapter.

The alternatives under consideration must include a “no action” alternative, as prescribed by NEPA regulations at 40 Code of Federal Regulations (CFR) 1502.14. The no action alternative in this document is the continuation of the park’s current management actions and policies related to deer and their effects on vegetation.

The interdisciplinary planning team, with feedback from the public and the science team during the planning process, developed three action alternatives. These alternatives meet, to a large degree, the objectives developed for this plan and also the purpose of and need for action as expressed in “Chapter 1: Purpose of and Need for Action.” Because these action alternatives would be technically and economically feasible and show evidence of common sense, they are considered “reasonable” (CEQ 1981).

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*No-Action Alternative*  
— *The alternative in which baseline conditions and trends are projected into the future without any substantive changes in management.*

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## INTRODUCTION AND OVERVIEW OF ALTERNATIVES

This chapter describes the alternatives developed by the interdisciplinary team for this Draft White-tailed Deer Management Plan / Environmental Impact Statement (plan/EIS), as well as the background information used in setting a deer density goal and an action threshold for implementing the preferred alternative, based on regeneration of tree seedlings. All alternatives were developed to meet the purpose, need, and objectives of this plan. Input from the science team and the public was considered and used to refine the preliminary alternatives as the planning process progressed.

The alternatives selected for detailed analysis are briefly described below. This is followed by a description of Rock Creek’s deer density goal and the threshold for taking action, which are needed to fully understand the action alternatives (i.e., alternatives B, C, and D). Next, detailed descriptions of each alternative are presented, followed by a discussion of adaptive management and how it could be applied to the alternatives. The remainder of the chapter addresses alternatives that were considered but eliminated from detailed analysis and the identification of the agency’s preferred and the environmentally preferred alternative.

### NO ACTION ALTERNATIVE

- **Alternative A: No Action** — Current deer management actions and policies would continue under alternative A, including monitoring deer density and relative numbers, monitoring vegetation, data management, and opportunity for research. Protective caging and limited use of deer repellents may also be used to protect rare plants in natural areas and small areas in landscaped and cultural areas. Current educational and interpretive measures, as well as inter-jurisdictional communication, would continue. No new actions would occur to reduce the effects of deer overbrowsing.

## ACTION ALTERNATIVES

- **Alternative B: Combined Non-Lethal Actions** — Alternative B would include all actions described under alternative A, but would also incorporate several non-lethal actions to protect forest seedlings, promote forest regeneration, and gradually reduce deer numbers in the park. The additional actions would include the construction of large-scale deer exclosures (large fenced areas) and reproductive control of does via sterilization and an acceptable reproductive control agent when feasible. Reproductive control implementation may require construction of temporary holding areas to house captured deer prior to treatment.
- **Alternative C: Combined Lethal Actions** — Alternative C would include all actions described under alternative A, but would also incorporate two lethal deer management actions to reduce the herd size. The additional actions would include reduction of the deer herd by either sharpshooting or by implementing capture and euthanasia of individual deer, to be used in limited circumstances where sharpshooting may not be appropriate.
- **Alternative D: Combined Lethal and Non-Lethal Actions** — Alternative D would include all actions described under alternative A, but would also include a combination of certain additional lethal and non-lethal actions from alternatives B and C to reduce deer herd numbers. The lethal actions would include both sharpshooting and capture/euthanasia and would be taken initially to quickly reduce the deer herd numbers. Population maintenance would be conducted via reproductive control methods if these are available and feasible; if not, sharpshooting would be used as a default option for maintenance.

## DEER DENSITY GOAL AND THRESHOLD FOR TAKING ACTION UNDER THE ACTION ALTERNATIVES

The action alternatives (B, C, and D) contain actions to support forest regeneration and to protect, conserve, and restore native species and cultural landscapes. Before an action alternative may be implemented, the park must first determine (1) when action needs to be taken (i.e., when damage to forest vegetation reaches unacceptable levels); and (2) how many deer would need to be removed (for those alternatives that include deer removal). The following discussion describes both the threshold for taking action (which is related to vegetation impacts from deer browsing) and the deer density goal (which would be used to determine the number of deer that would be removed).

### INITIAL DEER DENSITY GOAL

The deer density goal refers to an appropriate density that would allow for natural forest regeneration. This deer density would then be used as an appropriate goal for deer reduction under any of the action alternatives that include this action. Research has been conducted on tree regeneration and the impact of white-tailed deer on different forest types in the eastern United States. The predominant forest types in Rock Creek Park include beech (*Fagus* spp.)-white oak (*Quercus alba*)-mayapple (*Podophyllum peltatum*), tulip poplar (*Liriodendron tulipifera*), and chestnut oak (*Quercus prinus*), with mostly sycamore (*Platanus occidentalis*)-green ash (*Fraxinus pennsylvanica*) in floodplains and stream corridors. Research has suggested that in cherry (*Prunus* spp.)/maple (*Acer* spp.) forest types in the Allegheny Plateau (western Pennsylvania, West Virginia, and eastern Ohio), deer density should be 20 to 40 animals per square mile in unmanaged areas, and 15 to 18 animals in managed timber areas, to maintain natural regeneration (Tilghman 1989). Marquis et al. (1992) suggested that tree regeneration fails with deer densities at 32 deer per square mile. This research also demonstrated that a species shift occurs in beech/birch (*Betula* spp.)/maple forests at 18 deer per square mile, while an oak (*Quercus* spp.)/hickory (*Carya* spp.) forest successfully regenerates at 6 deer per square mile (Marquis et al. 1992). Research by deCalesta (1992, 1994) showed that seedling richness begins to decline with just 10 deer per square mile, and that songbird habitat is negatively impacted with 20 to 39 deer per square mile in a cherry/maple

forest. Horsley et al. (2003) showed that negative impacts began in cherry/maple forests at 20 deer per square mile within the Allegheny Plateau from 1979 to 1989. In a study in the Central Adirondacks in maple/beech/birch, hemlock (*Tsuga* spp.)/birch, and spruce (*Picea* spp.)/fir (*Abies* spp.) forest types, Sage et al. (2003) found good tree regeneration with a density of 13 deer per square mile from 1954 to 2001. In 2006, the deer density at Rock Creek Park was 58 deer per square mile and in 2007 the deer density had climbed to 82 per square mile (K. Ferebee, pers. comm. 2008a). These figures exceed all deer density levels recommended for tree regeneration in similar forests.

As previously described, a science team consisting of scientists and other specialists from a variety of state and federal agencies was formed to provide technical information and input into the planning process (see “Scientific Background” in chapter 1), including a review of density information. The science team suggested that a range would be appropriate for the initial density goal and recommended a range of 15 to 20 deer per square mile. Based on the science team’s recommendation and recent research in forest types similar to Rock Creek, the park adopted a range of 15 to 20 deer per square mile as the initial deer density goal. This goal may be adjusted based on the results of vegetation and deer population monitoring, as described in the “Adaptive Management” section.

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*Based on the science team’s recommendation and recent research in forest types similar to Rock Creek, the park adopted a range of 15 to 20 deer per square mile as the initial deer density goal.*

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## THRESHOLD FOR TAKING ACTION

The science team also discussed methods of identifying an appropriate threshold for taking action to protect vegetation. Because the deer population is to be managed based on the success of forest regeneration, tree seedlings must be monitored to determine at what point the browsing impacts would warrant implementation of the selected management alternative. The point at which action would be needed is called the “threshold for taking action.”

Since 1990, various vegetation-monitoring projects have been conducted within Rock Creek Park. In 1990, 27 long-term plots (unfenced) were randomly located throughout the park to capture general changes in the vegetation over time. These plots have been monitored every four years starting in 1991. Tree seedling data collected from these plots could be used to determine if action needs to be taken to limit deer browsing impacts.

The regeneration standard adopted by the park was developed based on research by Dr. Susan Stout (1999) in a similar eastern hardwood forest environment in Cuyahoga National Recreation Area, now known as Cuyahoga National Park (McWilliams et al. 1995). While ecological histories may vary, there are many similarities between the



*Paired fenced/unfenced plot showing vegetation conditions inside and outside of the fence.*

forests at Cuyahoga and Rock Creek Park which support the use of this research. Dr. Stout’s method measures the number of tree seedlings and their heights in circular (1-meter- [3.28-foot-] radius) sampling

plots under different levels of deer herbivory. The seedlings were divided into eight height classes. Based on this work, Stout recommended regeneration thresholds for Cuyahoga. These thresholds were converted into Rock Creek’s plot size, which includes a sampling area of four 2-meter × 2-meter (6.56-foot × 6.56-foot) subplots contained within each of the 27 long-term unfenced plots. At Rock Creek Park, Stout’s results indicated that under conditions of low deer density, successful regeneration would be defined as having 51 seedlings or more within the four 2-meter × 2-meter (6.56-foot × 6.56-foot) subplots (a total sampling area of 16 square meters [172 square feet] or 0.0016 hectares [0.004 acres]) in 67% or more of the long-term monitoring plots (table 3). Low deer density has been defined as that from 13 to 21 deer per square mile relative to levels observed in the Mid Atlantic Region (Horsley et al. 2003) and is in the range of the desired deer density proposed for this plan. High deer density has been defined as 56 to 64 deer per square mile (Horsley et al. 2003). Under high deer densities, successful regeneration is defined as having 153 seedlings per 16 square meters (172 square feet). The following table summarizes this information.

**TABLE 3. MINIMUM NUMBER OF SEEDLINGS/PLOT**

Deer Density <sup>a</sup> (deer/mi <sup>2</sup> )	16 Square Meter Plot
Low	51
High	153

Source: Stout 1999

Note: Low density = 67% of plots have 51 seedlings or more

High density = 67% of plots have 153 seedlings or more

Low density = 13–20 deer/mi<sup>2</sup>

High density = 56–64 deer/mi<sup>2</sup>

Source: Horsley et al. 2003

Based on the science team’s review of the literature, the park decided to use Stout’s suggested regeneration standard as the threshold for taking action under this plan. That is, at low deer densities, successful forest regeneration would be indicated when there are 51 seedlings or more within the subplots in 67% or more of the unfenced long-term plots monitored by the park. The park would determine the level of regeneration every four years from data collected from the plots, as described in the monitoring plan presented in appendix A.

**ALTERNATIVE A: NO ACTION (EXISTING MANAGEMENT CONTINUED)**

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*Caging — Small scale fencing placed around individual plants to protect them from deer browsing.*

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Under the “no action” alternative, Rock Creek Park would continue to implement current management actions and policies related to deer and their effects. This would include deer population monitoring (including Distance Sampling), as well as caging of small areas and using small amounts of repellents to protect native plants and ornamental landscaping. Current monitoring efforts would continue to record deer browsing impacts and deer population numbers within the park, although specific monitoring actions may be modified or discontinued over time, depending on the results and need for monitoring. Educational and interpretive activities would continue to be used to inform the public about deer ecology and park resource issues and cooperation with

regional entities and inter-jurisdictional agencies would continue. No additional deer management actions to reduce the deer population would occur under this alternative.

Because alternative A includes no measures to reduce the white-tailed deer population or to control population growth, it is assumed that the population would stay at high levels, albeit with annual fluctuations and may gradually increase over the life of the plan (15 years). The amount of increase is unknown; however, high deer density is expected to continue to negatively affect vegetation (NPS 2007d), and deer density would likely reach or exceed the previously recorded high of 98 deer per square mile, with numbers fluctuating annually due to factors such as weather, herd health, removals outside the park (by other agencies), and food availability. This alternative serves as the baseline for analyzing and comparing the effects of the other alternatives.

The actions that would continue under alternative A are described below in detail. These actions would also be common to all action alternatives as well.

## CURRENT ACTIONS

### MONITORING, DATA MANAGEMENT, AND RESEARCH

Current monitoring of both vegetation impacts and deer population levels would continue and would be modified as necessary to better understand any correlations between the two.

Monitoring and data collection activities that would be common to all alternatives could include any or all of the following:

- Monitoring deer numbers by parkwide observations. The park would continue to use the Distance Sampling method to estimate the deer population density annually using an established protocol (NPS 2004g).
- Use of spotlight surveys to monitor population composition (i.e., age, sex ratios).
- Monitoring tree seedlings to determine the status of forest regeneration. Paired plots would be read annually, while the 27 long-term plots would continue to be read every four years (three times during the 15-year life of this plan).
- Monitoring deer health as the population shows signs of disease or if a disease has been discovered within the region. Appendix B and the following section specifically outline actions being taken to address chronic wasting disease (CWD).
- Tracking of research related to deer management, including the outcome of actions being taken by neighboring jurisdictions, and the latest research on various deer management methods, including reproductive control.
- Monitoring the costs of these actions, including those related to staff time, training, administrative, legal, and public communications, plus the costs of monitoring as described above.

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*Chronic Wasting  
Disease (CWD) — A  
slowly progressive,  
infectious, self-  
propagating  
neurological disease  
of captive and free-  
ranging deer, elk, and  
moose.*

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Under all of the alternatives, Rock Creek Park may solicit the help of skilled volunteers. Where hunting is not authorized, the use of skilled volunteers, pursuant to the *Volunteers in Parks Act*, to assist the National Park Service (NPS) in reducing deer populations is compatible with existing laws, regulations, and NPS policy. For the purposes of this plan/EIS, skilled volunteers would not be used to implement the administering of reproductive controls or lethal reduction (firearms or chemicals). Safety concerns related to high visitation, park boundaries, and topography make this an infeasible option. However, skilled volunteers could be used to assist in the implementation of other elements included in the action alternatives.

## *Alternatives*

All actions involving direct management of individual animals would be conducted in accordance with American Veterinary Medical Association (AVMA) recommendations for the humane treatment of animals to the greatest extent possible (see AVMA website at <[www.avma.org/resources/euthanasia.pdf](http://www.avma.org/resources/euthanasia.pdf)> for examples). Every effort would be made to minimize the degree of human contact during procedures that require the handling of deer (AVMA 2001).

Specific deer population and vegetation monitoring methods that would be used under alternative A, as well as the other alternatives, are included in appendix A.

### **CHRONIC WASTING DISEASE**

CWD is in the family of diseases known as the transmissible spongiform encephalopathies (TSEs) or prion diseases. Other TSEs include scrapie in sheep, bovine spongiform encephalopathy (BSE or mad cow disease), and Creutzfeldt-Jakob disease (CJD) in humans. Chronic wasting disease causes brain lesions that result in progressive weight loss, behavioral changes, and eventually death in affected cervids, including deer. There is currently no evidence that the disease is transmissible to humans or domestic livestock; however, the disease could limit populations of deer and could result in impacts on the recreational value of these species. Also, although wildlife biologists are still learning about this relatively new disease, studies have shown that greater density of deer and other ungulates increases the likelihood of transmission of CWD (see appendix B).

Generally, the NPS has identified two levels of action pertaining to CWD based on risk of transmission (see appendix B): (1) when the disease is not known to occur within a 60-mile radius of the park; and (2) when the disease is known to occur within the park or within a 60-mile radius of the park. As of 2007, the nearest known case of CWD in free-ranging deer is greater than 100 miles from Rock Creek Park. Therefore, the park would continue to take the following actions under the existing categorical exclusion provisions.

#### **Surveillance/Testing**

The park would continue to perform opportunistic surveillance on available carcasses. Opportunistic surveillance means taking biological samples from available dead animals (e.g., road kill, predation). This does not mean animals would be killed for the purpose of CWD surveillance. Opportunistic sampling is likely to be a more sensitive measure of disease detection because it includes testing animals that may have not been able to react quickly to oncoming vehicles or predators due to the effects of the disease.

In addition, the park staff is currently under direction to report any deer exhibiting clinical signs of CWD to the NPS Biological Resources Management Division for direction on additional action or testing. This targeted surveillance generally involves lethal removal and testing of any deer exhibiting clinical signs consistent with CWD. If CWD would be found within 60 miles of the park, opportunistic surveillance efforts would continue and targeted surveillance (lethal removal and testing) may be required.

#### **Coordination**

The park would continue to coordinate with the state wildlife agencies and the District of Columbia regarding CWD surveillance methods and results.

#### **Disposal/Consumption**

The park would follow NPS Public Health Service guidance pertaining to the donation of meat from a documented CWD area (NPS 2005e). Any deer confirmed with CWD would be disposed of in accordance with NPS Public Health Service disposal guidelines.

### **LIMITED USE OF SMALL AREA PROTECTIVE FENCING (CAGES)**

In areas containing landscape plantings, new restoration plantings, or rare plant species, the park would consider caging of individual plants and small groups of plants to protect them from deer browsing. Landscape plantings typically consist of ornamental vegetation in and around buildings and in other park developed areas. Park staff may erect small cages or tree tubes around trees or seedlings that have been recently planted in restoration areas. If rare understory plant species that deer browse are found in the park, they would be protected with caging.

The caging used would be limited to the immediate area around the plants to be protected, typically less than 43 square feet (4 square meters) total, and would consist of a 5-foot-high, woven wire fence (typically a 1-inch by 2-inch mesh), with netting or other covering over the top as appropriate.

### **LIMITED APPLICATION OF REPELLENTS**

The park may consider use of small amounts of commercially available deer repellents in landscaped areas. Repellents could also be used on plantings in cultural landscape areas where caging would be undesirable because of its visual impact.

Repellents work by reducing the attractiveness and palatability of treated plants to a level lower than that for other available forage. Repellents are more effective on less palatable plant species than on highly preferred species (Swihart and Conover 1991). Repellent performance seems to be negatively correlated with deer density, meaning that the higher the abundance of deer, the less likely the repellent would be effective. Success with repellents is measured as a reduction in damage; total elimination of damage should not be expected (Craven and Hygnstrom 1994).

Deer repellent products are generally either odor- or taste-based. Odor-based repellents incorporate a smell that is supposed to be offensive to deer, such as human hair, soaps, garlic, rotten eggs, blood meal, or seaweed, and they tend to work best in areas where deer have not adapted to close human interaction. Taste-based repellents incorporate a taste that is offensive to deer, such as hot pepper juice. These repellents tend to work in areas where deer have adapted to close human interaction and where odor-based repellents are not effective.

Both repellent types are available in chemical and organic forms. The organic repellents are biodegradable and are expected to be the least harmful to the environment. Some of the more recently available products, such as Plantskydd®, Liquid Fence®, and Deer Busters®, have the longest residence time (period of effectiveness between applications). Many other brands are also commercially available (e.g., Deer Blocker®, Gempler's®, Deer-Off®, Scoot Deer®, and Deer Scram®). Different brands may provide different results; therefore, park staff would experiment with the available products to determine which worked best in each application area. Both types of repellents can have a short residence time when applied to plant material and must be monitored and applied frequently to retain their effectiveness. Many commercial repellents indicate that they persist after normal rain events, with varying persistence of one to six months. In all cases, the NPS Integrated Pest Management Coordinator would approve the repellents used.

Commercially available deer repellents would be used in selected park areas where fencing would cause unacceptable visual impacts and where repellents would likely have some success. Repellents would be applied during the growing season and limited to hand-held sprays. Repeated applications of spray repellents would be necessary due to weather and emergence of new growth. Because the effectiveness of repellents is variable, they would be used on an experimental basis until the level of effectiveness was established. Large-scale application of repellents is not practical due to high application cost, label restrictions on use, and variable effectiveness.

**EDUCATIONAL AND INTERPRETIVE MEASURES**

Communication with and input from other organizations and the public would be a key component of alternative A, as well as the other alternatives. Such activities would include continuing education and interpretive programs, displaying exhibits at visitor gathering areas, and producing brochures and publications about deer management issues. The park’s website would also be used to discuss what the park is doing related to deer management and relevant articles may be published in local newspapers.

**CONTINUED AGENCY AND INTER-JURISDICTIONAL COOPERATION**

The park would continue to coordinate with other wildlife management agencies (Maryland National Capital Park and Planning Commission, DC Division of Fisheries and Wildlife) on the implementation of deer management efforts. Chapter 1 (“Purpose of and Need for Action”) contains additional information on the neighboring agencies and jurisdictions with whom the park would consult on this planning effort.

**IMPLEMENTATION COSTS**

The costs associated with alternative A would primarily be for monitoring, plus limited small area protective caging and repellent application, as shown in table 4.

**TABLE 4. COST ESTIMATE — ALTERNATIVE A: NO ACTION**

Action	Assumptions	Annual Cost	Cost for the 15-year Planning Period
Population Trend Counts (Spotlight Surveys)	Four nights of survey (three hours each night for three staff) plus data analysis	\$1,400	\$21,000
Distance Sampling	Three nights of survey (2 ½ hours each night for three staff) plus data analysis	\$1,200	\$18,000
Radio Telemetry	One deer tracked – average 42 times per year – tracking plus analysis	\$2,000	\$30,000
Vegetation Monitoring of Existing Plots	Data collection and analysis		
	<ul style="list-style-type: none"> <li>• 17 paired plots</li> <li>• 27 long-term permanent plots</li> </ul>	\$12,000 annually \$22,000 every 4 years	\$180,000 \$66,000
Maintenance of Existing Monitoring Plots	Assumes five hours labor	\$200	\$3,000
Small Area Protective Caging	Small areas caged	\$100	\$1,500
Repellent Use	Limited use around developed/landscaped areas – 5 gallons at \$100 per gallon (concentrate)	\$500	\$7,500
<b>Total</b>			<b>\$327,000</b>

The cost associated with CWD testing is not included in the table, since it is assumed that any lab testing would be conducted by the NPS Biological Research Management Division at no cost to the park. Also,

the collection cost (physical collection of a sample from the carcass) is expected to be minimal, since the staff is trained in proper sample collection and handling, and the time needed for this overlaps with labor costs to dispose of the carcass. Therefore, it is assumed that the cost of CWD testing would be covered in existing labor costs and not itemized in table 4.

**ALTERNATIVE B:  
COMBINED NON-LETHAL ACTIONS — LARGE ENCLOSURES AND  
REPRODUCTIVE CONTROL OF DOES**

A combination of non-lethal actions would be implemented under alternative B, in addition to the actions described under alternative A, to protect forest seedlings, promote forest regeneration, and gradually reduce deer numbers in the park. The additional actions would include constructing large-scale fenced enclosures, and controlling doe reproduction through surgical sterilization and use of an approved reproductive control agent.

During the development of the alternatives, it was determined that implementation of any of the non-lethal actions alone would be insufficient to address forest regeneration and would not meet plan objectives. For example, the use of fencing alone would not reduce deer density. The use of reproductive control alone would take longer to have an effect and would not provide immediate protection for tree seedlings or sensitive vegetation. Therefore, alternative B includes a combination of non-lethal actions.

**ADDITIONAL ACTIONS PROPOSED UNDER ALTERNATIVE B**

**LARGE ENCLOSURES**

In addition to the small area protective caging that would be installed in select areas under all alternatives, alternative B would include large enclosures to further allow reforestation. A large deer enclosure is defined as a fenced area of more than 5 acres constructed for the purpose of excluding deer from entering. It has been suggested that the minimum area that would need to be fenced at one time to meet the park’s forest regeneration goal would be from 5% to 10% of the forested area (Bowersox, pers. comm. 2005). Based on this, park staff would construct up to 14 large enclosures of various configurations to fit the landscape, each covering from about 7 to 25 acres or up to a total of approximately 167 acres. This represents approximately 5% of the entire park and approximately 10% of the main park reservation, which is largely forested. The enclosures would be initially located throughout the main park unit (Reservation 339), with their locations based on several criteria: they are relatively easy to access, yet away from high use visitor areas or scenic views; they fit into the park’s topography and current trails systems; and they avoid steep slopes and existing long-term vegetation monitoring plots. Areas containing valuable habitats (i.e., areas that are diverse, sensitive, free of invasive plants, and/or relatively pristine) would be targeted for protection. Potential deer enclosure locations are shown in figure 4 and are listed in table 5.



*Enclosure — A large area enclosed by fencing to keep out deer and allow vegetation to regenerate.*

**TABLE 5. PROPOSED DEER EXCLOSURES**

<b>Name</b>	<b>Approximate Perimeter in Feet (Meters)</b>	<b>Approximate Acres</b>
Northern Floodplain	3,329 (1,015 )	10
Weir Pond	4,050 (1,235)	20
Pinehurst West	4,497 (1,371)	17
Holly Trail	2,440 (744)	8
Rolling Meadows	2,306 (703)	7
Ross Drive	4,592 (1,400)	25
West Spring	2,706 (825)	11
Grant Road	2,900 (884)	9
H3	2,217 (676)	7
Pinehurst Central	3,680 (1,122)	16
Floodplain 2	2,578 (786)	7
Wise Road South	3,293 (1,004)	10
Wise Road North	3,004 (916)	7
Military Road	3,949 (1,204)	13
<b>TOTAL</b>	<b>45,541 (13,885)</b>	<b>167</b>

Although these locations appear to meet the siting criteria for the most part, these locations may be adjusted based on final field verification of current conditions when the plan is implemented.

The deer exclosures would be a minimum of 8 feet high and would consist of woven wire with 3- to 4-inch openings to allow some small animals to move freely through the fence. Metal posts would be placed approximately every 20 feet along each side of the exclosure, with pressure-treated 4-inch by 4-inch wooden posts set in concrete as corner supports. Electric fencing would not be used in the park based on concerns for visitor safety, difficulty in accessing a power source, and long-term maintenance requirements.

Deer would be driven out of the exclosures by park staff before completion. Visitors would not be able to use the areas included in the exclosures during or after construction for approximately 10 years. Park staff would maintain all exclosures. A visual inspection would be performed once a month and after storm events. Maintenance on the exclosures would be performed on an as needed basis but a minimum of four times a year. If deer are found within an exclosure, they would be removed, as would any other animals that appeared to be trapped within the exclosure and repairs made as needed.



# Proposed Deer Enclosures

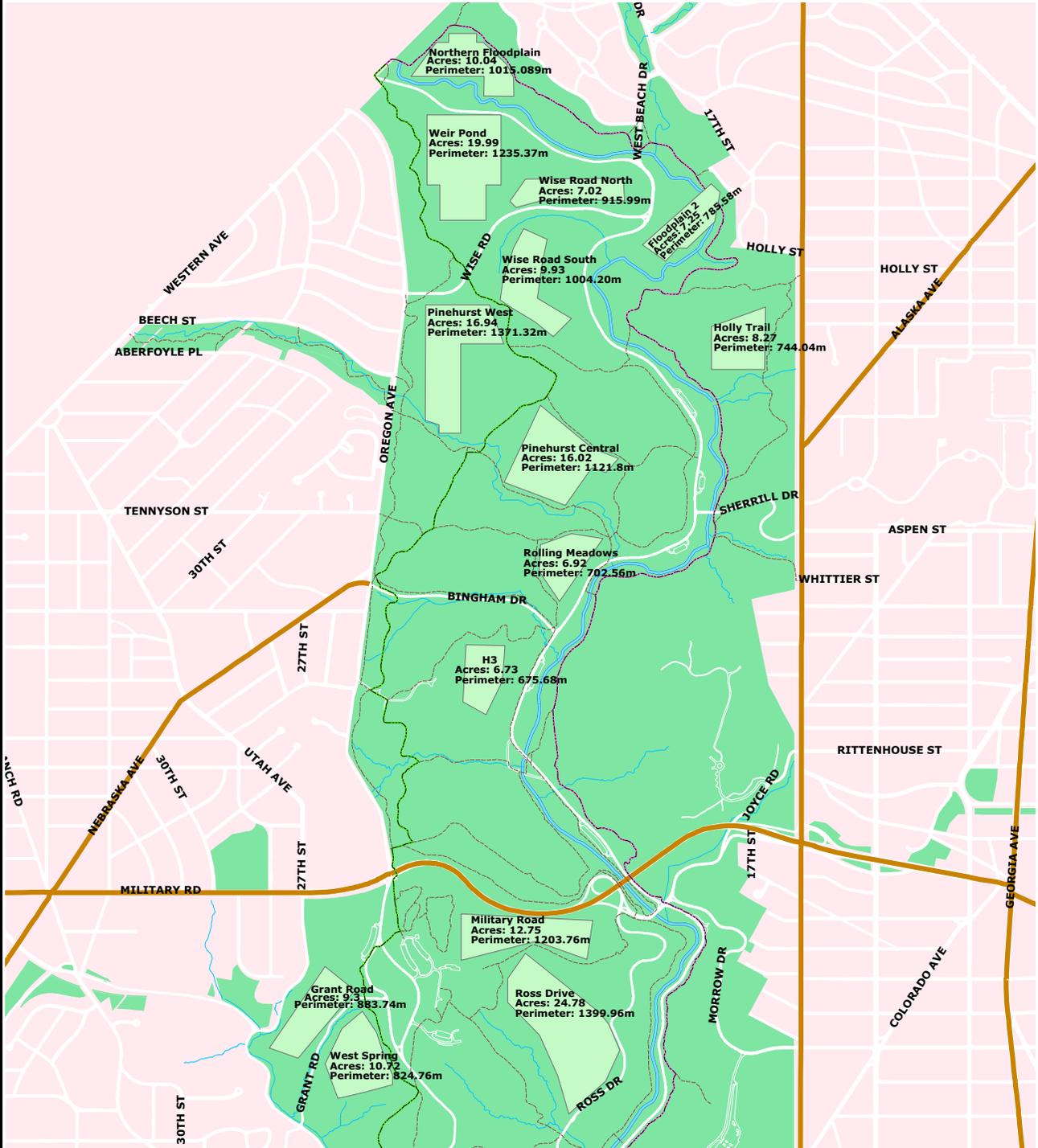


Figure 4. Proposed Deer Enclosures



It is estimated that up to 10 years would be required for seedling growth in the exclosures to exceed the typical deer browsing height (approximately 60 inches or 150 centimeters) (Horsley et al. 2003). After seedlings exceeded this height, the exclosures would be moved to immediately adjacent areas in order to reuse one side of the previous exclosure, thus minimizing relocation and labor costs. This would happen once during the life of this plan.

It is assumed that most of the recovered woody vegetation in the exclosures would persist after 10 years in most of the exclosures. Therefore, for purposes of the plan and the impact analysis presented in “Chapter 4: Environmental Consequences,” it is assumed that the exclosures in alternative B would achieve woody forest regeneration in about 5% to 10% of the entire park over the 15-year life of the plan (the 5% originally fenced for the first 10 years that has grown beyond the reach of deer, plus the additional 5% fenced in the second round of fencing in years 11 through 20). However, the herbaceous layer in the original exclosures would be exposed to deer browsing pressure after the exclosure was removed; therefore, the herbaceous regeneration would be met within a maximum of about 5% of the entire park at any one time.

### **REPRODUCTIVE CONTROL OF DOES**

This alternative would use both sterilization of does and use of an acceptable reproductive control agent (when feasible) in a phased approach to control population growth and eventually reduce the size of the population through natural mortality.

#### **Sterilization**

Sterilization of does would be the initial action taken. Even though both sexes can be treated, surgical sterilization is more effective on females in polygamous populations like white-tailed deer. In addition, males are generally more difficult to capture because they are more wary and less gregarious than does. Sterilization of does is an invasive procedure requiring the surgical removal of ovaries or a tubal ligation. Procedures require full anesthesia and must be conducted by a veterinarian. It is possible to conduct the surgery in the field. However, complications could result due to the potential for higher incidence of infection than in a controlled environment. If field surgery is required, a temporary or mobile field station could be set up to minimize potential for infection and reduce impacts to visitors (Mathews et al. 2005). Because surgical sterilization is permanent, the animal is handled only once.

Few documented studies were found regarding the use of surgical sterilization of white-tailed deer as a population control measure. The Milwaukee County Zoo sterilized 16 deer on zoo grounds (which are fenced) between 1990 and 1995 with positive results. This provided the basis for a study in Highland Park, Illinois, between 2002 and 2005, in which 66 deer were sterilized over the 3-year period (Mathews et al. 2005). The treatment area was approximately 8.5 square miles, unfenced, and consisted of a mix of large residential lots, parks, forest preserves, and golf courses. The deer density was estimated at six to eight deer per square mile prior to the study, with a goal of five deer per square mile. The Illinois Department of Natural Resources believes that this program was not effective and that the high number of road-killed deer was the main factor in keeping deer densities low. Therefore, the program has been suspended (S. Bates, pers. comm. with Marty Jones, Deer Program Manager, Illinois Department of Natural Resources, May 8, 2008, reported in S. Bates pers.comm. 2008d).

Even though the deer density and density goals in the Highland Park study are different from those identified for Rock Creek Park, the methods for implementation could be applied. Therefore, implementation of this method follows the parameters used in the study; however, actual implementation may be modified as more information is learned about this method of population control.

There are a number of concerns regarding implementing this control method, primarily due to the lack of experience in using it as a population control in free-ranging deer and the limited data available on the structure of the population (age statistics) within the park. Surgical sterilization results in permanent

sterilization of the treated deer; therefore, it would require active monitoring of the population to identify the proper number of deer to be treated annually to ensure a long-term population in the park.

A number of factors may influence the efficacy and reduction period of this method, including the amount of immigration/emigration of deer to/from the park, availability of veterinarian and surgical facilities (at zoo or mobile field unit), and mortality and recruitment rates. Based on the ligation procedures used in Illinois (Mathews et al. 2005), the procedure can be done while the doe is pregnant without affecting the fetus(es). Thus, the population would continue to increase in the initial years of implementation, until the recruitment rate drops below the mortality rate.

There is concern that sterilization could affect breeding and social behavior (extended rut) due to loss of production of reproductive hormones. Specific effects are not well documented, but deer would be expected to react in a similar way to deer that have been treated with reproductive control agents (see the “Reproductive Controls” section and appendix C). Monitoring of deer behavior would be part of adaptive management under this alternative. Also, some handling-related mortality could occur under this method due to tranquilizer use and stress on the doe.

### **Administration of Sterilization**

**Timing of Application**—Surgical sterilization could be administered at anytime during the year; however, it would primarily be conducted between October and April when capturing deer is expected to be easiest and temperatures provide the least amount of stress on the animals. It was assumed that implementation would start in year 1 of the plan, provided that the use of reproductive control agents is not feasible at that time (see criteria under “Reproductive Controls,” below).

**Number of Does Treated**—To effectively reduce population size, treatment with a reproductive control measure must decrease the reproductive rate to less than the mortality rate. In urban deer populations, mortality rates are approximately 10%. Based on research of reproductive controls in a free-ranging deer population, it would be necessary to treat at least 90% of the does annually in order to halt population growth (Hobbs et al. 2000; Rudolph et al. 2000). After several years of application at this rate of treatment, a small (e.g., 5%) reduction in the population could be expected (Hobbs et al. 2000).

Rock Creek’s 2007 parkwide deer population is estimated at 385 deer (82 deer per square mile by 4.69 square miles of parkland). The park has estimated through sampling data that does comprise 65% of the population (or 250 does) (K. Ferebee, pers. comm., 2008g). Therefore, to control population growth, a minimum of 225 does (90% of 250) would need to be treated. However, because of the number of deer in the park and the time it would take to capture and sterilize that many deer, sterilization would need to be phased in over a number of years. It is estimated that about two does may be treated in a day, depending on veterinarian and staff availability and capture success. Based on this estimate, the park would be able to sterilize up to 45 does per year, resulting in it taking a minimum of five years to reach the treatment goal of 90%. It was assumed for the purposes of this plan that up to 10 does per year thereafter would require reproductive control in order to control population growth from the untreated does.

**Application Procedures**—Treated does would need to be marked for identification to avoid future capture of the same does. This can be accomplished using ear tags. With the ear tag technique, each doe must be captured and handled at least once initially, which would be done at the time of sterilization.

Given the number of does that would need to be treated initially, bait piles would be used to concentrate does in certain locations so that the trapping or darting could be done as efficiently as possible. As many does as possible would be treated annually until 90% of the does had been sterilized. If more does were captured at once than could be treated, temporary holding areas may be necessary to house deer prior to treatment. Holding areas would be in compliance with AVMA standards and the holding period would not be more than a day.

Visitor access would be restricted in certain areas of the park during the treatment period. The areas targeted for treatment would be chosen based on maximizing deer availability and accessibility, while minimizing disruption to visitor experience. The sterilization of does would be conducted throughout the day depending on vet availability and trapping success and would primarily occur between October and April.

### Reproductive Control

Use of acceptable reproductive control agents with does would be phased in under alternative B when feasible, which is defined for this plan as when the following criteria are met:

- there is a federally approved fertility control agent for application to free-ranging populations;
- the agent provides multiple year (more than three years) efficacy;
- the agent can be administered through remote injection;
- the agent would leave no residual in the meat (meat would be safe for human consumption); and
- overall there is substantial proof of success in a free-ranging population, based on science team review.

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*Immunocontraceptive  
— A reproductive  
control agent that  
causes an animal to  
produce antibodies  
against some protein  
or peptide involved in  
reproduction. The  
antibodies hinder or  
prevent some aspect of  
the reproductive  
process.*

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Such an agent is not currently available; however, several reproductive control agents are currently being developed and tested for use in deer population control (Fraker et al. 2002). These include porcine zona pellucida (PZP) (Naugle et al. 2002; Turner et al. 1996; Kilpatrick et al. 1992); uniquely formulated PZP, such as SpayVac®; Gonadotropin Releasing Hormone (GnRH) (Miller et al. 2000, 2001; Curtis et al. 2002; Fraker et al. 2002); prostaglandin F<sub>2α</sub> (DeNicola et al. 1997); and leuprolide (Baker et al. 2002, 2004). Each of these agents is described in detail in appendix C, which provides an overview of reproductive control technologies for deer management. Table 6 lists those that could be considered for use in this plan. However, until an agent that meets NPS criteria is available and feasible, sterilization would continue to be used for population control in subsequent years. But, for purposes of the analysis and cost estimate for this plan, it is assumed that leuprolide, a currently available agent with single-year application, would be used.

While neither the U.S. Food and Drug Administration (FDA) nor the EPA has approved a product specifically for the purpose of controlling reproduction in white-tailed deer as of the date of this document, several FDA-approved products are available for therapeutic (medical) use in either domestic animals (prostaglandin F<sub>2α</sub>) or humans (leuprolide). These products can be used with a veterinary prescription under the *Animal Drug Use and Clarification Act of 1994*. The prescribing veterinarian and the client (the national park unit) must clearly understand how and why the drug would be used in an off-label manner. It is the responsibility of the prescribing veterinarian to give an appropriate meat withdrawal period for food-producing animals that may enter the human food chain. The veterinarian may determine there is no meat withdrawal period for a particular drug. If this is the case, the animal does not need to be marked. If there is a meat withdrawal period, then the animal needs to be appropriately marked.

**TABLE 6. REPRODUCTIVE CONTROL AGENTS**

Issue	Standard or Native PZP Vaccine	SpayVac® (PZP vaccine) <sup>a</sup>	GnRH Vaccine (e.g., GonaCon®)	Leuprolide (GnRH agonist)
Mode of Action	Blocks sperm penetration and fertilization; estrous cycles continue	Blocks sperm penetration and fertilization; estrous cycles continue	Prevents secondary hormone (LH and FSH) secretion, which stops folliculogenesis and ovulation	Prevents secondary hormone (LH and FSH) secretion, which stops folliculogenesis and ovulation
How Administered	Injection	Injection	Injection	Injection
Number of Doses	Twice initially and an annual booster	Initially a single injection; if and when antibodies decline, female would need to be retreated	Likely a single injection initially; if and when antibodies decline, retreatment would be required	Current formulation — annually
Timing	Treat prior to breeding season and allow sufficient time for antibody development	Treat prior to breeding season and allow sufficient time for antibody development	Treat prior to breeding season and allow sufficient time for antibody development	Treat immediately prior to breeding season on an annual basis

Notes:

FSH = follicle stimulating hormone  
LH= luteinizing hormone

Other reproductive control agents are currently available only for research use and are available under an Investigational New Animal Drug exemption by the FDA. The important aspect of a research setting is that new information regarding the safety and efficacy of the experimental drug is carefully and systematically gathered by a researcher. The use of reproductive control agents for population management would likely require approval from the Environmental Protection Agency and individual state resource agencies would have final project approval.

Under alternative B, if the criteria for use of a reproductive control agent were met, the park would initiate a reproductive control program using an approved agent. For purposes of this discussion, it is assumed that leuprolide or a similar agent would be used (see appendix C for more details on reproductive control agents). The park would also monitor the status of ongoing reproductive control research. If advances in technology could benefit deer management in the park, then the future choice of a reproductive control agent could change, and the final choice would be determined by availability, cost, efficacy, duration, and safety at the time the action was implemented.

**Administration of the Reproductive Control Agent**

**Timing of Application**—Leuprolide (or a similar agent) would need to be administered in the two months prior to the deer rut (the breeding season). At Rock Creek Park, the application of leuprolide would occur primarily in September and October.

**Number of Does Treated**—As previously discussed, to effectively reduce population size, treatment with a reproductive control agent must decrease the reproductive rate to less than the mortality rate, which is approximately 10% in urban deer populations. Under this alternative, it is assumed that it would be necessary to treat at least 90% of the unsterilized does annually in order to halt population growth (Hobbs et al. 2000; Rudolph et al. 2000). After several years of application at this rate of treatment, a small (e.g., 5%) reduction in the population could be expected (Hobbs et al. 2000).

At Rock Creek, assuming 45 does are treated each year, surgical sterilization would be used in years 1 to 5 to treat approximately 90% of the does in the park (about 225 does, based on 2007 data). It was also assumed for purposes of this plan that 10 to 12 does would need to be treated annually starting in year 6, using a reproductive control agent if one is available and feasible, but sterilization would be used as a back-up method if no drugs met the required use criteria. The annual number treated would be managed adaptively to manage population growth and slowly reduce the population size through mortality.

**Application Procedures**—Depending on the reproductive control agent to be used, treated does would need to be marked for non-consumption. This could be accomplished using ear tags with a unique identifier and a statement “Not for Human Consumption.” The ear tag would also facilitate identification of which does have been treated. With the ear tag technique, each doe must be captured and handled at least once initially and may require additional annual treatment. Tracking and capturing previously treated does would require time to locate the doe or to lure it to a trap site so that it could be temporarily restrained and treated. After does have been handled one or more times, successfully capturing them for subsequent treatments can become very difficult (Rudolph et al. 2000). Given that the number of deer to be treated would be small, locating the deer to be treated may be the most time consuming part of implementing this method under this alternative. Radio collars may be considered if tracking becomes prohibitive.

One method that has been developed to deliver treatments without the physical capture or handling of does is a remote application (biobullet) delivered with a dart-type gun (similar to a shotgun). With this method the biobullets remain with the doe and it is not necessary to recover spent darts. Factors for consideration with this method include the maximum distance to the doe that allows the needed penetration for delivery, consistency in dosage delivery, and accurate documentation of which deer have been treated. This method would still require some marking technique to prevent multiple dosing of the same animal.

Telemetry darting would be the primary capture method used because leuprolide has not yet been successfully delivered from a biobullet. With this method a tranquilizer dart is fitted with a radio transmitter, which allows the animal to be located after the tranquilizer has taken effect. The dart is then recovered, the doe marked, the control agent administered, and the doe released. Some handling-related mortality could occur under this method due to tranquilizer use and stress on the doe (DeNicola and Swihart 1997; Kilpatrick et al. 1997); no more than 5% mortality would be accepted by the park. The application of annual treatments by remote delivery can be time consuming and expensive, and human and animal safety precautions must be addressed. An alternative capture method would include the use of traps or nets.

Bait piles could be used to concentrate does in certain locations so that the darting could be done as efficiently as possible. As many does as possible would be treated daily until 90% of the unsterilized does had been treated. Visitor access would be restricted in certain areas of the park during the treatment period. The areas targeted for treatment would be chosen based on maximizing deer presence and accessibility, while minimizing disruption to visitor experience. The treatment of does would be conducted during the off-peak visitor hours (early morning and evening) and weekdays to the extent possible, but would need to occur in the period immediately preceding the deer rut (September and October).

**Training**—Regardless of the technique implemented, NPS employees or their authorized agents trained in the administration of reproductive controls would perform these activities. Training would include safety measures, particularly related to use of the dart gun, to protect both visitors and NPS employees. If more than one shooting location was used to remotely administer controls with dart guns, these areas would be adequately separated for safety reasons. NPS employees or their authorized agents would also be qualified to handle live does in order to prevent disease transmission or any harm to the animal or the employee.

## MONITORING

### LARGE ENCLOSURES

As deer were excluded from feeding within the large enclosures, open (non-treated) areas would be monitored for changes in vegetation because of probable increased browsing pressure. Forest regeneration would be monitored both inside and outside the enclosures as described under alternative A and appendix A. Additional monitoring of the 14 enclosures (some may have multiple monitoring plots) would also be conducted on a four-year rotation, with up to six large enclosures (and adjacent paired unfenced plots) monitored each year.



*Vegetation sampling within an unfenced plot, which is a specific area that allows effects on deer browsing to be seen when compared to the adjacent fenced plot.*

### REPRODUCTIVE CONTROL

The ability to achieve target levels of infertility in the deer population would require knowledge of the fertility status of individual deer that had been treated (Hobbs et al. 2000). To monitor treated animals, surveys would be conducted in the summer, at which time observations would indicate if reproduction had occurred (referred to as a fawn survey). Additional observations would be made during the annual Distance Sampling surveys conducted in the fall.

### CHRONIC WASTING DISEASE

Testing for CWD would occur as described under alternative A, i.e. the park would continue to perform opportunistic and targeted surveillance under the existing categorical exclusion provisions.

### IMPLEMENTATION COSTS

Costs of implementing alternative B would include the same costs described under alternative A (continued monitoring programs, limited small area protective caging, and repellent use), plus costs of constructing and maintaining large enclosures, and reproductive control and monitoring. The overall cost of implementing alternative B would depend on the number of deer treated, methods used, number of personnel, and monitoring costs. These costs are not yet explicitly defined, but estimates based on certain assumptions are provided in table 7.

TABLE 7. COST ESTIMATE — ALTERNATIVE B: NON-LETHAL ACTIONS

Action	Assumptions	Annual Cost	Cost for the 15-year Planning Period
Same actions as alternative A (common to all alternatives)	See alternative A		\$327,000
<b>Large Enclosures</b>			
Construction	14 enclosures (total of 45,540 linear feet of fence at \$5 per linear foot)	\$227,700 (first year only)	\$227,700
Relocation	Every 10 years at 75% of original cost	\$170,775 (once every 10 years)	\$170,775
Maintenance	Four visits per year per enclosure plot (48 staff days; \$17,535); also storm damage materials and labor cost (varies by year; estimated average \$10,317)  Monthly inspection of all enclosures - \$3,517	\$31,369	\$470,535
Vegetation Monitoring	Additional vegetation monitoring in six large enclosures per year (three staff, three hours each per enclosure) plus analysis	\$5,500	\$82,500
<b>Surgical Sterilization</b>	45 deer per year treated in years 1 through 5 at \$1,000 per deer	\$45,000 in years 1 through 5	\$225,000
<b>Reproductive Control<sup>a</sup></b>	Cost would depend on number of deer treated and current available technology  Assume up to 10 does treated each year, beginning at year 6	\$1,000 per deer × 10 does = \$10,000 for 10 years	\$100,000
Additional Deer Population Monitoring	Three days of survey plus data analysis each summer (fawn survey)  May include global positioning system tracking of does if radio collars are used on sterilized deer	\$5,000	\$75,000
<b>Total</b>			<b>\$1,678,510</b>

a. Total cost could be reduced considerably if reproductive control costs could be decreased based on improved technology.

## LARGE ENCLOSURES

Large enclosures would be a minimum of 8 feet tall, using woven wire fence, metal fence posts, and wooden 4- by 4-inch posts set in concrete on the corners. Material and installation costs are estimated at \$5 per linear foot of fence (K. Ferebee, pers. comm. 2008g). The park has estimated approximately 45,540 linear feet of fence needed to construct the 14 large enclosures and that it would take up to 150 working days to construct all enclosures.

## *Alternatives*

Exclosures would be relocated approximately every 10 years. Costs for this are estimated at 75% of the original cost to relocate 14 exclosures.

Maintenance costs could be substantial due to the remoteness of some exclosures and potential vandalism. Labor to inspect and maintain fences is estimated at approximately 12 days with 2 staff, assuming up to four visits per year. Using an average hourly rate for the two staff and 12 days to cover all of the exclosures per visit, the annual maintenance cost would be \$17,535 for labor. An additional \$10,317 per year would be needed for maintenance materials and additional visits due to storm damage. Monthly inspections would add another \$3,517 annually. The additional annual vegetation monitoring cost for six exclosures per year would be approximately \$5,500 (based on annual monitoring and analysis costs used in alternative A).

### **SURGICAL STERILIZATION**

The costs identified by Mathews et al. (2005) were \$1,000 per deer, with about \$600 for the veterinarian, \$150 in drugs, and \$250 in labor for capture and monitoring prior to and after release. The labor costs for capturing deer may be the most variable, since they are dependent on the deer and park conditions and the need for construction of temporary holding facilities. The amount of time for post-surgery monitoring may also vary depending on the surgical method used and the length of time and frequency of monitoring for surgery-related mortality. For this analysis, an estimate of \$5,000 was used to cover a summer fawn survey and potential for global positioning system monitoring of sterilized does.

### **REPRODUCTIVE CONTROL**

A study in New York (one of the few conducted on a suburban, free-ranging deer population) estimated that the minimum annual time commitment per deer for reproductive control (using PZP) was approximately 20 hours, costing in the range of \$450 to \$1,000 per deer (Rudolph et al. 2000). Vaccine trials in Connecticut cost \$1,128 per deer for 30 deer over two years, with 64% of the cost going to labor (Walter et al. 2002). Cost to administer PZP at Fire Island was \$186 per deer for labor and material in 2007. The number of treated deer has dropped from 246 in 1998 to 149 in 2005 but no total population number was given (Naugle and Rutberg 2007). The Northeast Deer Technical Committee (2008) reports a cost of \$1,000 per deer for immunocontraception.

Costs per deer would include costs for the reproductive control agent, labor and equipment, and bait piles. The estimated cost is \$200 per dose of leuprolide. Additional handling and processing costs associated with delivering the treatment would also apply. In the urban setting at Rock Creek, the expected costs for implementing reproductive controls would likely be at the high end of the range, and for this analysis \$1,000 per deer was used. However, these costs could vary based on improved technology and market demand once federal approval is obtained.

The additional monitoring required for reproductive controls would be as described under sterilization, with a summer fawn survey to document the number of fawns.

### **ALTERNATIVE C: COMBINED LETHAL ACTIONS — SHARPSHOOTING AND CAPTURE AND EUTHANASIA**

Alternative C would continue the actions described under alternative A, with two types of lethal action used to reduce and control deer herd numbers. NPS or their authorized agents would conduct sharpshooting and capture and euthanasia to reduce the deer population.

## ADDITIONAL PROPOSED ACTIONS UNDER ALTERNATIVE C

### SHARPSHOOTING

Sharpshooting would be used to initially reduce the deer population in areas of the park and as a maintenance treatment if needed. Sharpshooting would involve using trained sharpshooters to shoot deer in designated areas, generally using firearms. However, the use of archery may be considered on a case-by-case basis in certain areas where use of firearms is not appropriate, such as near residences. Methods, removal numbers, and gender preferences are described in more detail below.

This action would continue for a minimum of three years, at which time it is estimated that the population would be reduced to the initial density goal of 15 to 20 deer per square mile.

#### Methods

Qualified federal employees or contractors would be used to implement this alternative. All employees or contractors used would be experienced with sharpshooting methods and would have the necessary sharpshooting qualifications. They typically would be expected to coordinate all details related to sharpshooting actions, such as setting up bait stations, locating deer, sharpshooting, and disposition of the deer (donation of meat and/or disposal of waste or carcasses).

In most locations, high-power, small caliber rifles would be used from close range. Every effort would be made to make the shootings as humane as possible. Deer injured during the operation would be put down as quickly as possible to minimize suffering. Noise suppression devices and night vision equipment would be used to reduce disturbance to the public. Activities would be in compliance with all federal firearm laws administered by the Bureau of Alcohol, Tobacco, and Firearms (ATF).

In certain locations, sharpshooting may be done using archery (bow and arrow). Possible locations would include areas of the park that are too narrow or close to occupied buildings or residences. Shooting with bow and arrow would be done from close range by federal employees or contractors specifically experienced with this type of deer removal.

Sharpshooting with firearms would primarily occur at night (between dusk and dawn), primarily during late fall and winter months when deer are more visible and fewer visitors are in the park. In some restricted areas, sharpshooting may be done during the day if needed, which could maximize effectiveness and minimize overall time of restrictions. If this is done, the areas would be closed to park visitors. The public would be notified of any park closures in advance, exhibits regarding deer management would be displayed at visitor centers, and information would be posted on the park's website to inform the public of deer management actions. Visitor access could be limited as necessary while reductions were taking place, and NPS personnel and U.S. Park Police (USPP) would patrol public areas to ensure compliance with park closures and public safety measures.

Qualified federal employees or contractors trained in all aspects of sharpshooting actions would perform all sharpshooting activities. Training would include safety measures to protect both visitors and NPS employees. If more than one shooting location was used, areas would be adequately separated to ensure safety.

Bait stations could be used to attract deer to safe removal locations, concentrate deer, improve removal success, and allow the maximum use of ground as a backstop (i.e., shooting would be directed downward

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*Qualified, trained federal employees or contractors would be used to implement this alternative. Every effort would be made to make the shootings as humane as possible.*

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toward the ground). Bait stations would consist of small grains, apples, hay, or other food placed on the ground. The stations would be placed in park-approved locations away from public use areas to maximize the efficiency and safety of the reduction program. The amount of bait placed in any one location would vary depending on the bait used and the number of deer in the immediate area.

The park intends to donate all deer meat to local charitable organizations to the maximum extent possible.

#### **CAPTURE AND EUTHANASIA**

Capture and euthanasia would be used in limited circumstances where sharpshooting may not be appropriate. The preferred technique for this method would be for NPS employees or their authorized agents to trap deer, approach them on foot, and euthanize them. Activities would occur at dawn or dusk and in the fall or winter months when fewer visitors are in the park, but may occur at any time of day depending on deer activities.

Deer would be captured with nets, traps, or chemical immobilization by dart gun and euthanized as humanely as possible. Euthanasia methods could include a combination of penetrating captive bolt gun and potassium chloride, exsanguination, or other drugs considered to be humane. Several methods of wildlife trapping could be used, including but not limited to drop nets and box traps. Most trapping methods involve using bait to attract deer to a specific area or trap. Box traps involve a confined space that would safely hold deer, while net traps are triggered to drop over deer and restrain them for staff to approach (Lopez et al. 1998). The method of capture would be selected based on the specific circumstances (location, number of deer, accessibility).

Deer could also be immobilized by darting with a tranquilizer dart gun (Schwartz et al. 1997). This method could be used in cases where deer had not been successfully attracted to a trap area or when trapping is not practical. Similarly, if for some reason the penetrating captive bolt gun technique could not be used to euthanize a trapped animal, injecting a lethal dose of a drug (under supervision of a veterinarian or NPS park practitioner) could be used. However, when chemicals are used for either immobilization or for euthanasia, the meat from that animal may not be able to be donated as food and the carcass may be unsuitable for surface disposal. If this is the case, the carcasses would be buried or disposed of as described under the following disposal section.

Several actions would be taken to ensure safety of the operation. NPS employees or their authorized agents trained in the use of penetrating captive bolt guns or tranquilizer guns would perform these actions. Training would include safety measures to protect both visitors and NPS employees. NPS employees or authorized agents would also be qualified to handle live deer in order to prevent disease transmission and prevent any harm to an animal or an employee/agent. Appropriate safety measures would be followed when setting drop nets or box traps. Visitor access could be limited as necessary while capture and euthanasia activities were taking place, and USPP officers, supplemented by NPS park rangers, would patrol public areas to ensure compliance with park closures and public safety measures.

All actions would be conducted in accordance with American Veterinary Medical Association (AVMA) recommendations for the humane treatment of animals to the greatest extent possible (AVMA 2001).

The number of deer removed by capture and euthanasia would be recorded, including the age and sex, location of removal, circumstance requiring removal and capture, and lethal method used.

#### **Numbers of Deer Removed (combination of sharpshooting and capture and euthanasia)**

Based on the 2007 survey, Rock Creek's deer population is estimated at 385, or 82 deer per square mile for the 4.69 square miles of the entire park management unit. Park staff would determine the number of deer to be removed from the park based on the most recent survey and a population goal of 15 to 20 deer per square mile. At least three years would be required to reach this goal, given the limited accessibility to

some areas of the park and changes in population movements as the population decreased. Based on 2007 data, the following assumptions were used for analysis:

- *Year 1* — With concentrated efforts, about one-half of the deer could be removed the first year (193 deer: 183 from sharpshooting and 10 from capture and euthanasia), assuming periodic removal efforts over a five-month period (November to March). This would reduce the population to 192 deer or 41 deer per square mile.
- *Year 2* — Assuming a 20% growth rate in the deer herd (a general rate commonly used by deer managers considering reproduction, mortality, and recruitment), the deer population would be an estimated 230 deer by the second year. If half of this population was removed (115 deer: 105 from sharpshooting and 10 from capture and euthanasia), 115 deer would remain in the park, or about 25 deer per square mile.
- *Year 3* — Again assuming a 20% growth rate in the deer herd, the deer population would be an estimated 138 deer by the third year. If half of this population was removed (69 deer: 59 from sharpshooting and 10 from capture and euthanasia), 69 deer would remain in the park, or about 15 deer per square mile.
- *Subsequent Years* — Assuming the same 20% growth rate in the deer herd, about 14 deer would need to be removed annually in subsequent years to maintain the population at about 69 deer or 15 deer per square mile. This number may vary annually depending on success of previous removal efforts, deer adaptations to removal efforts, regeneration response, and other factors.

Several factors could influence the number of years to reach the initial deer density goal. A key factor would be the response of vegetation to reduced deer browsing pressure. Additionally, as the deer population decreased through successful reduction efforts, deer might become adapted to the capture operations and become more evasive, increasing the effort necessary to reach the removal numbers in any year. Existing reproduction and mortality rates might differ from the estimate used in this projection. If reproduction rates were higher and mortality lower than estimated, the population growth would be greater than 20%, and more deer would need to be removed, potentially increasing the time to reach the initial density goal. The converse would be true if reproduction rates were lower and mortality rates higher than estimated, resulting in fewer deer having to be removed, and efforts could take less time. Immigration of deer into the park could also have a substantial effect on the number of deer to be removed, especially if the goal was toward a low population density (Porter et al. 2004).

The number of females in the population would also influence reproduction rates. Does would be preferentially removed during the first few years (see following discussion), which would shift the herd composition to a 50:50 or less sex ratio. Reproduction should decrease as the number of females in the population decreases.

### **Gender Preference**

During the first two to three years of removal, both does and antlered deer (bucks) would be removed based on opportunity, although there would be a preference for removing does because this would reduce the population level more efficiently over the long term. Buck-only removal would not control population growth, as deer populations are largely dependent on the number of does with potential for reproduction. Harvest of does is necessary to stabilize or reduce populations, and for a rapid decrease in deer population, at least 15 does should be taken for every 10 bucks during the first three years of treatment (West Virginia University 1985).

Records would be kept on the age and gender of all deer removed from the park to aid in defining the local population composition. This information would be compared with composition data collected during park population surveys.

## **Disposal**

The park intends to donate as much deer meat to local charitable organizations as possible. If this is done, field dressing would occur in the park, and the entrails would be placed in barrels for disposal at a facility that accepts such waste from deer removal operations, or possibly buried if there is an appropriate location. The meat processor would work with charitable organizations to distribute the meat.

In cases where a few deer have been euthanized (without chemical use) at a given site, the waste or carcasses may be moved away from roads and trails and left on the surface to be naturally scavenged and/or decompose. Carcasses may also be taken to a location where they would be left in an isolated area away from the public to decompose and/or be scavenged. The selected disposal option would be dependent on the whether chemicals were used, suitability of meat for donation, amount of waste or carcasses, and distance from trails, roads, and nearby facilities and residences.

In cases where the meat from deer is unsuitable for donation to charity or surface disposal, the carcasses and waste would be buried on site or collected for disposal in an approved landfill. There are no landfills in the District, and the District's transfer station (garbage collection / sorting facility) does not accept dead animals; however, nearby Maryland landfills may accept dead animals as long as they are not diseased. The park would investigate the cost of sending carcasses to landfills in both Maryland and Virginia as the need arises.

If on-site burial is selected, any burial locations would be in previously disturbed sites in or near developed areas of the park. These sites would be generally devoid of vegetation except for weeds and outside any floodplain boundaries or wetlands. In addition, these sites would not be located within an area identified as an archeological site or as having archeological resources. Disposal pits would be approximately 8 feet wide by 8 feet long by 5 feet deep. They would be dug prior to removal activities and covered and surrounded with fencing to prevent entry. Soil removed from the pits would remain on site and be covered to prevent erosion. Carcasses and waste would be transported to the pit(s) within 12 hours, and a layer of carcasses and waste would be put into the pit. That layer would be covered by hand with approximately 1 foot of the soil that was removed from the pit. Another layer of carcasses and waste would be put on top of the soil layer and covered with approximately 1 foot of soil. The final layer of carcasses and waste would be covered with approximately 3 feet of soil. The soil covering the filled pit would be covered with straw or wood chips to prevent erosion. The fence would be secured between uses to prevent entry.

If the pits are not completely filled between removal activities or if the soil is frozen, the pit would be covered with tarps or plywood, and fencing would be installed to prevent entry and reduce visibility. When conditions permit, the carcasses and waste would be covered with soil or the pit filled. When the weather and season are appropriate, the soil covering the pits would be seeded with an NPS approved seed mix and mulched. Any soil not used to refill the pits would be used in other locations within the park.

Should CWD be found in the deer herd, the park would follow current NPS Public Health Service guidelines or NPS Standard Operating Procedures for storage and disposal of deer infected with the disease. A standard operating procedure is now under development for the NPS National Capital Region.

## **MONITORING**

### **SHARPSHOOTING AND CAPTURE AND EUTHANASIA**

Throughout the removal efforts, vegetation monitoring would be conducted, as described under alternative A and in appendix A, to document changes in deer browsing and forest regeneration that might result from reduced deer numbers. Vegetation monitoring would be conducted annually to document vegetation recovery. If the objectives were being met and changes in regeneration were observed as anticipated at the target deer density goal, removal efforts would be maintained at the level necessary to

keep the deer population at the target density. Adjustment of the removal goal in either direction from the initial deer density goal could be made based on how close the conditions indicated by the vegetation monitoring were to the park’s forest regeneration objectives (see “Adaptive Management” section).

### CHRONIC WASTING DISEASE

CWD opportunistic and targeted surveillance would occur as described under alternative A. Sharpshooting and the use of captive bolt gun may result in animals being unable to be tested (due to location of impact); however, CWD testing would be performed whenever possible. All animals sampled would be stored per approved standard operating procedures until test results are obtained. All deer testing negative for CWD would be donated in accordance with NPS Public Health guidelines.

### IMPLEMENTATION COSTS

Costs of implementing alternative C would include the same costs described under alternative A (continued monitoring programs, limited small area protective caging), plus the cost of sharpshooting and capture/euthanasia. Costs to cover additional staffing using USPP that would likely be necessary for closing off all or portions of the park during sharpshooting have also been included. Estimated costs for alternative C are discussed below and summarized in table 8.

**TABLE 8. COST ESTIMATE — ALTERNATIVE C: COMBINED LETHAL ACTIONS**

Action	Assumptions	Annual Cost	Cost for the 15-year Planning Period
Same actions as described for alternative A (common to all alternatives)	See alternative A		\$327,000
Sharpshooting <sup>a</sup>	Years 1–3 at \$200 per deer (183 deer in year 1, 105 in year 2, and 59 in year 3)	Year 1 — \$36,600 Year 2 — \$21,000 Year 3 — \$11,800	\$399,100 <sup>a</sup>
	Years 4–15 at \$400 per deer (14 deer annually)	Years 4–15 — 14 deer × \$400/deer = \$5,600/year × 12 = \$67,200	
	USPP staffing for park closure and safety	Year 1 — \$75,000 Year 2 — \$37,500 Year 3 — \$22,500 Years 4–15 — 12 × \$7,500 = \$90,000 Subtotal - \$225,000	
	Park staff support for park closures	Years 1–15 — 15 × \$2,500/year = \$37,500	
Capture and Euthanasia <sup>b</sup>	For estimate, assume up to 10 deer removed per year in years 1–3 and assume a maximum of five deer in years 4–15 at \$500 per deer <sup>b</sup>	Year 1 — \$5,000 Year 2 — \$5,000 Year 3 — \$5,000 Years 4–15 — \$2,500/year = (12 × \$30,000) + 15,000	\$45,000
<b>Total</b>			<b>\$771,100</b>

a. This cost could increase if deer density goal is not reached by the fourth year.

b. Costs for this method would vary from \$100 to \$1,000 per deer, but is expected to be in the middle (\$500) of this range.

## **SHARPSHOOTING**

Factors affecting the final cost of implementing this alternative include deer density, number of deer to be removed, ease of access to deer, number and location of bait stations, equipment availability, amount of data to be collected from deer, and processing requirements. The greatest costs would generally be incurred when the deer and bait stations were difficult to access, when deer were wary of humans, the removal area was large, and when deer densities were lower (requiring more time to find each deer). Conversely, lower costs could be expected when the removal area was smaller, deer density was high (less time to find each deer), and deer were accustomed to human activities.

Costs and efficiencies of sharpshooting programs have been assessed in the literature. One study documented that costs ranged from \$72 to \$260 per deer harvested (Warren 1997). A study in Minnesota compared methods to reduce deer abundance, and sharpshooting averaged \$121 per deer harvested (Doerr et al. 2001). Gettysburg National Military Park reported that costs averaged \$128 per deer, with 355 deer removed (Frost et al. 1997). Costs of up to \$354 per deer were recently reported ( DeNicola and Williamson 2008).

It is estimated that the sharpshooting part of this alternative would initially cost \$200 per deer for the first 3 years, increasing to \$400 per deer as the population decreased.

Costs for USPP staffing to close off the park during sharpshooting were estimated assuming that there would be 20 staff needed during a 6-hour night shift to close off all or parts of the park. Also, it was assumed that deer removal would require 10 nights in year 1, 5 nights in year 2, 3 nights in year 3, and 1 night in subsequent years, and that overtime pay would be required.

## **CAPTURE AND EUTHANASIA**

The costs for capturing deer would likely vary. Factors would include the location of the removal, accessibility, type of trap or immobilization drug used, the means of deer disposal, and the type of euthanasia used. Based on the experience of park personnel, and the range of costs identified for capturing deer under the reproductive control action, costs could range from \$100 to \$1,000 per deer. An experienced contractor estimates that the minimum cost for capture and euthanasia would be \$400 per animal (White Buffalo, Inc. 2005); therefore, actual costs for this method would likely be closer to the middle of the range (\$500). It was assumed that 10 deer would be removed by this technique in the first three years, and a maximum of five deer per year in subsequent years.

## **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

Alternative D would include all actions described under alternative A, plus a combination of certain additional lethal and non-lethal actions from alternatives B and C to reduce deer herd numbers. The lethal actions would include both sharpshooting and capture/euthanasia, and these actions would be taken initially to quickly reduce the deer herd numbers. Reproductive control of does would be implemented to maintain the reduced herd numbers through sterilization or acceptable reproductive control agents, if feasible. If reproductive controls meeting required criteria become available sooner than expected, the park could select to use these first (before the initial sharpshooting), so that deer are not as hard to capture and more can be treated. However, for this analysis, it is assumed that sharpshooting would be conducted first and that population maintenance would be conducted via the most practicable method and could include a combination of lethal and non-lethal methods (i.e., sharpshooting could be used for maintaining the deer herd if necessary).

## **ADDITIONAL PROPOSED ACTIONS UNDER ALTERNATIVE D**

### **SHARPSHOOTING**

Sharpshooting would be used to initially reduce the deer population in areas of the park and as a maintenance treatment if needed. Generally, the methods described in alternative C, using sharpshooting instead of capture and euthanasia as the primary removal method, would be implemented. Sharpshooting would involve using trained sharpshooters to shoot deer in designated areas using small caliber rifles from close range. Removal numbers and gender preferences would also be similar to alternative C. This action would continue for a minimum of three years, at which time it is estimated that the population would be reduced to the initial density goal of 15 to 20 deer per square mile. The disposal methods described in alternative C would apply to alternative D as well.

### **CAPTURE AND EUTHANASIA**

Capture and euthanasia would be implemented in areas where sharpshooting may be inappropriate (e.g., near residences where there could be a concern about safety or noise). This procedure would include trapping or immobilizing deer using the technique that would create the least amount of stress as described in alternative C. The disposal methods described under alternative C would apply to alternative D as well.

### **REPRODUCTIVE CONTROL**

Reproductive control could be implemented, as described under alternative B, to maintain the deer population level. Assuming lethal actions reduced the deer population to the initial deer density goal after year 3, for this analysis it was assumed that an acceptable reproductive control agent (if available and feasible) would be used to maintain the desired population number starting in year 4. The success of using a reproductive control agent on a population that has undergone sharpshooting efforts for several years would depend on advances in reproductive control technology, sensitivity of the deer herd to humans, methods used by the sharpshooters, changes in immigration with reduced deer density, and general deer movement behavior (Porter et al. 2004; Naugle et al. 2002). It should be expected that getting close enough to administer remote injections would become increasingly difficult after sharpshooting efforts due to deer behavior changes in response to previous human interaction. Sterilization would also be considered as a reproductive control maintenance option. This would reduce the number of does requiring treatment over the long term, although the initial cost per doe is about the same as reproductive control.

Assuming a park deer population of 69 deer (density of about 15 per square mile) following sharpshooting, with 65% (45) of the deer being does (K. Ferebee, pers.comm. 2008g), 41 does (45 × 90%) would need to be treated annually, assuming that leuprolide or a similar agent were used. If an agent like Gonacon® is available and meets the criteria established for use of reproductive control agents, the frequency of treatment and costs would be reduced (current formulations of Gonacon® last up to four years). However, until a reproductive control agent meets the use criteria described under alternative B, sharpshooting would be used for long-term maintenance of the reduced deer population size as needed (i.e., approximately 14 deer would be removed annually as described under alternative B).

### **MONITORING**

Monitoring under this alternative would include the same opportunistic and targeted surveillance for CWD described under alternative A, as well as the same techniques described for capture and euthanasia (alternative C), and reproductive controls (alternative B). This would include spotlight surveys to assess the effectiveness of reproductive controls and vegetation monitoring to document changes in forest regeneration that would result from reduced deer numbers. The numbers of deer to be removed or treated in subsequent years would be adjusted based on the success of previous removal or reproductive control efforts, projected growth in the population, and vegetation and deer monitoring results.

## IMPLEMENTATION COSTS

Costs of implementing alternative D would include the same costs described under alternative A, plus additional costs for sharpshooting, capture and euthanasia, and reproductive control. Estimated costs for alternative D based on assumptions provided are discussed below and summarized in table 9.

**TABLE 9. COST ESTIMATE — ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

Action	Assumptions	Annual Cost	Cost for the 15-year Planning Period
Same actions as described for alternative A	See alternative A		\$327,000
Sharpshooting <sup>a</sup>	Years 1–3 at \$200 per deer (183 deer in year 1, 105 in year 2, and 59 in year 3)	Year 1 — \$36,600 Year 2 — \$21,000 Year 3 — \$11,800 Subtotal - \$69,400	\$241,900
	USPP staffing for park closure and safety (years 1–3 only)	Year 1 — \$75,000 Year 2 — \$37,500 Year 3 — \$22,500 Subtotal - \$135,000	
	Park staff support for park closures	Years 1–15 — 15 × \$2,500/year = \$37,500	
Capture and Euthanasia <sup>b</sup>	For estimate, assume up to 10 deer removed per year in years 1–3 at \$500 per deer	Year 1 — \$5,000 Year 2 — \$5,000 Year 3 — \$5,000	\$15,000
Reproductive Control <sup>c</sup>	For estimate, assume treatment of 41 does annually starting in year 4 (for 12 years)	\$1,000 per deer or \$41,000 per year	\$492,000
Deer Population Monitoring	Three days of survey plus data Analysis each summer (same as alternative B)	\$5,000	\$75,000
<b>Total</b>			<b>\$1,150,900</b>

- a. This cost could increase if the deer density goal was not reached by the fourth year.
- b. Costs for this method would vary but assumed mid-range cost of \$500.
- c. Reproductive control costs could be reduced considerably with improved technology. For example, if Gonacon® or a similar agent were used, with treatments needed only once every four years, costs after the first year of reproductive control could fall to about \$20,000 per year. Reproductive control costs could similarly be reduced over the long term if sterilization is used.

## SHARPSHOOTING

Factors affecting the final cost of implementing this alternative include deer density, number of deer to be removed, ease of access to deer, number and location of bait stations, equipment availability, amount of data to be collected from deer, and processing requirements. The greatest costs would generally be incurred when the deer and bait stations were difficult to access, when deer were wary of humans, the removal area was large, and when deer densities were lower (requiring more time to find each deer). Conversely, lower costs could be expected when the removal area was smaller, deer density was high (less time to find each deer), and deer were accustomed to human activities.

Costs and efficiencies of sharpshooting programs have been assessed in the literature. One study documented that costs ranged from \$72 to \$260 per deer harvested (Warren 1997). A study in Minnesota compared methods to reduce deer abundance and sharpshooting averaged \$121 per deer harvested (Doerr et al. 2001). Gettysburg National Military Park reported that costs averaged \$128 per deer, with 355 deer removed (Frost et al. 1997). Sharpshooting costs of up to \$354 per deer were reported by DeNicola and Williamson (2008), and costs of \$91 to \$300 per deer were reported by McDonald and McKinley in 2009.

It is estimated that this alternative would cost \$200 per deer. However, if sharpshooting were needed in the future years (e.g., if reproductive control or capture and euthanasia were not used for maintenance), costs could increase up to \$400 per deer as the population decreased.

Costs for USPP staffing to close off all or portions of the park during sharpshooting were estimated assuming that there would be 20 staff needed during a 6-hour night shift, and that deer removal would require 10 nights in year 1, 5 nights in year 2, and 3 nights in year 3, and that overtime pay would be required..

### **CAPTURE AND EUTHANASIA**

The cost for using capture and euthanasia to supplement the sharpshooting effort would be the same as described for alternative C. For the purposes of analysis for this plan, it is assumed that up to 10 deer would be removed per year in years 1–3 at \$500 per deer.

### **REPRODUCTIVE CONTROL**

For purposes of analysis for this plan, it is assumed that reproductive control would begin in year 4. Costs could be reduced considerably depending on the results of the lethal efforts, the cost per deer based on current technology, and the year treatment begins. To minimize costs (to reduce the number of deer to be treated), sharpshooting would occur before reproductive control is implemented. Sharpshooting would also focus on removing does to minimize reproduction. If reproductive control criteria are met, an acceptable reproductive control agent would be used to maintain the reduced population size. Until the criteria are met, reduction through sharpshooting would continue for population size maintenance.

### **ADAPTIVE MANAGEMENT**

The U.S. Department of the Interior (USDI) requires that its agencies “. . . use adaptive management to fully comply” with the Council on Environmental Quality’s (CEQ) guidance that requires “a monitoring and enforcement program to be adopted . . . where applicable, for any mitigation” required in a NEPA planning process (516 Departmental Manual [DM] 1.3 D[7]; 40 CFR 1505.2). In addition, the Department has recently outlined the adaptive management approach in a technical guide developed to provide guidance to all USDI bureaus and agencies (Williams et al. 2007).

According to the USDI Technical Guide (Williams et al. 2007), “Adaptive management is a systematic approach for improving resource management by learning from management outcomes (Sexton et al. 1999). An adaptive approach involves exploring ways to meet management objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions (Murray and Marmorek 2004). Adaptive management focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders who learn together how to create and maintain sustainable resource systems (Bormann et al. 2006).”

Adaptive management should be used when decisions must be made despite uncertainty and there is a commitment to using this approach. In addition to these two primary conditions, adaptive management should be used when (1) there is a real management choice to be made; (2) there is an opportunity to apply learning; (3) clear and understandable objectives can be identified; (4) the value of information gained is high; (5) uncertainty can be expressed as models that can be tested; and (6) monitoring is in

place or can be put in place to reduce uncertainty (Williams et al. 2007). The deer management situation at Rock Creek Park meets all of these conditions.

Appendix D provides more details about the phases of adaptive management as it would be applied to this deer management plan.

### **HOW ALTERNATIVES MEET OBJECTIVES**

As stated in chapter 1, all action alternatives selected for analysis must meet all objectives to a large degree. The action alternatives must also address the stated purpose of taking action and resolve the need for action; therefore, the alternatives were individually assessed in light of how well they would meet the objectives for this plan and EIS, which are stated on page 4. Alternatives that did not meet the objectives were not analyzed further (see the “Alternatives Eliminated from Further Consideration” section in this chapter).

Table 10 compares the alternatives by summarizing the elements being considered, while table 11 compares how each of the alternatives described in this chapter would meet the plan objectives. “Chapter 4: Environmental Consequences” describes the effects of each alternative on each impact topic, including the impact on recreational values and visitor experience. These impacts are summarized in table 12.

TABLE 10. COMPARISON OF ALTERNATIVES

	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Management Actions	Continue deer monitoring, data gathering, data management and research, limited use of small area caging and repellents, plus education, outreach, and inter-jurisdictional cooperation	All actions under alternative A, plus: <ul style="list-style-type: none"> <li>Construct 14 large enclosures to protect vegetation from deer browsing throughout the main reservation of the park</li> <li>Implement reproductive control of does, including sterilization for the first four years and subsequent reproductive control if available and feasible, based on criteria for use established by the park</li> </ul>	All actions under alternative A, plus: <ul style="list-style-type: none"> <li>Use sharpshooting and limited capture and euthanasia to reduce deer herd numbers</li> <li>Donate meat, if possible</li> </ul>	All actions under alternative A, plus use a combination of techniques from alternatives B and C: <ul style="list-style-type: none"> <li>Use sharpshooting and limited capture and euthanasia to reduce deer herd numbers</li> <li>Apply reproductive controls (if feasible) to maintain population size, with sharpshooting used periodically, if needed</li> <li>Donate meat, if possible</li> </ul>
Reduction in Deer Population	None, other than current sources of mortality	Potentially reduce deer population if reproductive controls are successful and then only after the first several years of treatment or until natural mortality exceeded reproduction and reduced the population; population reduction would be very gradual	Initially remove an estimated 193 deer, 115 deer in year 2, and 69 deer in year 3, with fewer deer in subsequent years. To maintain the population at target levels (15 to 20 deer per square mile), remove an estimated 14 deer beginning in year 4. Capture and euthanasia would account for 10 of the deer removed in the first three years and very few additional (five or less) in subsequent years	Similar to alternative C. Potential for future reductions through reproductive control (if feasible) used as a population maintenance tool, with sharpshooting available as back-up

Alternatives

	<b>Alternative A: No Action Alternative</b>	<b>Alternative B: Combined Non-lethal Actions</b>	<b>Alternative C: Combined Lethal Actions</b>	<b>Alternative D: Combined Lethal and Non-lethal Actions</b>
Time Required to Achieve Desired Forest Regeneration	Forest regeneration cannot be achieved without reducing browsing impacts	Five to 10% of park woody vegetation would be protected or regenerated by end of plan due to exclosures; reproductive control would contribute to additional forest regeneration by gradually limiting deer numbers	Would reduce deer population by year 3, with changes in regeneration expected 3-4 years after deer density goal is reached*, and trends toward regeneration success by end of plan  *This was achieved at Gettysburg National Military Park (Niewinski et al. 2006)	Same as alternative C
Handling of Deer	Handling only as required for monitoring	No physical handling of deer required to drive them out of fenced areas  Intensive physical handling of deer required for sterilization  Reproductive control application could also involve trapping or a telemetry dart application that requires marking and handling of does. Handling and chemical applications would follow AVMA recommendations, but there would be increased stress levels in captured deer	No capture required for sharpshooting; capture and euthanasia requires capture and handling; would follow AVMA recommendations, but there would be increased stress levels in captured deer compared to other methods	Same as alternative B for reproductive control and alternative C for lethal actions
Monitoring	Continued inventorying vegetation monitoring and monitoring of deer population numbers to assess impacts	Continued monitoring as described under alternative A, plus monitoring of plants for signs of recovery within exclosures  For reproductive control, monitoring of treated deer using additional fawn surveys to determine reproductive control effectiveness	Annual monitoring of plants for six years after deer density goal reached to identify any signs of forest recovery, plus continued monitoring as described under alternative A	Same as alternatives B and C

	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Regulatory Considerations	No specific regulatory requirements	Same as alternative A, plus: Veterinarian prescription required pursuant to the <i>Animal Drug Use and Clarification Act</i> for off-label use in deer. The Environmental Protection Agency would likely authorize the use of reproductive control agents and individual state resource agencies would have final project approval Additional requirements could be prescribed by a veterinarian (e.g., meat withdrawal period, marking)	Same as alternative A plus: Any necessary ATF permits would be obtained Coordination with state/local/nonprofit/private entities might be needed to donate meat Follow state/local regulatory requirements for any landfill disposal of deer	Same as alternatives B and C
CWD Testing	Testing coordinated with the state; primarily opportunistic surveillance	Same as alternative A	Same as alternative A	Same as alternative A
Park Closure or Restricted Access	None	Restricted access within exclosures or in areas of active reproductive control activities	Park closed or access restricted during management activities; closures or restrictions minimized by conducting activities during periods between dusk and dawn and primarily in late fall/winter for larger reductions	Same as alternatives B (reproductive control) and C
Adaptive Management	No specific adaptive management included under this alternative	Relocation of vegetation monitoring plots, changes in action thresholds or deer density goals, possible changes in number and locations of large exclosures, possible change in reproductive control agent used and its application procedures	Relocation of vegetation monitoring plots, changes in action thresholds or deer density goals, or possible changes to implementation procedures for this action	Relocation of vegetation monitoring plots, changes in action thresholds or deer density goals, possible change in reproductive control agent used and its application procedures or timing of use, as well as number of removal actions needed

Alternatives

	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Estimated Cost (15-year Plan) with Leuprolide-type Reproductive Control Agent	\$327,000	\$1,678,510	\$771,100	\$1,150,900

TABLE 11. ANALYSIS OF HOW THE ALTERNATIVES MEET OBJECTIVES

Objective	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	<b>Vegetation</b>			
<ul style="list-style-type: none"> <li>Develop and implement informed, scientifically-based vegetation impact levels and corresponding measures of deer population density that would serve as a threshold for taking prescribed management actions within the park</li> </ul>	Does not meet objective: Thresholds for taking action and deer density goal do not apply to the no action alternative	Fully meets objective: Plan provides action thresholds and target deer density for all action alternatives	Fully meets objective: Same as alternative B	Fully meets objective: Same as alternative B
<ul style="list-style-type: none"> <li>Protect the natural abundance, distribution, and diversity of native plant species within the applicable park units by reducing excessive deer browsing, trampling, and nonnative seed dispersal</li> </ul>	Does not meet objective: No reduction in deer browsing pressure, resulting in insufficient tree regeneration and adverse effects on native plant species	Partially meets objective: Up to 10% of the park's woody vegetation protected over the life of the plan; a maximum of about 5% of the herbaceous cover totally protected at any one time A minimum of 10 years for reproductive control to be effective with current methods	Fully meets objective: Reduction of deer herd over a minimum of four years, helping to ensure tree regeneration and protection of native plants	Fully meets objective: Same as alternative C

Objective	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
<ul style="list-style-type: none"> <li>Maintain, restore, and promote a mix of native plant species and reduce the spread of nonnative plant species through effective deer management</li> </ul>	<p>Does not meet objective: No mix of native herbaceous plant species because of overbrowsing and continued contribution to the spread of invasive species</p>	<p>Partially meets objective: Mix of native herbaceous plant species in exclosures</p> <p>No native herbaceous species in park areas that cannot be fenced and continued contribution to the spread of invasive species due to overbrowsing outside exclosures</p>	<p>Fully meets objective: Forest regeneration likely because of a smaller deer herd, resulting in a mix of native herbaceous plant species</p> <p>Spread of invasive species due to overbrowsing would be reduced</p>	<p>Fully meets objective: Same as alternative C</p>
<b>Wildlife and Wildlife Habitat</b>				
<ul style="list-style-type: none"> <li>Allow for a white-tailed deer population within the park while protecting other park resources</li> </ul>	<p>Does not meet objective: Deer population not in balance with the forest ecosystem</p> <p>Very limited protection for other park resources</p>	<p>Partially meets objective: A self-sustaining deer population, but at the expense of a healthy forest and other park resources</p> <p>Other park resources protected only within exclosures</p>	<p>Fully meets objective: Allows for a viable deer population and other park resources protected as a result of reducing the herd size</p>	<p>Fully meets objective: Same as alternative C</p>
<ul style="list-style-type: none"> <li>Protect the natural abundance, distribution, and diversity of native animal species within the park by reducing excessive deer browsing, trampling, and nonnative seed dispersal</li> </ul>	<p>Does not meet objective: Continued browsing pressure would reduce the amount of habitat within the park and adversely affect other wildlife</p>	<p>Partially meets objective: Native habitat would be restored, but only very gradually and exclosures can affect the natural distribution of native species</p>	<p>Fully meets objective: Forest regeneration possible with a smaller deer herd, resulting in a protection of wildlife habitat</p>	<p>Fully meets objective: Same as alternative C</p>
<ul style="list-style-type: none"> <li>Protect lower canopy and ground nesting bird habitat from adverse effects of deer browsing</li> </ul>	<p>Does not meet objective: No natural regeneration in lower canopy due to continued browsing pressure, reducing the amount of habitat for ground nesting birds within the park</p>	<p>Partially meets objective: Lower canopy and ground nesting bird habitat protected only in exclosures</p>	<p>Fully meets objective: Forest regeneration possible with a smaller deer herd, resulting in a lower forest canopy and ground nesting bird habitat</p>	<p>Fully meets objective: Same as alternative C</p>

Alternatives

Objective	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
<b>Threatened, Endangered, and Species of Special Concern</b>				
<ul style="list-style-type: none"> <li>Protect habitat of rare plant and animal species from adverse effects of deer, such as excessive deer browsing, trampling, and nonnative seed dispersal.</li> </ul>	Partially meets objective: Some sensitive plant species in limited locations protected by small caged exclosures	Partially meets objective: Caging required to protect sensitive herbaceous species that would never grow out of browse range  No protection for species in park areas that cannot be caged	Fully meets objective: Most sensitive species protected if deer density goal is reached	Fully meets objective: Same as alternative C
<b>Cultural Resources</b>				
<ul style="list-style-type: none"> <li>Protect the integrity, variety, and character of the cultural landscapes by reducing excessive deer browsing, trampling, and nonnative seed dispersal</li> </ul>	Partially meets objective: Landscaped area plantings protected from excessive deer browsing by caging, but no protection for the park's cultural landscapes	Partially meets objective: In addition to landscaped area plantings protected by caging, protection of vegetation within exclosures, but no protection for the park's overall cultural landscape outside exclosures	Fully meets objective: Forest regeneration allowed with a smaller deer herd, thus protecting the forest as a cultural landscape	Fully meets objective: Same as alternative C
<b>Visitor Experience</b>				
<ul style="list-style-type: none"> <li>Share information with the public regarding the deer population and the forest regeneration process and diversity, including the role of deer as part of a functioning park ecosystem, not the primary driving force within it</li> </ul>	Partially meets objective: Education and outreach efforts continued, but with limited emphasis on deer management options	Fully meets objective: Public outreach would address deer management and forest regeneration under all action alternatives	Fully meets objective: Same as alternative B	Fully meets objective: Same as alternative B

Objective	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
<ul style="list-style-type: none"> <li>Initiate cooperative efforts to address deer effects on the park and surrounding communities</li> </ul>	Partially meets objective: Cooperative efforts exist and are ongoing, but lack of management actions limits what can be done to fully cooperate with surrounding communities	Fully meets objective: Would enable park to cooperate with surrounding communities	Fully meets objective: Same as alternative B	Fully meets objective: Same as alternative B
<b>Park Management and Operations</b>				
<ul style="list-style-type: none"> <li>Share information with park staff and other regional parks regarding the deer population and management strategies</li> </ul>	Fully meets objective: Would share information as obtained	Fully meets objective: Same as alternative A	Fully meets objective: Same as alternative A	Fully meets objective: Same as alternative A

TABLE 12. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Vegetation	<i>Direct/Indirect Impact:</i> The impacts of large numbers of deer browsing on a very large percentage of the park's woody and herbaceous vegetation and consequently limiting natural regeneration would be adverse, long term, and major.	<i>Direct/Indirect Impact:</i> Since the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to woody and herbaceous vegetation would be adverse, long term, and major	<i>Direct/Indirect Impact:</i> Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through direct reduction would result in beneficial, long-term impacts. Over time as natural forest regeneration occurred, adverse, long-term, major impacts that could be expected if the deer herd continued unchecked would be reduced to minor levels.	<i>Direct/Indirect Impact:</i> Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through the use of reproductive control (and direct reduction if needed) would result in beneficial, long-term impacts. Over time as natural forest regeneration occurred, adverse, long-term, major impacts would be reduced to minor levels.
	<i>Cumulative Impact:</i> Would result in adverse, long-term, major	<i>Cumulative Impact:</i> Would result in long-term, moderate to major	<i>Cumulative Impact:</i> Would result in beneficial, long-term cumulative	<i>Cumulative Impact:</i> Would result in beneficial, long-term cumulative

Alternatives

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	cumulative impacts.  <i>Potential for Impairment:</i> Current conditions in the park indicate severe adverse impacts on vegetation resources. Under alternative A it is expected that impairment of vegetation resources would occur over the long term.	adverse cumulative impacts.  <i>Potential for Impairment:</i> It is not expected that impairment of vegetation resources would occur under this alternative.	impacts.  <i>Potential for Impairment:</i> No impairment of vegetation resources would occur under this alternative.	impacts.  <i>Potential for Impairment:</i> No impairment of vegetation resources would occur under this alternative.
Soils and Water Quality	<i>Direct/Indirect Impact:</i> Soil erosion and sedimentation due to loss of vegetation from increased deer browsing could result in adverse long-term, negligible to minor impacts on soils and water quality.	<i>Direct/Indirect Impact:</i> If deer displaced by the fenced enclosures concentrated in other areas of the park, resulting in increased loss of vegetation in those areas and a potential increase in soil erosion, adverse, long-term, minor impacts to soils and water quality could occur. Impacts would gradually shift to beneficial in the long term.	<i>Direct/Indirect Impact:</i> Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on soils and water quality.	<i>Direct/Indirect Impact:</i> Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on soils and water quality.
	<i>Cumulative Impact:</i> Would result in adverse, long-term, minor cumulative impacts on soil and water quality.	<i>Cumulative Impact:</i> Would result in adverse, long term, and minor cumulative impacts.	<i>Cumulative Impact:</i> Would result in adverse, long term, and minor cumulative impacts.	<i>Cumulative Impact:</i> Would result in adverse, long term, and minor cumulative impacts.
Wetlands and Floodplains	<i>Direct/Indirect Impact:</i> Loss of vegetation from increased deer browsing, disturbance to small wetland areas and vernal pools and changes in species composition would result in adverse, long-term, moderate impacts on wetlands and	<i>Direct/Indirect Impact:</i> Use of enclosures to protect many of the park's forested wetlands would gradually result in beneficial long-term impacts to wetlands, although continued long-term minor to moderate adverse impacts would be expected in areas that are not fenced and in smaller wetland	<i>Direct/Indirect Impact:</i> Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on wetlands and floodplains.	<i>Direct/Indirect Impact:</i> Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on wetlands and floodplains.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	floodplains.	areas and seeps. Beneficial long-term impacts would also result from decreased vegetation loss. Construction of exclosures within the 100-year floodplain could result in short-term, minor adverse impacts on the floodplain.		
	<i>Cumulative Impact:</i> Would result in adverse, long-term, moderate impacts on wetlands and floodplains.	<i>Cumulative Impact:</i> Would result in adverse, long-term, moderate impacts on wetlands and floodplains.	<i>Cumulative Impact:</i> Would result in adverse, long term, minor to moderate cumulative impacts due mainly to past actions.	<i>Cumulative Impact:</i> Would result in adverse, long term, minor to moderate cumulative impacts due mainly to past actions.
	<i>Potential for Impairment:</i> No impairment of wetlands or floodplains would occur under this alternative.	<i>Potential for Impairment:</i> No impairment of wetlands or floodplains would occur under this alternative.	<i>Potential for Impairment:</i> No impairment of wetlands or floodplains would occur under this alternative.	<i>Potential for Impairment:</i> No impairment of wetlands or floodplains would occur under this alternative.
White-tailed Deer	<i>Direct/Indirect Impact:</i> Excessive deer browsing that would degrade habitat and limit food sources would result in long-term, moderate adverse impacts.	<i>Direct/Indirect Impact.</i> Because the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to deer habitat, and in turn deer, would be adverse, long term, and moderate as a result of habitat degradation and loss of food sources. There could also be long-term, major adverse impacts to individual deer from the physiological, biological, and behavioral effects associated with the use of reproductive control; however, long-term impacts to the population would be minor to moderate because the adverse effects would be offset over time by the benefits of population reduction.	<i>Direct/Indirect Impact.</i> The relatively rapid reduction of the deer herd and the resultant regeneration of forage would result in beneficial effects on deer herd health and would reduce adverse impacts to negligible or minor levels over the long term.	<i>Direct/Indirect Impact:</i> Enhancing natural forest regeneration by quickly reducing deer browsing pressure would result in beneficial, long-term impacts to deer and deer habitat. Over time as natural forest regeneration occurred, adverse, long-term, major impacts would be reduced to negligible to minor levels. If reproductive controls are used, there could also be long-term, major adverse impacts to individual deer from the physiological, biological, and behavioral effects associated with the use of reproductive control; however, long-term impacts to the population would be minor to moderate because the adverse effects would be offset over time by the benefits of population

Alternatives

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	<p><i>Cumulative Impact:</i> Would result in adverse, long-term, moderate cumulative impacts.</p> <p><i>Potential for Impairment:</i> Although impacts to deer under alternative A could be severe, they would not approach the level of impairment over the long term.</p>	<p><i>Cumulative Impact:</i> Would result in long-term, moderate adverse cumulative impacts.</p> <p><i>Potential for Impairment:</i> It is not expected that impairment of the white-tailed deer herd in Rock Creek Park would occur under this alternative.</p>	<p><i>Cumulative Impact:</i> Would result in long-term, beneficial, cumulative impacts on deer herd health.</p> <p><i>Potential for Impairment:</i> No impairment of the white-tailed deer population would occur under this alternative.</p>	<p>reduction.</p> <p><i>Cumulative Impact:</i> Would result in beneficial, long-term cumulative impacts.</p> <p><i>Potential for Impairment:</i> No impairment of the white-tailed deer population would occur under this alternative.</p>
Other Wildlife and Wildlife Habitat	<p><i>Direct/Indirect Impact:</i> A continued large deer population and related browsing, resulting in decreased plant diversity, increased invasive exotic plants, and reduced forest regeneration would result in adverse effects on other wildlife. A few predator species would benefit from a large deer population and an open understory; however, the impacts of large numbers of deer browsing on vegetation would adversely affect a large percentage of habitats for other wildlife (e.g., ground-nesting birds, frogs, snakes, and turtles), resulting in adverse, long-term, and negligible to potentially major impacts, depending on the species.</p> <p><i>Cumulative Impact:</i> Would result in both adverse and beneficial impacts, with adverse, long-term, major cumulative impacts.</p>	<p><i>Direct/Indirect Impact:</i> Construction of large, fenced enclosures over the life of the plan would protect some habitat; however, the remaining habitat would continue to be subject to a high degree of deer browsing, adversely impacting both ground and shrub layer habitat for many other species of wildlife until reproductive controls took effect and reduced the deer population. A few species would tend to benefit from a large deer population and an open understory but overall, impacts to other wildlife would be adverse, long term, and negligible to potentially major, depending on the species.</p> <p><i>Cumulative Impact:</i> Would result in both adverse and beneficial impacts, with overall adverse, long term, moderate to major cumulative impacts.</p>	<p><i>Direct/Indirect Impact:</i> Rapid reductions in deer numbers in the park, thereby reducing deer browsing pressure on woody and herbaceous vegetation and allowing increased abundance and diversity of other wildlife that depend on understory vegetation would result in beneficial long term impacts. Adverse, long-term impacts would be reduced to negligible or minor levels over time.</p>	<p><i>Direct/Indirect Impact:</i> Rapid reductions in deer numbers in the park, thereby reducing deer browsing pressure on woody and herbaceous vegetation and allowing increased abundance and diversity of other wildlife that depend on understory vegetation would result in beneficial long term impacts. Adverse, long-term impacts would be reduced to negligible or minor levels over time.</p> <p><i>Cumulative Impact:</i> Would result in beneficial, long-term cumulative impacts.</p>

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Rare, Unique, Threatened, or Endangered Species	<p><i>Potential for Impairment:</i> As explained in "Vegetation" above, alternative A would not reverse the expected long-term continued growth in the deer population, and wildlife habitat would likely continue to be degraded. Although not all wildlife species would be affected to the same extent, impairment of those wildlife species that depend on the presence of ground cover and understory vegetation that are heavily browsed by deer could occur under this alternative over the long term.</p>	<p><i>Potential for Impairment:</i> It is not expected that impairment of other wildlife species or habitat would occur under this alternative.</p>	<p><i>Potential for Impairment:</i> No impairment of the white-tailed deer population would occur under this alternative.</p>	<p><i>Potential for Impairment:</i> No impairment of the white-tailed deer population would occur under this alternative.</p>
	<p><i>Direct/Indirect Impact:</i> Impacts to rare, unique, threatened, or endangered species under alternative A would be both beneficial and adverse. Adverse impacts to the federally listed Hay's spring amphipod (<i>Stygobromus hayi</i>) would be long term and negligible to minor. Beneficial impacts to state-listed plants would result from establishing caging around known individual plants and from establishing caging around newly discovered plants in the park. Overall, there would be adverse, long-term, negligible to major impacts to rare, unique, threatened, or endangered species, from excessive deer browsing and the associated habitat degradation that could result in lack of food or cover for</p>	<p><i>Direct/Indirect Impact:</i> Adverse impacts to the federally listed Hay's spring amphipod would be long term and negligible to minor. Impacts to species listed or considered special status species by Maryland and the District of Columbia would be adverse, long term, and moderate to major, until reproductive controls on the park deer herd were effective. The placement and maintenance of large exclosures would include many species listed or considered special status species by Maryland and the District of Columbia, resulting in beneficial, long-term impacts. However, adverse, long-term, negligible to moderate impacts due to deer browsing would continue outside the exclosures.</p>	<p><i>Direct/Indirect Impact:</i> The reduced deer density would minimize potential impacts on the habitat for the Hay's spring amphipod, resulting in long-term, beneficial effects that would reduce adverse impacts to negligible. Impacts on species listed or considered special status species by Maryland and the District of Columbia, as well as their habitat, would be beneficial and long term as a result of rapid reductions in deer numbers in the park that would reduce deer browsing pressure on woody and herbaceous vegetation. A few predators that use deer as a food source could be adversely affected by a lower deer density, as could scavengers that feed on deer carcasses, but this alternative</p>	<p><i>Direct/Indirect Impact:</i> The reduced deer density would minimize potential impacts on the habitat for the Hay's spring amphipod, resulting in long-term, beneficial effects that would reduce adverse impacts to negligible. Impacts on species listed or considered special status species by Maryland and the District of Columbia, as well as their habitat, would be beneficial and long term as a result of rapid reductions in deer numbers in the park that would reduce deer browsing pressure on woody and herbaceous vegetation. Adverse, long-term impacts would be reduced to negligible or minor levels over time. A few predators and scavengers that use deer and their carcasses as a food source could be adversely affected by a</p>

Alternatives

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	such species.		could also increase the availability of other prey. Adverse, long-term impacts would be reduced to negligible or minor levels over time.	lower deer density or denser understory conditions, but this alternative could also increase the availability of other prey. Adverse, long-term impacts would be reduced to negligible or minor levels over time.
	<i>Cumulative Impact:</i> Would result in both adverse and beneficial impacts, with overall long-term, minor to major, adverse cumulative impacts.	<i>Cumulative Impact:</i> Would result in both beneficial and adverse impacts.	<i>Cumulative Impact:</i> Would result in long-term, beneficial, cumulative impacts.	<i>Cumulative Impact:</i> Would result in long-term, beneficial, cumulative impacts.
	<i>Potential for Impairment:</i> Impairment under alternative A would be possible for some of the state-listed plants that are palatable to deer, as well as habitat for rare, unique, threatened, or endangered species, because alternative A would not reverse the expected long-term continued growth in the deer population and damage to vegetation would likely continue, as described under “Vegetation” above. Therefore, it is expected that impairment of certain state-listed plants could occur over the long term.	<i>Potential for Impairment:</i> It is not expected that impairment of state-listed plants, as well as habitat for rare, unique, threatened, or endangered species, would occur over the long term.	<i>Potential for Impairment:</i> No impairment of rare, unique, threatened, or endangered species would occur under this alternative.	<i>Potential for Impairment:</i> No impairment of rare, unique, threatened, or endangered species would occur under this alternative.
Cultural Landscapes	<i>Direct/Indirect Impact:</i> The use of small cages and repellents to protect landscape plantings, new restoration plantings, or rare plant species at specified areas could result in beneficial, long-term, minor impacts to these parts of the park’s vegetation. However, continued growth of the deer population and the associated	<i>Direct/Indirect Impact:</i> Constructing enclosures over the life of this plan would preserve some vegetation that is part of the cultural landscapes of the park. However, remaining vegetation within the park would continue to be adversely affected by deer browsing over the long term until reproductive controls became	<i>Direct/Indirect Impact:</i> Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through direct reduction would result in beneficial, long-term impacts.	<i>Direct/Indirect Impact:</i> Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through direct reduction would result in beneficial, long-term impacts.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	<p>ongoing decline in the abundance and diversity of the native plant communities and cultural plantings would result in an adverse, long-term, minor to moderate impact to the park's cultural landscapes.</p>	<p>effective and the population decreased. Since the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to cultural landscapes would be adverse, long term, and minor to moderate.</p>		
	<p><i>Cumulative Impact:</i> Would result in adverse, long-term, minor to moderate cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in long-term, moderate adverse cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in beneficial, long-term cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in beneficial, long-term cumulative impacts.</p>
	<p><i>Potential for Impairment:</i> No impairment of cultural landscapes would occur under this alternative.</p>	<p><i>Potential for Impairment:</i> It is not expected that impairment of cultural landscapes would occur under this alternative.</p>	<p><i>Potential for Impairment:</i> No impairment of cultural landscapes would occur under this alternative.</p>	<p><i>Potential for Impairment:</i> No impairment of cultural landscapes would occur under this alternative.</p>
Soundscapes	<p><i>Direct/Indirect Impact:</i> Actions taken to protect plants and monitor the deer population and park vegetation would result in an adverse, short-term, negligible adverse impact on soundscapes.</p>	<p><i>Direct/Indirect Impact:</i> Intermittent construction of enclosures and reproductive control activities would result in short term, negligible to minor, adverse impacts Individual construction and reproductive control activities would be short term, but would continue indefinitely into the future, resulting in both short- and long-term, negligible to minor, adverse impacts.</p>	<p><i>Direct/Indirect Impact:</i> Sharpshooting would result in adverse impacts, primarily affecting nearby residents. Perception of the intensity of the impacts would vary depending on several factors, including timing, attenuation levels, and distance from the source, resulting in minor to moderate impacts to individuals experiencing the sound.</p>	<p><i>Direct/Indirect Impact:</i> Sharpshooting would result in adverse impacts, primarily affecting nearby residents. Perception of the intensity of the impacts would vary depending on several factors, including timing, attenuation levels, and distance from the source, resulting in minor to moderate impacts to individuals experiencing the sound.</p>
	<p><i>Cumulative Impact:</i> Would result in cumulative impacts ranging from minor to moderate and adverse depending on the source, due to the variety and abundance of noise sources that already exist around and within the park.</p>	<p><i>Cumulative Impact:</i> Would result in cumulative impacts ranging from minor to moderate and adverse depending on the source, due to the variety and abundance of noise sources that already exist around and within the park.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, short and long term, and minor to moderate cumulative impacts. However, these impacts would be expected to decrease in the long term, as deer populations in all affected areas decrease and the need for direct reduction decreases as well.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, short and long term, and minor to moderate cumulative impacts. However, these impacts would be expected to decrease in the long term, as deer populations in all affected areas decrease and the need for direct reduction decreases as well.</p>

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Visitor Use and Experience	<p><i>Potential for Impairment:</i> No impairment of the park's soundscapes would occur under this alternative.</p> <p><i>Direct/Indirect Impact:</i> Impacts to visitor use and experience would be both beneficial and adverse to those visitors who maybe primarily interested in viewing deer (beneficial in that there would be more deer to see, adverse in that the appearance of the herd could be poor). However, overall impacts related to a decreased ability to view scenery and other wildlife would be long term, minor to moderate and adverse.</p>	<p><i>Potential for Impairment:</i> No impairment of the park's soundscapes would occur under this alternative.</p> <p><i>Direct/Indirect Impact:</i> Visitors would experience adverse, short-term impacts primarily due to aesthetics and closures of certain areas of the park, as well as a slight increase in occasional noise levels. These impacts would be offset by the educational and interpretive information, which would reduce adverse impacts to minor. Short-term impacts would eventually give way to beneficial, long-term impacts as the need for exclosures diminished and the deer population declined, resulting in a restored forest ecosystem throughout the park. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such an impact would be negligible to minor, as opportunities to view deer would still exist.</p> <p><i>Cumulative Impact:</i> Would result in mostly beneficial and long term cumulative impacts due to the effects of combined forest regeneration activities.</p>	<p><i>Potential for Impairment:</i> No impairment of the park's soundscapes would occur under this alternative.</p> <p><i>Direct/Indirect Impact:</i> Adverse, short-term impacts that could occur if visitors were exposed to management actions would be offset by educational and interpretive information, resulting in negligible adverse impacts. Beneficial impacts would occur in the long term, as the forest regenerated and visitors could see increased plant and animal diversity, and enjoy enhanced scenery. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such impact would be negligible to minor, as opportunities to view deer would still exist.</p> <p><i>Cumulative Impact:</i> Would result in cumulative impacts that would be primarily beneficial and long term.</p>	<p><i>Potential for Impairment:</i> No impairment of the park's soundscapes would occur under this alternative.</p> <p><i>Direct/Indirect Impact:</i> Adverse, short-term impacts that could occur if visitors were exposed to management actions would be offset by educational and interpretive information, resulting in negligible adverse impacts. Beneficial impacts would occur in the long term, as the forest regenerated and visitors could see increased plant and animal diversity, and enjoy enhanced scenery. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such impact would be negligible to minor, as opportunities to view deer would still exist.</p> <p><i>Cumulative Impact:</i> Would result in cumulative impacts that would be primarily beneficial and long term.</p>

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Visitor Safety	<p><i>Direct/Indirect Impact:</i> Because it is expected that no discernible effects to visitor safety would result from deer management actions, but vehicle collisions would continue, adverse, long-term, negligible to moderate adverse impacts could occur.</p> <p><i>Cumulative Impact:</i> Would result in adverse, long term, and minor cumulative impacts.</p>	<p><i>Direct/Indirect Impact:</i> Adverse impacts to visitors would be short and long term and negligible from deer management, although the continued presence of a large number of deer over the life of the plan would continue to contribute to vehicle deer collisions on park roads and result in minor to moderate adverse impacts.</p> <p><i>Cumulative Impact:</i> Would result in adverse, long term, and minor cumulative impacts.</p>	<p><i>Direct/Indirect Impact:</i> The extent of safety measures would result in adverse, short- and long-term, negligible to minor impacts, as it is expected that no discernible effects to visitor safety would occur from deer management actions and the possibility of deer-vehicle collisions would be diminished.</p> <p><i>Cumulative Impact:</i> Would result in adverse, long term, and negligible to minor cumulative impacts.</p>	<p><i>Direct/Indirect Impact:</i> The extent of safety measures that would be used and locating activities away from park boundaries would result in adverse, short- and long-term, negligible impacts. The possibility of deer-vehicle collisions would be greatly diminished.</p> <p><i>Cumulative Impact:</i> Would result in adverse, long term, and negligible to minor cumulative impacts.</p>
Employee Safety	<p><i>Direct/Indirect Impact:</i> Because it is expected that no discernible effects to employee safety would occur as a result of deer management actions, impacts would be adverse, long term, and negligible.</p> <p><i>Cumulative Impact:</i> Would result in adverse, long term, and negligible cumulative impacts.</p>	<p><i>Direct/Indirect Impact:</i> Adverse impacts to government employees would be short and long term and negligible to minor.</p> <p><i>Cumulative Impact:</i> Would result in adverse, long term, and negligible cumulative impacts.</p>	<p><i>Direct/Indirect Impact:</i> Adverse, short- and long-term, negligible to minor impacts would occur.</p> <p><i>Cumulative Impact:</i> Would result in adverse, long term, and negligible cumulative impacts.</p>	<p><i>Direct/Indirect Impact:</i> Adverse, short- and long-term, negligible to minor impacts would occur.</p> <p><i>Cumulative Impact:</i> Would result in adverse, long term, and negligible to minor cumulative impacts.</p>
Socio-economic Resources	<p><i>Direct/Indirect Impact:</i> The continued high numbers of deer and likely long-term increase in the deer population in Rock Creek Park would result in additional damage to landscaping in the surrounding areas and could result in varying impacts, ranging from minor to moderate and adverse.</p>	<p><i>Direct/Indirect Impact:</i> Reproductive controls (if successful) would allow for only a gradual reduction in the number of deer, and there could be some displacement of deer from the park due to exclosures. The net effect on surrounding property could result in slightly greater damage to landscaping, the impacts of which would be long term and moderate.</p>	<p><i>Direct/Indirect Impact:</i> The reduction of the existing deer populations in both the short and long term could result in fewer deer leaving the park and browsing landscaping on adjacent lands, with long-term beneficial effects that would reduce adverse impacts to negligible or minor levels.</p>	<p><i>Direct/Indirect Impact:</i> The reduction of the existing deer populations in both the short and long term could result in fewer deer leaving the park and browsing landscaping on adjacent lands, with long-term beneficial effects that would reduce adverse impacts to negligible or minor levels.</p>

Alternatives

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Park Management and Operations	<p><i>Cumulative Impact:</i> Would result in adverse, long term, and minor to moderate cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in moderate adverse long-term cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in long-term minor cumulative adverse impacts.</p>	<p><i>Cumulative Impact:</i> Would result in long-term minor cumulative adverse impacts.</p>
	<p><i>Direct/Indirect Impact:</i> Long-term demands on park staff and funding for managing the deer herd and protecting other park resources would result in adverse, long term, and minor to moderate impacts.</p>	<p><i>Direct/Indirect Impact:</i> Installing and maintaining large exclosures and implementing and monitoring reproductive controls would result in long-term, moderate adverse impacts.</p>	<p><i>Direct/Indirect Impact:</i> The need for additional staff time for monitoring and coordinating activities under alternative C would result in adverse, moderate impacts initially, reduced to minor over time.</p>	<p><i>Direct/Indirect Impact:</i> The need for additional staff time for monitoring and coordinating activities under alternative C would result in adverse, moderate impacts initially, reduced to minor over time.</p>
	<p><i>Cumulative Impact:</i> Would result in adverse, long-term, moderate cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, long-term, moderate cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, long-term, minor to moderate cumulative impacts.</p>	<p><i>Cumulative Impact:</i> Would result in adverse, long-term, minor to moderate cumulative impacts.</p>

## ALTERNATIVES CONSIDERED BUT REJECTED

The following alternatives were considered but rejected as explained below:

### MANAGED HUNT

A managed public hunt was considered as a preliminary alternative to reduce the white-tailed deer population. A public hunting alternative was not carried forward for further analysis because it would be inconsistent with existing laws, policies, regulations, and case law regarding public hunts in units of the National Park System; it would be inconsistent with long-standing basic policy objectives for National Park System units; and the likelihood that the NPS would change its long-standing Servicewide policies and regulations regarding hunting in parks is remote and speculative.

Throughout the years the NPS has taken differing approaches to wildlife management, but for the most part it has maintained a strict policy of not allowing hunting in park units of the national park system. In 1970, Congress passed the *General Authorities Act* and in 1978 the “Redwood Amendment,” which clarified and reiterated that the single purpose of the NPS *Organic Act* is conservation. While the *Organic Act* gives the Secretary of the Interior the authority to destroy plants or animals for the purposes of preventing detriment to park resources, it does not give the Secretary authority to permit the destruction of animals for recreational purposes. In 1984, after careful consideration of congressional intent with respect to hunting in national parks, the NPS promulgated a rule that allows public hunting in national park areas only where “specifically mandated by Federal statutory law” (36 CFR 2.2). The NPS re-affirmed this approach in its *Management Policies 2006*.

Congress has not authorized hunting in any legislation for Rock Creek Park. Therefore, in order to legally allow hunting at the park, the current NPS hunting regulation would have to be changed, or Congress would need to specifically authorize hunting. The NPS has a legislative mandate to protect the natural and cultural resources within national parks in order to allow for their enjoyment by future generations. The NPS does not have a mandate to allow public hunting in national parks. At this time, the agency intends to exhaust all other possible alternatives before it attempts to change its governing laws, regulations, or policies due to concerns that such actions may have negative impacts on the visitors and resources of other parks in the national park system.

In addition to legal and policy-related concerns, a managed public hunt was also evaluated based on cost, efficiency, safety, and the likelihood of achieving long-term management goals. A managed hunt has not been shown to be more cost-effective or efficient than other direct reduction methods such as sharpshooting by agency personnel, which is currently allowed under NPS laws and policies. In fact, when compared to sharpshooting, a managed hunt lacks similar efficiency, safety, and the likelihood of successful long-term management.

Based on the literature, costs for managed hunts generally range between \$83 and \$237 for each deer removed (Warren 1997). A white-tailed deer study in Minnesota that compared four lethal removal methods found that the cost of a managed hunt averaged \$117 per deer removed, based on the average net cost per deer after including revenues generated by selling permits to participating hunters (Doerr et al. 2001). Even after considering permit revenue, however, the cost of a managed hunt is not necessarily lower than other removal methods such as sharpshooting. Warren documents that costs for sharpshooting programs have ranged from \$72 to \$260 per deer harvested (Warren 1997). In the Minnesota study mentioned above, the cost for sharpshooting averaged \$121 per deer harvested (compared to \$117 per deer harvested in the managed hunt after revenue from license sales was considered; Doerr et al. 2001). Gettysburg National Military Park reported sharpshooting costs averaged \$128 per deer (Frost et al. 1997). The range of costs for sharpshooting (\$72 to \$260 per animal harvested) substantially overlaps the range of costs reported for managed hunts (\$83 to \$237 per animal harvested), suggesting that there is a minimal to no cost savings by using citizen hunters.

Managed hunts are also less efficient in meeting ungulate reduction project goals when compared to sharpshooting. Doerr et al. noted that the highest harvest rate (0.55 deer per hour) was achieved when sharpshooters shot over bait. This was compared to hunting, which resulted in a rate of 0.03 deer per hour or 31 hunter-hours per deer killed. In addition to harvest rates, sharpshooting is also more selective than hunting. As the reduction in does was the primary goal, 59% of the hunting harvest was females, whereas 63% of the sharpshooting harvest was females (Doerr et al. 2001).

In addition to cost and efficiency, safety is also an issue to consider when using lethal control methods. It is suggested that sharpshooting offers safety features that a typical managed hunt does not. For example, sharpshooting over predetermined bait sites can establish shooting lanes and backstops. Also, sharpshooting can take place when park visitation is low or absent, reducing or eliminating public safety concerns. It is not suggested that hunts are not safe, and in areas where they are used, safety is a major concern that is addressed. However, the extensive planning and oversight that would be required to ensure a level of safety comparable to wildlife professionals engaged in sharpshooting activities would likely make a managed hunt less feasible.

The safety of park visitors and security in developed areas are concerns at Rock Creek Park. Fully addressing these two issues would reduce the area where a managed public hunt could occur, limiting its usefulness. For example, due to developed areas and potentially occupied buildings, approximately 20% of the park would be closed to a managed hunt. This percentage would increase as buffer zones around roads and parking areas would also be created to ensure visitor safety. In addition, the topography of the park would further limit public hunter access to more remote areas of the park. These necessary safety and security restrictions, as well as the landscape of the park, would make it difficult to meet the purpose, need, and objectives of this planning effort.

Several potential problems associated with a managed hunt could seriously impact its effectiveness as a management tool, especially over the long term. The critical assumption in using managed hunts is that an adequate number of hunters would participate annually. This assumption is extremely important because without adequate hunter numbers, management actions would likely fail or be postponed for a year, allowing ungulate populations to continue to increase. A number of studies that have analyzed managed hunts have shown that retaining adequate hunter numbers is difficult, especially as ungulate densities drop and management enters the maintenance phase. Hansen and Beringer (1997) noted that “managed firearm hunts . . . lasting more than two consecutive days are not cost effective because participation and harvest decline sharply after day 2.” In fact, they experienced difficulty in recruiting adequate hunters for areas where hunts had already been conducted. Kilpatrick and Walter documented a 66% decline in hunter applicants in Connecticut from the first to the second year of a controlled hunt. This translated into a 26% decrease in hunter participation after one year (Kilpatrick and Walter 1999). Without consistent annual hunter effort, long-term management through public hunting would likely be unsuccessful.

In conclusion, the NPS considered and rejected a managed public hunt as a reasonable alternative for this plan for the following reasons: (1) implementing a public hunt in this park would require changes to basic NPS regulations and policy or an act of Congress; (2) case law supports dismissing an alternative that would require a major change in long-standing basic policy; (3) other direct removal alternatives, such as using agency personnel as sharpshooters, could be implemented without changing current laws and policies and would better meet the purpose, needs, and objectives of the plan; and (4) other direct removal alternatives raise fewer safety concerns and would have substantially the same environmental effects as a managed hunt.

### **REPRODUCTIVE CONTROL OF BUCKS**

Another form of reproductive control includes sterilization of bucks. In a study of sterilization of feral horses, sterilizing only dominant harem stallions resulted in relatively modest reductions in population growth. Substantial reproduction may occur even when 100% of the dominant harem stallions are

sterilized if other males perform as little as 10% of the breeding. Adequate suppression of population growth may be attained only if a large proportion of all males in the population are sterilized (Garrott and Siniff 1992).

Another study on the use of vasectomy on wolves (*Canis lupis*) suggested that population reduction depends largely on the degree of annual immigration. With high immigration (which could be expected at Rock Creek because of the presence of deer on neighboring parklands), periodic sterilization produced only moderate reductions in population size relative to an untreated population. Similar reductions in population size were obtained by periodically removing large numbers of wolves (Haight and Mech 1997).

Under this alternative, long-term population stability would become an issue, along with genetic variability (a few non-dominant bucks could breed the entire herd). If females did not become pregnant, their estrous cycle could be extended, resulting in later pregnancies and lower survival for fawns born later in the year (as a result of a higher winter-kill potential). The population dynamic and make up of the herd could suffer under this alternative.

Because of the concerns described above relating to effectiveness, population stability, and genetic variability, this alternative was dismissed from detailed analysis.

#### **WOLF REINTRODUCTION**

Relationships between predators and prey are complex, and the impact of predators on herbivore populations is variable (McCullough 1979). Wolves are efficient deer predators, but they have been eliminated from much of the United States. Reintroducing these predators into Rock Creek Park would not be feasible due to a lack of suitable habitat. Wolves have home ranges averaging 30 square miles when deer are the primary prey (Mech 1990), which is much larger than Rock Creek's 4.7 square miles. Most of the park area is surrounded by an urban or suburban environment, making it inappropriate for such predators to be reintroduced (MD DNR 1998). Other native animals, as well as domestic pets, could also become potential prey if wolves were reintroduced to the Rock Creek area.

For the reasons described above relating to effectiveness, habitat limitations, and human safety concerns, reintroduction of wolves was dismissed as a reasonable alternative.

#### **CAPTURE AND RELOCATION**

Capturing deer within Rock Creek Park and relocating them would be in violation of NPS policy regarding translocation, outlined in a Director's CWD Guidance Memorandum of July 26, 2002 (NPS 2002a). Even if the policy was not in effect, relocating deer to areas a sufficient distance from the park to ensure that they would not return would require permits, and because of concerns of CWD testing, possible quarantine processes would be required. Given the abundance of deer in Maryland and most of the United States, recipients for such a program would be very limited. Also, live capture and relocation methods can result in high mortality rates among captured and/or relocated deer. Implementation of this alternative could result in the death of more than 50% of the deer during the first year after release (Jones and Witham 1990). In one study only 15% of the relocated deer survived one year after relocation (O'Bryan and McCullough 1985). Due to the concerns discussed above relating to policy, costs, feasibility, and high mortality, capture and release was dismissed as a reasonable alternative.

#### **SUPPLEMENTAL FEEDING**

Providing supplemental food sources for deer would potentially decrease browsing pressure on vegetation resources at Rock Creek Park. However, increasing food sources would increase deer health and reproduction, leading to a growing deer population. In the long term this would compound problems associated with high deer numbers (MD DNR 1998). For these reasons, this alternative was dismissed.

### **FENCING THE ENTIRE PARK (OR EXCLUSIVE USE OF FENCING)**

The entire park unit could be fenced to prevent deer from entering or leaving. A fence approximately 8 feet high would be needed to prevent deer from jumping over the barrier. However, vegetation within Rock Creek Park would continue to suffer the effects of deer browsing, the deer population within the fenced area would continue to increase, and the health of the contained herd would suffer. Therefore, all deer within the fenced area would either need to be removed or the deer population within the fence would need to be managed with other methods to meet the objectives of the park management plan. For these reasons, this alternative was dismissed.

Exclusive use of fencing would not be sufficient to protect sensitive plant species and allow for forest regeneration. To protect sufficient area, fencing would need to cover a large portion of the park, and this would result in unacceptable impacts to visitor use, visual quality of the park, the cultural landscape of the park, and other wildlife species. Areas not fenced would be subject to increased pressure from deer browsing. For these reasons, exclusive use of fencing without other action to reduce deer numbers was eliminated as a reasonable alternative, but fencing was included as a component of alternative B.

### **CONTRAGESTIVES**

A contragestive is an abortion drug applied after a doe becomes pregnant that terminates the pregnancy. Therefore, this method would need to be implemented annually. Depending on the stage of pregnancy, the drug could make the delivery of a dead fetus difficult if it is late in the pregnancy; however, if applied too early a doe could become pregnant again. Efficacy is approximately 75% to 80% depending on timing. Contragestive agents provide two distinct differences from contraceptive control methods: the time of application (during pregnancy rather than prior to) and the potential harm to the deer. This method could be used in conjunction with a contraceptive program to supplement their effectiveness, essentially treating animals missed with contraceptive treatments or those where the treatment was not effective. The difficulty then becomes how to determine which deer are pregnant. This would require either substantial monitoring/observation of the deer or recapturing of does to check for pregnancy.

Given the number of deer in the area and the size of the park, implementation of contragestives on a large scale would not be feasible due to the amount of staff time and monitoring required deeming it effective. Even on a limited scale, the use of other reproductive control measures would provide greater efficacy and efficiency than contragestives. In addition, contragestives may be considered inhumane because of their mode of action and there is potential to harm the doe. There is also concern about potential effects to non-target species (through food chain transfer). Therefore, the park has dismissed the use of contragestives as a reproductive control option.

### **WIDESPREAD USE OF REPELLENTS**

Although limited use of commercially available repellents would be considered in small areas around landscaped vegetation, large-scale application of repellents is not practical due to the need for frequent applications resulting in high application cost, label restrictions on use, and variable effectiveness. Repeated applications of spray repellents would be necessary due to weather and emergence of new growth. Because the effectiveness of repellents is variable and is least effective with high deer densities and size of the areas that would require treatment, repellent use within the park as a management alternative was dismissed.

### **LANDSCAPE MODIFICATION/PLANTINGS**

White-tailed deer are very adaptable animals and they will adjust their diets to available food sources. Therefore, trying to manage a deer population through managing the habitat to manipulate deer feeding behavior and movements in a highly fragmented environment, surrounded by suburban land uses would be extremely complex, inefficient, and likely unsuccessful.

Introducing plantings of non-palatable species on a parkwide scale would not be feasible. Typically, non-palatable plants are those that are nonnative and often invasive, which is counter to the goals of most parks, including Rock Creek. The effort needed to replace existing palatable vegetation with non-palatable would be extensive and the result expected is that deer would eventually adapt to the available food source. Additionally, removal of large areas of existing vegetation would have adverse effects on other wildlife species.

Landscape modification does not appear to be a viable option for reasons described above. Additionally, landscape modification actions to discourage deer density would also negatively impact other wildlife. Drastic landscape modification actions, such as removing large tracts of forests to eliminate deer cover, would require additional NEPA documentation. Based on the reasons above, this alternative was dismissed.

### **SPEED LIMIT REDUCTION**

Implementation of a reduced speed limit through the park, with the intent to reduce deer/vehicle collisions, was raised by the public in public scoping as a desired action for the park to consider. However, this is not consistent with the objectives of the park nor would it address the problem being addressed by this plan, the overbrowsing of vegetation by deer. Therefore, this was not considered as an alternative element.

### **CONSISTENCY WITH THE PURPOSES OF THE NATIONAL ENVIRONMENTAL POLICY ACT**

The *National Environmental Policy Act* requires an analysis of how each alternative meets or achieves the purposes of the act, as stated in Section 101(b). Each alternative analyzed in a NEPA document must be assessed as to how it meets the following purposes:

- (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
- (2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;
- (3) attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
- (4) preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;
- (5) achieve a balance between population and resource use that would permit high standards of living and a wide sharing of life's amenities; and
- (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

The CEQ has promulgated regulations for federal agencies' implementation of NEPA (40 CFR Parts 1500–1508). Section 1500.2 states that federal agencies shall, to the fullest extent possible, interpret and administer the policies, regulations, and public laws of the United States in accordance with the policies set forth in the act (sections 101[b] and 102[1]); therefore, other acts and NPS policies are referenced as applicable in the following discussion.

## *Alternatives*

Alternative A: No Action

Alternative B: Combined Non-Lethal Actions

Alternative C: Lethal Action

Alternative D: Combined Lethal and Non-Lethal Actions

### **ENVIRONMENTALLY PREFERRED ALTERNATIVE**

The NPS is required to identify the environmentally preferred alternative in its NEPA documents for public review and comment. Guidance from the CEQ states that the environmentally preferred alternative is “the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources” (CEQ 1981). Alternative D was selected as the environmentally preferred alternative, because it is the alternative that would best protect the biological and physical environment by ensuring an immediate reduction in deer population numbers that could be sustained with proven methods over the life of the plan. Alternative D would also best protect, preserve, and enhance the cultural and natural processes that support the park’s forests and cultural landscapes by providing multiple management options to maintain low deer numbers. Although alternatives C and D are very close in meeting the guidance for identification of the environmentally preferred alternative, alternative D was selected primarily because it provides the park with the ability to select the least environmentally damaging option as science and technology advance. Alternatives A and B were not considered environmentally preferred because of their lack of effect on the deer population numbers, which would result in potential or continued adverse impacts on the biological and cultural resources of the park over the life of the plan.

### **NATIONAL PARK SERVICE PREFERRED ALTERNATIVE**

To identify the preferred alternative, the planning team evaluated each alternative based on its ability to meet the plan objectives (see table 11) and the potential impacts on the environment (“Chapter 4: Environmental Consequences”). Alternative D was identified as the NPS preferred alternative.

Both alternatives C and D fully meet the plan objectives and are very close in their meeting of all objectives and their relative impacts. However, alternative D provides for the opportunity to use a wider variety of management methods, including reproductive control, which would be an option when the criteria established by the planning team are met. Alternative D provides for an efficient initial removal of deer, and the flexibility to address future removals in different ways. If reproductive control is used, there could be reduced impacts relating to visitors, safety, and the environment, by eliminating the need to close the park for extended periods of time and limiting the time that shooting would occur in the park.

Alternative B partially meets some of the objectives, because of the lack of immediate reduction in deer numbers and the uncertainty that the deer density goal would be achieved even over an extended period of time. Alternative A (no action) fails to meet or fully meet the objectives of the plan, since no action would be taken to reduce deer numbers or effect a change in conditions that are the basis for the purpose of and need for action.

NPS will consider comments on this Draft Plan/EIS and may modify or adjust the preferred alternative accordingly. Any modifications or adjustments will be disclosed in the published Final EIS. A Record of Decision will follow the Final EIS and will be made available to the public.

## AFFECTED ENVIRONMENT

The “Affected Environment” describes existing conditions for those elements of the natural and cultural environments that would be affected by the implementation of the actions considered in this Draft White-tailed Deer Management Plan / Environmental Impact Statement (plan/EIS). The natural environment components addressed include vegetation; soils and water quality; wetlands and floodplains; wildlife and wildlife habitats (including deer); and rare, unique, threatened, or endangered species. The Rock Creek Park cultural environment includes cultural landscapes, soundscapes, visitor use and experience, visitor and employee safety, socioeconomic resources, and park management and operations. Impacts for each of these topics are analyzed in “Chapter 4: Environmental Consequences.”

### VEGETATION

#### CURRENT VEGETATION STATUS AND ROLE OF DEER

Numerous studies within eastern deciduous forests have shown that browsing by white-tailed deer (*Odocoileus virginianus*) at densities greater than 15 to 20 deer per square mile can influence forest regeneration success (Hough 1965; Behrend et al. 1970; Marquis 1981; Tilghman 1989; Redding 1995; Augustine and deCalesta 2003; Bowersox et al. 2002; Horsley et al. 2003; Sage et al. 2003). Deer impacts on plant communities consist of three primary effects: (1) failure to reproduce, especially in slowly maturing woody species where seedlings are killed; (2) alteration of species composition, which occurs where deer remove preferred browse species and indirectly create opportunities for less preferred or unpalatable species to proliferate; and (3) extirpation of highly palatable plants, especially those that were naturally uncommon or of local occurrence (Langdon 1985). For more than 20 years, Rock Creek Park has collected data on the park’s white-tailed deer population that has shown that the rising number of deer may be adversely impacting plant communities in the park.

Vegetation monitoring results have demonstrated the role of deer in the current vegetation status of the park. In analyses by Hatfield (2005), data from the long-term (unfenced) vegetation plots indicate that in 1991,  $3.1 \pm 0.9\%$  of the stems were browsed compared to  $31.1 \pm 2.9\%$  in 2003. During this time, the shrub cover decreased from  $54.63 \pm 5.9\%$  in 1991 to  $14.92 \pm 2.2\%$  in 2003. Tree seedlings decreased significantly from 1991 across all other years measured.

The number of tree seedlings to replace the loss of a portion or all of a forest is called the “stocking rate,” (or the tree seedling weighted measure, appendix A). Tree seedlings were weighted by height class because the taller

seedlings survive better than the shorter seedlings. The tree seedling weighted measures for 1991 through 2003 were all below the recommended level for successful forest regeneration; that is, 67% of the long-term plots had less than 51 tree seedlings in all areas of the park (see discussion of action thresholds in chapter 2). Preliminary data from 2007 (Hatfield 2008) reinforced this result. Seedling counts for all height classes were near zero in 2007, and the tree seedling weighted measure was  $2.26 \pm 0.32\%$  for high deer density conditions, far under the recommended value of 67%.



*Corner marker of long-term plot*

Rossell et al. (2007) showed in analysis of 4 years of paired fenced and unfenced plot data that deer are adversely impacting plant communities in the park. The greatest effects of deer browsing occurred nearest the ground (0 to 30 cm, or about 12 inches) on structure and cover. The vegetation thickness measure is used as an index for wildlife using the habitat for cover or concealment. Vegetation cover at the bottom interval significantly increased by 30% in the paired-fenced plots compared to the paired-unfenced plots, which remained unchanged over the 4 years. There was significantly less plant cover for native species in paired-unfenced plots compared to the paired-fenced plots. This impact was seen in significantly less herbaceous and woody plant cover.

## OVERVIEW OF ROCK CREEK PARK VEGETATION

Rock Creek Park runs along the topographic break separating the Piedmont Plateau and the Atlantic Coastal Plain provinces. The vegetation in Rock Creek Park bears resemblance to both of these provinces and is closely aligned with vegetation types described in the nearby states of Maryland, New Jersey, Pennsylvania, and Virginia.

Approximately 80% (2,471 acres) of the park is covered with mature second growth forest that is approximately 125 years old. Activities before the park's establishment in 1890, such as timber cutting, farming, and Civil War clearing, removed much of the original forest. A few large oaks (*Quercus* spp.) still living in the park are estimated to be more than 275 years old and may be remnants of virgin growth. Woodlands currently in the park are primarily a mixture of deciduous species typical of the eastern deciduous forest in the later stages of succession (NPS 2005d).



*Forest vegetation at Rock Creek Park*

Rock Creek Park consists of the largest unbroken forest in the Washington metropolitan area, providing habitat for much of the city's wildlife and acting as an important contributor to the region's biodiversity. Past surveys have shown that the main unit of Rock Creek Park (Reservation 339) serves as a major reservoir of native flora for the region (NPS 2005a). Within Rock Creek Park, the deciduous forested habitat is characterized by an overstory dominated by tulip poplar (*Liriodendron tulipifera*) with fewer numbers of hickory (*Carya*) species, green ash (*Fraxinus pennsylvanica*), American beech (*Fagus grandifolia*), white oak (*Quercus alba*), northern red oak (*Quercus rubra*), southern red oak (*Quercus falcata*), and black locust (*Robinia pseudoacacia*). Dominant understory species in the forest include saplings, American holly

(*Ilex opaca*), spicebush (*Lindera benzoin*), greenbrier (*Smilax* spp.), Japanese honeysuckle (*Lonicera japonica*), English ivy (*Hedera helix*), and poison ivy (*Toxicodendron radicans*). There are also remnant Virginia pines (*Pinus virginia*) that occur mostly as scattered individuals or small clusters, as well as pine-oak mixed woodlands. Other vegetative types in the park include maintained lawns with landscaped trees and shrubs, including American holly, pin oak (*Quercus palustris*), willow oak (*Quercus phellos*), and tulip poplar saplings; and shrubs including witch hazel (*Hamamelis* spp.) and smooth serviceberry (*Amelanchier arborea*).

## FOREST COMMUNITIES

Figure 5 depicts the primary vegetation cover types found within Rock Creek Park. The primary forest associations in the park are also shown on figure 5, listed in table 13, and described below, based on the summaries provided in the National Biological Survey (NBS)/NPS Vegetation Mapping Program's *Vegetation Classification of Rock Creek Park* (The Nature Conservancy 1998).

# Rock Creek Park Units District of Columbia

Figure 5. Vegetation - 1998

## Legend

-  Park Boundary
-  District Boundary
-  Interstate
-  Major Road

## Vegetation Legend

-  Beech-White Oak/Mayapple Forest (Classic Type)
-  Beech/Tulip Poplar Variant of Beech White Oak/Mayapple Forest
-  Mixed Oak/Beech Variant of Beech-White Oak/Mayapple Forest
-  Tulip Poplar Forest
-  Chestnut Oak Forest
-  Sycamore-Green Ash Forest
-  Loblolly Pine-Mixed Oak Forest
-  Virginia Pine-Oak Forest
-  Shrub Areas
-  Forest Canopy Gap
-  Managed Grass/Lawns
-  Meadow Grass/Lawns with Trees
-  Meadow Grasslands
-  Water
-  Urban Disturbed

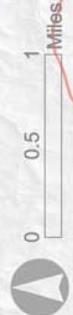
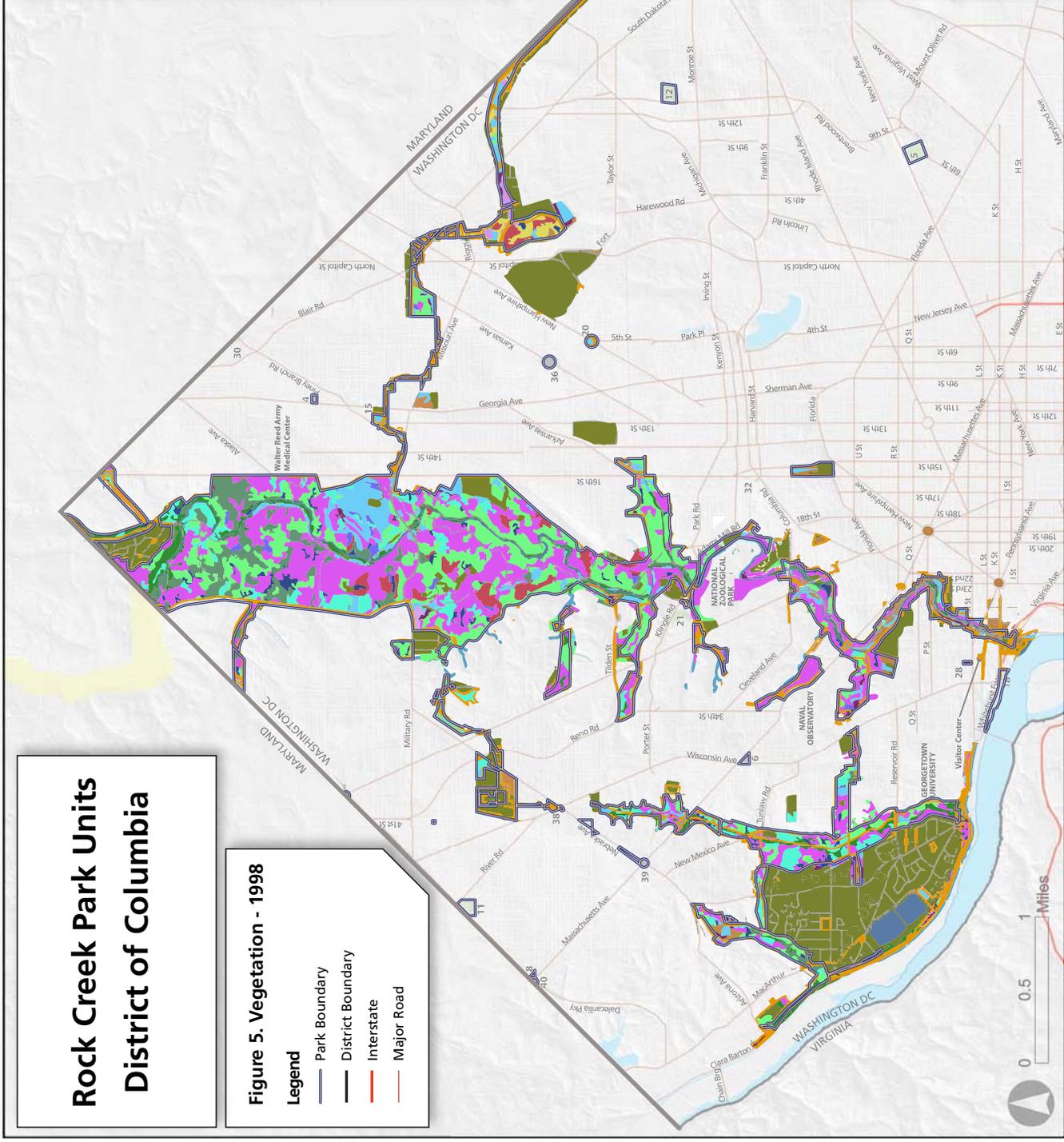
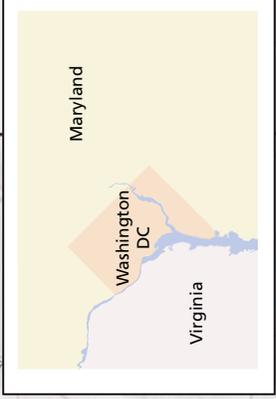




TABLE 13. FOREST ASSOCIATIONS FOUND WITHIN ROCK CREEK PARK

Forest Type	Major Tree or Shrub Species – Common Name	Major Tree or Shrub Species – Scientific Name	Acreage	Percent Cover in Park
<i>Beech-White Oak / Mayapple Forest</i>	Beech	<i>Fagus grandifolia</i>	996.27 (Most widespread association across the park)	33.2%
	White oak	<i>Quercus alba</i>		
	Mayapple	<i>Podophyllum peltatum</i>		
<i>Mixed Oak-Beech Variant</i>	Beech	<i>Fagus grandifolia</i>	619.38	20.7%
	Oak	<i>Quercus</i> spp.		
<i>Beech-Tulip Poplar Variant</i>	Beech	<i>Fagus grandifolia</i>	194.72	6.5%
	Tulip (yellow) poplar	<i>Liriodendron tulipifera</i>		
<i>Tulip Poplar Forest</i>	Tulip (yellow) poplar	<i>Liriodendron tulipifera</i>	245.87 (Scattered throughout the park)	8.2%
<i>Chestnut Oak Forest</i>	Chestnut oak	<i>Quercus prinus</i>	114.69 (Restricted primarily to hilltops)	3.8%
	Black oak	<i>Quercus velutina</i>		
	Huckleberry	<i>Gaylussacia baccata</i>		
<i>Sycamore-Green Ash Forest</i>	Sycamore	<i>Platanus occidentalis</i>	185.93 (Occurs only in floodplains, along narrow stream corridors in the park)	6.2%
	Green ash	<i>Fraxinus pennsylvanica</i>		
<i>Loblolly Pine-Mixed Oak Forest</i>	Loblolly pine	<i>Pinus taeda</i>	77.24 (Although uncommon in the park, widespread on the coastal plain from New Jersey, Maryland, Virginia, and south)	2.6%
	White oak	<i>Quercus alba</i>		
	Southern red oak	<i>Quercus falcata</i>		
	Post oak	<i>Quercus stellata</i>		
<i>Virginia Pine-Oak Forest</i>	Virginia pine	<i>Pinus virginiana</i>	37.08 (Uncommon in the park)	1.2%
	White oak	<i>Quercus alba</i>		
	Southern red oak	<i>Quercus falcata</i>		
	Post oak	<i>Quercus stellata</i>		
	Black oak	<i>Quercus velutina</i>		
<b>TOTAL</b>			<b>2471.18</b>	<b>82.4%</b> <b>(% of acres forested in the park)</b>

The **beech-white oak / mayapple association** is found on moderately dry slopes or gentle gradients on well-drained acidic sandy loam soils. The canopy is dominated by white oak, beech, and tulip poplar, and subcanopy and shrub layer species include American holly, flowering dogwood (*Cornus florida*), and mapleleaf viburnum (*Viburnum acerifolium*), which often forms a well-defined shrub layer. Herbaceous composition ranges from sparse to dense depending on soil type, disturbance history, and moisture. Typical herbaceous species include mayapple and jack-in-the-pulpit (*Arisaema atrorubens*). Christmas fern (*Polystrichum acrostichoides*) may be locally abundant, typically on hillsides.

Two variants of the beech-white oak/mayapple forest occur in the park; their composition and location relate to the local soil moisture regime. The mixed oak-beech variant occurs on drier sites, while the beech-tulip poplar variant occurs on more mesic (moderately moist) sites. The **mixed oak-beech variant** is characterized by a greater percent cover of oaks and less dominance by tulip poplar. The canopy is co-dominated by a mix of red oak, black oak, white oak, and chestnut oak. Beech usually occurs in the subcanopy and mapleleaf viburnum is common, but spicebush, hornbeam (*Carpinus caroliniana*), and jack-in-the-pulpit are conspicuously lacking or sparse, which distinguishes this from the classic beech-white oak-mayapple association. On the other hand, the **beech-tulip poplar variant** is characterized by a dominance of tulip poplar and beech in the canopy and subcanopy. Hornbeam is very characteristic and spicebush and viburnums (*Viburnum* spp.) are common in the shrub layer. The herb layer may be diverse, with jack-in-the-pulpit more prevalent. This variant often occurs near streams although not on the floodplain itself.

The **tulip poplar association** occurs on mesic, mid-slope to low-slope sites that were cleared and/or cultivated at one time. The canopy is dominated by tulip poplar, with no co-dominants. Tulip poplar and box elder (*Acer negundo*) comprise the subcanopy and spicebush and blackberry (*Rubus allegheniensis*) are present in the shrub layer. These sites tend to be weedy and nonnative plants are often prevalent.

The **chestnut oak forest (chestnut oak-black oak / huckleberry association)** occurs on ridgetops, upper slopes, and south-facing slopes on rocky soils with little organic matter. Surface runoff and erosion are common and of concern. There is a predominance of chestnut oak and blackgum (*Nyssa sylvatica*) and an absence or sparse cover of white oak. Red oak and/or black oak and red maple (*Acer rubrum*) are often present but sparse. Serviceberry (*Amelanchier* spp.) and sassafras (*Sassafras albidum*) are typical in the subcanopy and vines such as greenbrier and grape (*Vitis* spp.) are common. Characteristic shrubs include blueberry (*Vaccinium pallidum*), huckleberry, mountain laurel (*Kalmia latifolia*), and azalea (*Rhododendron periclymenoides*). The herbaceous layer tends to be sparse or absent.

The **sycamore-green ash association** is a floodplain forest, found along stream banks, low terraces, and other areas subject to temporary or irregular flooding. It occurs mostly on Codorus silt loam, with smaller deposits of sand and gravel intermixed on small tracts of 30 to 40 acres. The canopy is characterized by sycamore and box elder, with red maple and tulip poplar often co-dominant with the sycamore. Green ash, white ash (*F. americana*), and hickory species are frequent associates. The shrub layer may be dominated by spicebush, with black haw (*Viburnum prunifolium*) occurring less frequently. Characteristic herbaceous species include jewelweed (*Impatiens capensis*), mild water-pepper (*Polygonum hydropiperoides*), jack-in-the-pulpit, enchanter's nightshade (*Circea quadrisulcata*), skunk cabbage (*Symplocarpus foetidus*), and others.

The **loblolly pine-mixed oak association** is found exclusively on Joppa soils in the park, which are well-drained to excessively well-drained sandy loams of the coastal plain, on mid- to lower slopes or in sheltered ravines. This association is distinguished by the relatively high diversity of tree species, including a number of species that are not common at other locations in the park. No single species is dominant in the canopy. The community is characterized by the presence of black cherry (*Prunus serotina*), sweet gum (*Liquidambar styraciflua*), loblolly pine, blackjack oak (*Q. marilandica*), chestnut oak, post oak, and southern red oak. Willow oak is typical in the subcanopy and shrub layer. Beech tends to be absent or sparse. Typical shrubs and vines include Pennsylvania blackberry (*Rubus pennsylvanicus*),

greenbrier, Virginia creeper (*Parthenocissus quinquefolia*), arrow-wood (*Viburnum dentatum*), poison ivy, and grape. The herbaceous layer tends to be patchy, with seedlings of canopy tree species.

The **Virginia pine-oak association** occurs on well-drained soils of hilltops in the park. It is an early to mid-successional forest characterized by the presence of Virginia pine in the canopy. Associates include white oak, southern red oak, post oak, black oak, tulip poplar, and beech. Mapleleaf viburnum is typical in the shrub layer and herbs tend to be sparse.

Shrub areas in the park are found in forest openings, either along ecotones or in small gaps within the forest matrix. These occur on many different soil types and are an early successional stage, often with many exotic species. Typically seen are vines growing over blackberry, spicebush, and/or tree seedlings of tulip poplar, cherry, or slippery elm (*Ulmus rubra*).

**Meadow habitats** are also present in the park, with a total of 15 small meadow areas ranging in size from 0.3 to 4 acres. The meadow areas are composed mostly of deep grass and other herbs that grow when frequent mowing of lawn areas is stopped.

Some wetland vegetation is found in small areas of the sycamore-green ash association adjacent to Rock Creek (see the “Wetlands and Floodplains” section). Most wetland vegetation that naturally occurred along Rock Creek has been eliminated and replaced with seeded and transplanted species as the land was developed. The selection of species used for landscaping was based primarily on aesthetics and growth characteristics in the past, but now only native species are used unless a specific species is needed as part of a cultural site.

## EXOTIC INVASIVE SPECIES

### BACKGROUND

Invasive nonnative plants (exotic species) seriously threaten the integrity of native habitats, including eastern deciduous forests, by aggressively displacing and killing native plants, altering native habitats, and stifling forest regeneration. Exotic species populations have been slowly increasing over the past century or more and seem to have exploded within the last 30 years. The exotic species problem is particularly acute in urban parklands where extensive edges and frequent human disturbances enhance opportunities for aggressive exotic plants to become established, such as at Rock Creek Park (NPS 2004a).

Ornamental vines like Asiatic bittersweet (*Celastrus orbiculatus*), porcelain berry (*Ampelopsis brevipedunculata*), and English ivy kill trees along the edges of forest openings. Multiflora rose (*Rosa multiflora*) forms occasional dense thickets that out-compete native shrubs and ground covers. Herbaceous invaders like lesser celandine (*Ranunculus ficaria*) and Japanese stiltgrass (*Microstegium vimineum*) blanket the floodplain, crowding out native herbaceous species and, in some cases, changing soil chemistry to make it harder for native plants to recover. Most invasive plants get started in open, disturbed areas where there is ample space and light. However, several of the most aggressive invaders Asiatic bittersweet, English ivy, burning bush (*Euonymus alatus*), privet (*Ligustrum* spp.), nonnative viburnums (*Viburnum plicatum*, *V. dilatatum*, and *V. sieboldii*), Japanese barberry (*Berberis thunbergii*), garlic mustard (*Alliaria petiolata*), lesser celandine, and Japanese stiltgrass also penetrate undisturbed forest interiors, reducing light levels to the forest floor, limiting regeneration, and displacing native shrubs and saplings (NPS 2004a). Deer can promote nonnative species through habitat alteration (disturbance to vegetation and soils from trampling) and through seed dispersal from seeds carried on their coats or found in fecal matter (Vellend 2002; Vellend et al. 2004; Williams and Ward 2006).

The threat of exotic species in Rock Creek Park was recognized as early as the 1970s, when control efforts were undertaken against kudzu (*Pueraria lobata*) in the park. During the late 1970s, research specialists began studying the effects of several of the most aggressive vines including English ivy, wisteria (*Wisteria sinensis*), and kudzu. Park staff implemented various pilot projects to document the

spread of exotic species and find treatments for the most obvious threats. A research project was initiated in 1996 to determine the environmentally safest and most effective means of controlling woody vines, especially Asiatic bittersweet and porcelain berry, which were identified as the most ecologically damaging exotic species in the park. All other woody exotic species identified were also treated to avoid having one exotic plant replace another. During this research, staff treated not only the test plots, but also began to treat woody exotic species in large areas within the northern floodplains of the park. Another three-year research project (2000–2002) determined effective control methods for the invasive spring ephemeral lesser celandine. These studies have provided valuable information about how to control these most serious exotic plants. Through this research, park staff learned a great deal about the biology of the various species invading parklands and control methods for those that have been identified in the past (NPS 2004a).

The park began an invasive exotic plant management program in 1996 and efforts have thus far been directed at extending the areas treated during the research. Research plots were positioned in the densest areas of Asiatic bittersweet and porcelain berry and at the upstream end of Rock Creek in the park. Starting at these heavily infested areas allowed staff to remove the seed source for many woody vines in the Rock Creek floodplains. These floodplains also contain ephemeral ponds, an important wildlife habitat. In 2004, the park completed a draft of the “Invasive Exotic Plant Management Plan” (NPS 2004a). The purpose of this plan is to describe the principles under which exotic plant management will be prioritized and undertaken for all the natural areas within the park. The plan details methods to be used, with the understanding that methods will be adapted as more effective and efficient methods are developed and/or monitoring indicates that current methods are ineffective.

#### **EXOTIC INVASIVE SPECIES IN ROCK CREEK PARK**

There are currently 286 nonnative vascular plant species known to exist in the park, which vary widely in terms of their current and potential ecological effects. Some nonnative species have naturalized, but are not expected to cause damage to the ecosystem by displacing native species or changing the critical characteristics of the system, while a few species are ecologically destructive when allowed to spread. Several factors influence the relative adverse effects of a given exotic plant species:

- invasiveness, based on its life history
- potential ecological harm
- treatment potential
- discreteness of population

Based on literature searches and direct observation, the park’s natural resource management staff identified 56 of the 286 species that seem to be negatively impacting the park’s natural resources or have the potential to do so. Based on FY 2007 and 2008 expenditures to date, the park is spending about \$100,000 annually on invasive plant species control, including staff and volunteer time and contracted work (K. Ferebee, pers. comm. 2008e).

## SOILS AND WATER QUALITY

### SOILS

The primary concern related to soils and deer management identified in this plan/EIS is the potential for greater erosion as a result of increased deer browsing, which can reduce vegetative ground cover and result in sedimentation in the waters associated with the Rock Creek watershed. As detailed in the *1976 Soil Survey for the District of Columbia* (USDA 1976), 25 major soil types are documented within Rock Creek Park. Nearly all of these are moderately erodible, as indicated by their soil erodibility factor (K), which indicates the susceptibility of the whole soil to sheet and rill erosion by water. Possible values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water. For the purposes of this analysis, soils with an erodibility factor of 0.20 to 0.40 are considered moderately erodible, and soils with an erodibility factor greater than 0.40 are considered highly erodible. Therefore, based on the available soil survey data, most of Rock Creek Park's soils are identified as being moderately erodible, and two (Beltsville silt loam and Christiana silt loam) are highly erodible (USDA 1976). Both of these are found only in the Fort Circle Parks east of Rock Creek Park where deer are not currently found.

The degree of erodibility that soils exhibit is determined by physical factors such as drainage, permeability, texture, structure, and percent slope. The rate of erodibility is based on the amount of vegetative cover, climate, precipitation, proximity to water bodies, and land use. Disruptive activities accelerate the natural erosion process by exposing these erodible soils to precipitation and surface runoff, and those erodible soils found on steeper slopes and along the stream banks in the park would be susceptible to impacts from vegetation removal and trampling.

Currently, the park's soil resources are being adversely affected by accelerated erosion, compaction, and deposition caused by human activities inside and outside the park boundaries. Some areas that receive heavy visitor use are subject to soil compaction, removal of vegetation cover, and erosion. This is particularly evident along streambanks, at picnic groves and other popular recreation areas, and along heavily used or infrequently maintained trails. Accelerated streambank erosion is occurring as a result of increased runoff from the upstream watershed in the northern portion of the park. Associated deposition of some of the eroded soils is occurring in the floodplains in the central and southern portions of the park and parkway (NPS 2005a).

## WATER QUALITY

### ROCK CREEK WATERSHED OVERVIEW

As mentioned above, the primary issue relating to water quality and deer at Rock Creek Park is the potential for siltation from eroding soils or construction of exclosures near streams. Rock Creek is the primary water feature within Rock Creek Park. The creek flows from its headwaters in Laytonsville, Maryland, through Montgomery County, Maryland, and the northwest portion of Washington, D.C., to join with the Potomac River at Georgetown. The watershed is approximately 76.5 square miles with 15.9 square miles contained within the District of Columbia (DCDOH 2004a).

Two major tributaries drain into Rock Creek within Rock Creek Park. Broad Branch, which enters from the northwest, just opposite the intersection of Blagden Avenue and Beach Drive, and Piney Branch, which enters Rock Creek from the northeast at Piney Branch Parkway, approximately one-half mile south of Broad Branch. Sixteen smaller tributaries enter Rock Creek in Rock Creek Park. Figure 6 depicts the major watercourses and drainages in the Rock Creek watershed.

## EXISTING WATER QUALITY

An estimated 500,000 people reside within the Rock Creek Watershed, with approximately 70% of residential development occurring upstream from Rock Creek Park. Much of the developed area consists of impervious surfaces, such as buildings, roads, and driveways. Impervious surfaces (such as concrete and pavement) decrease the amount of rainfall that reaches the soil and increase the volume and velocity of stormwater that enters surface drainages during storms. The high level of development and increase of impervious surfaces within the watershed has led to increased stormwater runoff, which has damaged Rock Creek and its tributaries by increasing the amount of sedimentation in the creek, as well as carrying other pollutants into creek waters (NPS 2005a). Increases in stormwater runoff within the watershed increases the peak flow rates in Rock Creek, which increases the water velocities in the stream channel, resulting in erosion along the stream banks and excessive sedimentation downstream. Stream erosion activity widens the stream, reducing the depth of water during low flow periods and degrading the quality of the stream as aquatic habitat. Within Rock Creek Park, erosion is primarily the result of bank destabilization along drainage ways and tributaries of Rock Creek, and sedimentation and excess turbidity are most apparent in the smaller tributaries that are spring-fed and have less upstream flow (K. Ferebee, pers. comm. 2008a). Areas denuded of vegetation by deer browse, visitor use, or other disturbances also contribute to stormwater runoff and increase the potential for erosion and the transport of sediments and surface pollutants into adjacent water bodies.



Water quality in the Rock Creek watershed has been adversely affected by inputs from the surrounding urban area, including runoff from bare soils and construction sites (sediment); transportation corridors and parking lots (oils and greases, metals, sediments); and lawns, stables, and leaking sewer lines (coliform bacteria) (NPS 2005a). In 1996, the District of Columbia submitted the Total Maximum Daily Load (TMDL) Priority List and Report to the U.S. Environmental Protection Agency (EPA) containing a list of waters that do not or are not expected to meet water quality standards as required by Sections 303(d) of the *Clean Water Act*. These waters are then considered “impaired” for certain constituents under the *Clean Water Act* definition of impaired, which is not the same as the National Park Service (NPS) definition of that term. The Section 303(d) list was revised in 2002 based on additional water quality data. The TMDL for Rock Creek within the District of Columbia was completed in 2004 (DCDOH 2004a). All segments of Rock Creek in the park are listed as impaired by organics, bacteria, fecal bacteria, and metals (DCDOH 2004a).

The District also developed TMDLs for Rock Creek tributaries for organics and metals. Only Piney Branch was considered impaired for metals, while all tributaries were considered impaired for organics and fecal coliforms (DCDOH 2004b).

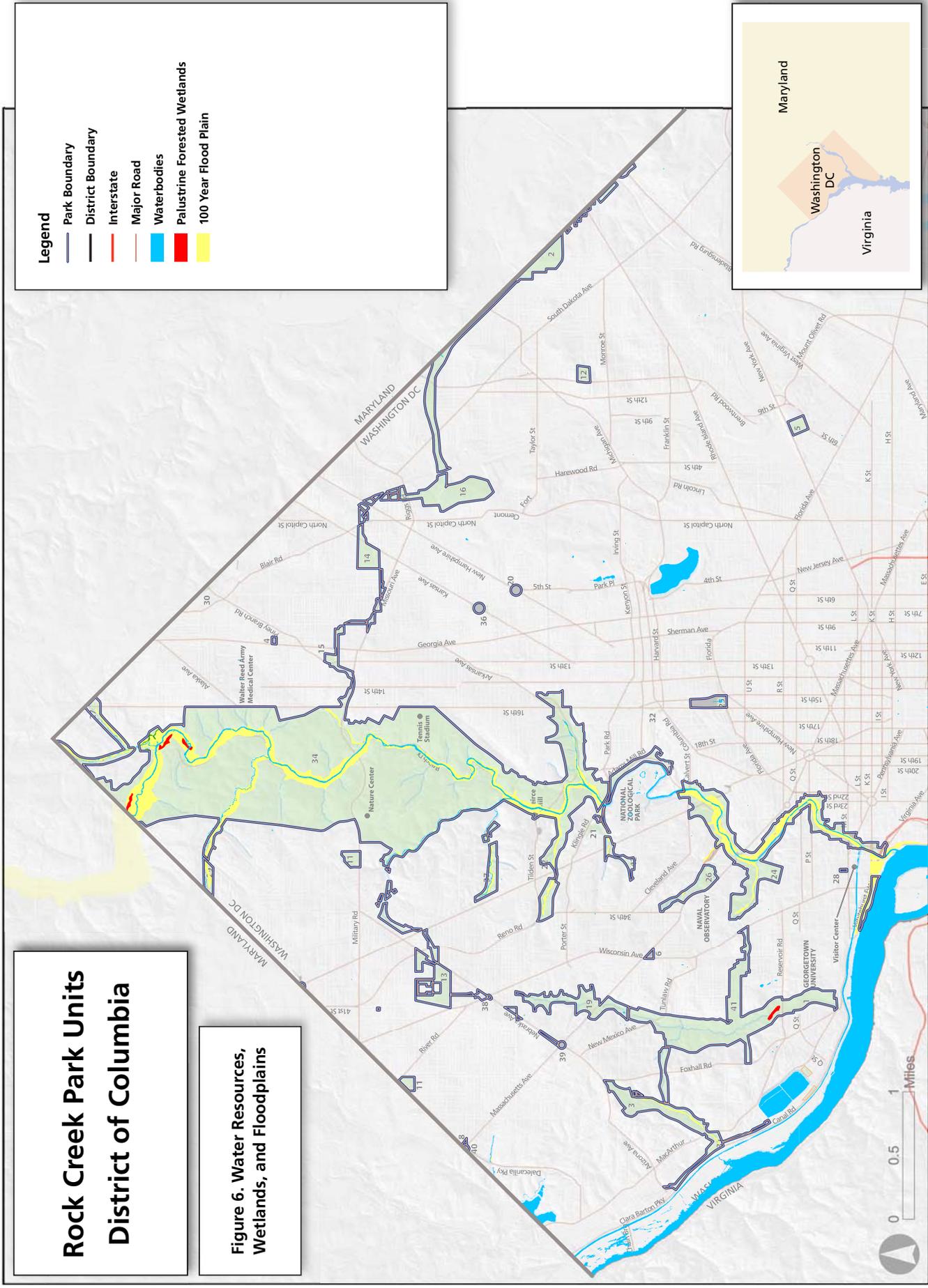
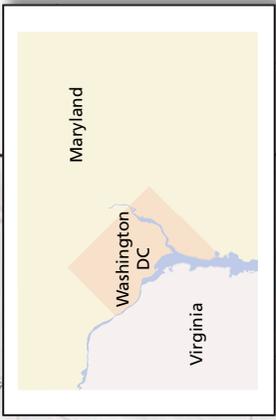
## STREAM DESIGNATIONS AND WATER QUALITY STANDARDS

For the purposes of water quality standards, the surface waters of the District of Columbia are classified based both on their current uses and the future uses to which the waters could be restored. Each designation category has applicable water quality standards that are the principal water quality management objectives for the park. The standards and classification of the District’s waters are published in the *District of Columbia Register, Chapter 11 of Title 21 DCMR* (NPS 2005a).

# Rock Creek Park Units District of Columbia

**Figure 6. Water Resources,  
Wetlands, and Floodplains**

- Legend**
-  Park Boundary
  -  District Boundary
  -  Interstate
  -  Major Road
  -  Waterbodies
  -  Palustrine Forested Wetlands
  -  100 Year Flood Plain





The District of Columbia Water Resources Management Division has designated Rock Creek and its tributaries for restoration to meet all five beneficial use classes. The classes and the status of surface waters in the park in meeting the standards associated with the classes are as follows:

- Class A is for primary contact recreation.
  - These standards are not being met in Rock Creek and its tributaries.
- Class B is for secondary contact recreation and aesthetic enjoyment.
  - These standards are not being met in Rock Creek and its tributaries.
- Class C is for propagation of fish, shellfish, and wildlife.
  - The water quality in some of the tributaries partially supports the Class C designation, but the water quality of Rock Creek does not currently support this designation.
- Class D is for protection of human health related to consumption of fish and shellfish.
  - The Class D standards are partially supported below the Peirce Mill Dam. However, at the time these standards were designated, the creek above the dam was not assessed for support of the Class D standards, because the dam would continue to be a barrier to the migration of fish until a fish bypass is completed as part of the mitigation program for the Woodrow Wilson Bridge. This bypass has recently been completed.
- Class E is for navigation.
  - The Class E designation is supported in Rock Creek.



*Combined sewer outfall in the park*

Rock Creek and its tributaries have also been designated “Special Waters of the District of Columbia” for their scenic and aesthetic importance (NPS 2005a). It is intended that the water quality of such designated waters be maintained and not allowed to degrade.

## WETLANDS AND FLOODPLAINS

Wetlands and floodplains are of concern because the park has many riparian wetlands that border streams, and the 100-year floodplain is found along the major streams and tributaries. Erosion and sedimentation caused by deer trampling and eating/removal of vegetation could affect the quality of wetland habitat similar to the effects described for soils and water quality, above. In addition, the exclosures that are proposed under one of the action alternatives could be constructed in the floodplain.

## WETLANDS

The Rock Creek watershed includes only a few areas designated as wetlands, as shown on figure 6. Current National Wetland Inventory (NWI) maps do not classify either the main stem of Rock Creek or its tributaries as wetlands, but do show several forested wetlands within the park boundaries (USFWS NWI 2007). Six temporarily or seasonally flooded, forested wetlands (NWI designation of “PFO1” or “palustrine forested broad-leaved deciduous”) are found along Rock Creek in the northern portion of the park and in the Pinehurst Branch area. These forested wetlands are located within the primary floodplain of the creeks and are typically covered by a sycamore-green ash forest (see the “Vegetation” section for more detail on this forest type). Other wetlands, not identified by the NWI (likely due to their small size),

are in the narrow alluvial deposits of the Pinehurst Branch, Fenwick Branch, and Joyce Branch drainages (NPS 2005a).

Vernal pools are widely scattered wetland features in the park, which are too small to appear on NWI maps or included within the mapped forested wetlands. These are small, temporary pools or ponds that typically appear during wet periods and are dry at other times. If they persist for four months or more, particularly in the spring and early summer, these limited habitats can be breeding places for frogs, toads, and salamanders. The U.S. Geological Survey Northeast Amphibian Research and Monitoring Initiative has been surveying vernal pools and streams in Rock Creek Park since 2001 as part of a northeast region amphibian monitoring program (NPS 2005a). In a parkwide inventory conducted in 2004, a total of eight vernal pools were located (NPS 2005a). The number of vernal pools in the park today may be reduced from the pre-urbanization era because of past draining or filling activities, stream bed scouring from increased runoff that has resulted from development in the watershed upstream from the park, and lowered water tables from incising of the stream channel or urban groundwater use.

Other important wetland-related features in the park include groundwater springs and seeps. These small, wet areas are fed by relatively dependable flows of pollutant-free water. Several of these wetlands support endemic, aquatic animal species such as amphipods and other macroscopic invertebrates. Researchers from the U.S. Geological Survey Northeast Amphibian Research and Monitoring Initiative identified 35 springs and seeps in the park (NPS 2005a).

#### **FLOODPLAINS**

Rock Creek descends over 150 feet from the Maryland/DC line to its confluence with the Potomac River. Flood levels in the park have been substantially affected by urbanization and associated increases in impervious surfaces in the Rock Creek watershed. Stream flows in the main stem of Rock Creek during storms are estimated to be more than double the predevelopment discharge (NPS 2005a).

Within Rock Creek Park, floodplain development is fairly restrictive, limited primarily to Rock Creek itself. According to the Federal Emergency Management Agency's flood insurance rate maps (Washington, D.C., Community-Panel Number 1100010010B and 1100010020B, effective date: November 15, 1985), the 100-year floodplain of Rock Creek ranges from 50 to 500 feet wide, depending upon the topography (FEMA 1985). Figure 6 depicts the 100-year floodplain of Rock Creek and its tributaries.

Four major park buildings are in the 100-year floodplain. Peirce Mill and the Miller Cabin are completely within the 100-year floodplain. Portions of the Lodge House and the Edgewater Stables building are on the fringe of the floodplain, but would not be subject to high velocities or deep water during flooding (NPS 2005a). Normally, the NPS would avoid occupying floodplains within the park. However, except for the Edgewater Stables, these buildings are historic structures that contribute to the significance of the Rock Creek Historic District and their location is integral to their significance. As a result, Director's Order 77-2, with its accompanying Procedural Manual 77-2, *Floodplain Management*, does not apply to these sites (NPS 2003c). Sections of Beach Drive and the Rock Creek and Potomac Parkway are within the 100-year floodplain, as are a number of picnic groves and associated parking areas, picnic shelters, and restrooms.

#### **WILDLIFE AND WILDLIFE HABITAT**

Deer can affect other wildlife and/or habitat by reducing habitat diversity through activities such as browsing, trampling, and seed dispersal. Deer are also an integral part of the wildlife in Rock Creek Park. The following subsections address both the white-tailed deer and other wildlife inhabiting the park that could be affected by deer or deer management actions.

## WHITE-TAILED DEER

Deer management must take into account the species biology and its interactions with key components of the habitat. It is essential to understand deer ecology, home ranges, population ecology, and factors, such as disease, that can also affect the numbers and viability of deer in the park.

### General Ecology

White-tailed deer are medium-sized ungulates, native to North America and regarded as one of the most adaptable mammals in the world (Hesselton and Hesselton 1982). Among the reasons for this adaptability are the hardiness, reproductive capability, wide range of plant species accepted as food, and the tolerance deer exhibit when in close contact with humans.

Most abundant in the eastern woodlands, white-tailed deer are typically forest dwellers, but often frequent wetlands or woodland openings while feeding. Deer also forage along forest margins, in orchards, and on farmlands. When deer populations become excessive, damage to vegetation may result, and in addition, their winter food may be reduced to the point where starvation results (Martin et al. 1951).



*Radio collared deer*

The diet of white-tailed deer consists of twigs and buds from shrubs and trees, as well as herbaceous (non-woody) plants, which are eaten frequently in spring and summer when they are abundant. Acorns, blackgum fruits, persimmons, and other kinds of fruits are consumed in late summer and fall. Some of the plants that deer browse heavily in the winter season are selected by necessity rather than choice (Martin et al. 1951).

White-tailed deer are well known for their ability to rapidly increase reproductive productivity given abundant food resources, and to limit productivity in the presence of less nutritious forage (Verme 1965;

Hesselton and Hesselton 1982). On good range containing abundant food, deer tend to produce more than one young, usually twins and sometimes triplets. Where food is limited, the number of births is typically restricted to a single fawn, and sometimes the doe does not ovulate (Morton and Cheatum 1946; Verme 1965; Hesselton and Hesselton 1982). Nutrition plays an important role in influencing the onset of puberty, with yearling (1.5-year-old) does on submarginal range possibly remaining sexually immature, while doe fawns on nutritious range possibly becoming reproductively active as early as six or seven months of age (Verme and Ullrey 1984). The potential for rapid expansion of deer populations, coupled with the wide variety of plant species deer consume, can result in substantial impacts to plant communities (Marquis 1981; Shafer 1965).

### Home Range and Deer Movement Outside the Park

The park performs limited radio telemetry studies. As reported in chapter 1, park staff have collared five does with a radio transmitter and recorded their movements since 2002. Data collected from these does include the areas they use and the



*Radio telemetry*

percent of time that the doe is inside or outside of the park. Preliminary data from the observational study indicate that the area used by deer ranges from about 31 to 260 acres, and that time spent outside the park ranges from about 5 to 42% (K. Ferebee, pers. comm. 2008d) Although this was a small and limited survey to provide some basic information on deer movements, results indicate that home range varies considerably among individual deer, with an “average” of 25% of time spent outside the park.

### **Population Size and Density**

Several methods have been used over the years to assess the size of the Rock Creek Park deer population. Spotlight counts have been conducted each September since 1996 to look at possible general population trends over time. Surveys are conducted over a four-night period following the same 22-mile route that covers the majority of Rock Creek Park (Reservation 339) and includes some roads in surrounding neighborhoods. Deer are counted both inside and outside the park boundary. The deer count numbers increased from an average of 16.5 per night in 1996 to a record average of 67.6 deer per night in 2003 (NPS 2005c). In 2007, the average was 66.75 per night (K. Ferebee, pers. comm., 2008f).

Since 2000, sampling surveys to determine a population density have been conducted in November on a shorter route (10.1 miles) using only park roads and counting only those deer within the park boundaries. Dr. Brian Underwood of the U.S. Geological Survey trained Rock Creek Park staff to conduct the sampling using the computer modeling program “DISTANCE” to calculate population density, estimating 62 deer per square mile within the park in 2000. Since that time, Distance Sampling has been repeated annually in November, over three to four nights each year. Deer density has ranged between 52 and 98 deer per square mile. Current (2007) density is estimated at 82 deer per square mile (K. Ferebee, pers. comm. 2008a, f). The results from the Distance Sampling surveys have not been published to date, but are listed in table 2.

The deer population density in the park has varied and will continue to vary over time depending on factors such as winter temperatures, snow depth and duration, disease, habitat conditions, deer movements, and acorn production. However, based on spotlight surveys and Distance Sampling observations between the mid-1990s and the present, the deer population has increased, and in the absence of any population management measures, this trend is expected to continue over time, with some fluctuations due to weather and other factors.

### **Factors that Can Affect Deer Health**

Deer herds in poor physical condition have typically exceeded the nutritional carrying capacity (the point at which deer herd health is at equilibrium with nutritional value obtained from forage). Poor herd health indicates that the habitat has been stressed and is no longer supporting healthy deer (Eve 1981).

When deer population density is high, signs of nutritional stress, such as low body and internal organ mass, low fecal nitrogen levels, and high prevalence of parasitic infections, typically occur. When deer density is reduced to the nutritional carrying capacity, all of these indicators show improved condition (Sams et al. 1998).

The park does not currently conduct any specific deer health studies. However, visual observations are made of the herd and deer showing visible signs of disease are noted. To date, only parasites have been noted by park staff (K. Ferebee pers. comm. 2007e). Deer observed from road kills where bone marrow was observed showed no signs of malnutrition (food is available both within and outside the park) and there have been no known cases of deer disease in the park. General appearance of the herd, as noted anecdotally by park staff, is relatively good, although some individuals appear thinner at the end of winter (ribs staring to show), which is normal for that time of year (K. Ferebee pers. comm. 2008a).

## Diseases of Concern

A number of diseases of concern exist in eastern deer populations. These include parasites, malnutrition, bluetongue virus, and epizootic hemorrhagic disease. Chronic wasting disease (CWD) has recently been documented in West Virginia (more than 100 miles from the park). New documented cases in West Virginia are being watched, as it is thought to be spread easily in areas with high concentrations of deer. The various diseases of concern are briefly described below.

**Parasitism**—Parasitism occurs when an organism grows, feeds, and is sheltered on or in a different organism, resulting in a type of symbiosis in which one species benefits at the expense of the other. There are many varieties of parasites, both internal and external. Parasites can have a variety of consequences from minimal to substantial on an individual or population.

**Malnutrition**—Malnutrition is the condition that develops when the body does not get adequate amounts of the vitamins, minerals, and other nutrients necessary to maintain healthy tissues and organ function. As described above, malnutrition can be caused by exceeding the nutritional carrying capacity of the habitat.

**Bluetongue Virus**—Bluetongue virus is an insect-transmitted, viral disease that affects ruminant mammals, including white-tailed deer. A bluetongue virus infection causes inflammation, swelling, and hemorrhage of the mucous membranes of the mouth, nose, and tongue. Inflammation and soreness of the feet also are associated with bluetongue virus. Bluetongue virus is considered by the Office International des Epizooties (the international organization that sets animal health standards) to be a disease that has the potential to spread rapidly. White-tailed deer can be severely affected by bluetongue virus because viral infections cause hemorrhaging and sudden death, and the mortality rate can be extremely high (APHIS 2003).

Biting gnats spread bluetongue virus from animal to animal. Animals cannot directly contract the disease from other animals. The disease is most prevalent in the United States in the southern and southwestern states. It is currently almost non-existent in the upper north central and northeastern states, where biting flies do not appear able to transmit the viruses (APHIS 2003).

Bluetongue virus is a seasonal disease that is generally observed in the late summer and early fall. Virus transmission begins in the early spring with the onset of insect flight activity and continues until the first hard frosts (APHIS 2003).

**Epizootic Hemorrhagic Disease**—Epizootic hemorrhagic disease is an insect-borne viral disease that affects ruminants. The disease causes widespread hemorrhages in mucous membranes, skin, and viscera, the result of disseminated intravascular clotting. Strains of epizootic hemorrhagic disease can cause widespread vascular lesions similar to those described for bluetongue virus. Degenerative changes (focal hemorrhage or dry and gray-white appearance, or both) in striated musculature are prominent in the esophagus, larynx, tongue, and skeletal muscles. Epizootic hemorrhagic disease in white-tailed deer can lead to death. Often, deer are found dead around waterholes, suggesting that they had a high fever and were dehydrated (Stott 1998). In 2007, there were two local confirmed cases of epizootic hemorrhagic disease near Rock Creek Park: one at the National Zoo and one on Theodore Roosevelt Island. There were also five suspect animals observed at the Naval Observatory. Therefore, there is a possibility that this disease may be seen in deer within Rock Creek Park in the future (K. Ferebee, pers. comm. 2007e).

Not all deer infected with epizootic hemorrhagic disease or bluetongue virus will die; this is known because many normal deer have antibodies that indicate prior exposure to various viruses. Deer that recover develop immunity to the specific virus, which protects against reinfection by the same virus.

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*A ruminant animal is an even-toed, hoofed mammal (such as sheep, oxen, and deer) that chews cud and has a complex three- or four-chambered stomach.*

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However, it is not known how well this immunity cross-protects deer against other hemorrhagic viruses. When deer survive infection with a virus from one virus type (epizootic hemorrhagic disease or bluetongue virus), there is good evidence to indicate they are not protected from disease caused by subsequent infection with a different virus strain (Southeastern Cooperative Wildlife Disease Study 2000).

**Chronic Wasting Disease (CWD)**—CWD belongs to a group of diseases known as transmissible spongiform encephalopathies (TSEs), which include scrapie, bovine spongiform encephalopathy, and Creutzfeldt-Jakob disease. The diseases are apparently caused by infectious agents called prions, which are proteins without associated nucleic acids. Prions have high resistance to both environmental conditions and a range of treatments that typically kill other infectious agents (Williams et al. 2008).

Deer and elk affected by CWD show loss of body condition and changes in behavior. Affected animals may demonstrate a variety of behavioral signs, including slow, repetitive behaviors (such as walking set patterns), showing periods of depression from which they are easily roused, and carrying their heads and ears lowered. Animals in the later stages of the disease become emaciated. Excessive drinking and urination are common in the terminal stages, and many animals in terminal stages exhibit excessive salivation and drooling, incoordination, fine head tremors, and a wide-based stance. Death is inevitable once clinical signs are visible (Williams et al. 2008).

The health risk for humans consuming elk or deer infected with CWD is unknown; however, the risk is likely extremely low and no cases of human disease have been associated with CWD. However, in the absence of complete information and in consideration of the similarities of animal and human TSEs, caution should be taken to avoid exposure (Williams et al. 2008). Appendix B provides additional information on CWD diagnosis and management.

## OTHER WILDLIFE

Common fauna likely to occur within Rock Creek Park include species adapted to disturbed habitat associated with an urban environment and transient species associated with the adjacent forested habitat. According to the NPSpecies database, 36 species of mammals, 13 species of amphibians, 6 species of reptiles, and 181 species of birds are present or probably present within park boundaries (NPS 2008b).



Coyote

### Mammals

The woodlands in Rock Creek Park provide suitable habitat for a variety of species of mammals, despite their location within the city limits of the District of Columbia. To date, 36 species of mammals have been documented as occurring or likely occurring in the park (NPS2008b). Common species include white-tailed deer, raccoon (*Procyon lotor*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), opossum (*Didelphis virginiana*), beaver (*Castor canadensis*), gray squirrel (*Sciurus carolinensis*), and eastern chipmunk (*Tamias striatus*). Coyotes (*Canis latrans*) have been sighted in the park since May 2004 and confirmed by park staff in September 2004 (NPS 2007c). Sightings are widespread and continue to be reported to park staff.

### Reptiles and Amphibians

The variety and numbers of amphibians and reptiles found in the park in recent years are markedly reduced compared to inventories from the early and middle parts of the 20<sup>th</sup> century. According to the

NPSpecies database, there are currently 13 amphibians present or probably present in the park, and 4 historic reports. For reptiles, there are only 6 species that are present or probably present in the park, but there were 13 historic occurrences that can no longer be confirmed (NPS 2008b).

Some amphibians, such as the gray treefrog (*Hyla versicolor*) and chorus frog (*Pseudacris triseriata*), have disappeared altogether from Rock Creek Park. Other amphibians, such as the spring peeper (*Hyla crucifer*), wood frog (*Rana sylvatica*), and spotted salamander (*Ambystoma maculatum*), can be found in modest numbers in wetland areas. Red-backed salamanders (*Plethodon cinereus*), which are not dependent upon wetlands, are relatively common in moist uplands where they inhabit moist niches under logs and leaf litter.

Relatively protected and abundant moist upland sites, which provide habitat for small snakes, such as the northern ringneck snake (*Diadophis punctatus*), are commonly found. Eastern box turtles (*Terrapene carolina*) and larger snakes, such as the black rat snake (*Elaphe obsoleta*), are much less common due to decreasing areas of suitable habitat.

## Birds

According to the NPSpecies database, 181 species of breeding or migrating birds have been documented in Rock Creek Park; there are 18 unconfirmed reports and 2 historic records (NPS 2008b). Most are migrants or seasonal visitors. The National Audubon Society and the American Bird Conservancy recognize Rock Creek Park as an important birding area due to its exceptional diversity of bird species during migration (Maryland/District of Columbia Audubon 2004).

Neotropical migrants are those avian species that breed in the United States and Canada and winter in Mexico, Central America, South America, or the Caribbean Islands (Smithsonian Migratory Bird Center 2003). Ten species of flycatchers, 6 species of vireos, 7 species of thrushes, and 35 species of warblers have been documented in the maintenance yard area based on observer information.

**Breeding Bird Census Area**—Data on breeding birds have been collected at two locations in Rock Creek Park. There is a breeding bird census area in Glover-Archbold Park between Reservoir Road and New Mexico Avenue that was established in 1959 and is still being surveyed by volunteers every year. Another census area within Rock Creek Park was established in 1948. The longevity of this site in an area of relatively undisturbed natural vegetation provides a baseline of relative abundance against which later data can be compared to determine if changes in bird populations are occurring. Twenty-two to 24 species nest in this breeding bird census area in Rock Creek Park (unpublished data from the Rock Creek Park breeding bird census, 1997 through 1999).

The primary breeding bird census area is an important bird-related resource within Rock Creek Park. The north edge generally extends along the Whitehorse Trail while the west and east sides begin at the public stables and Joyce Road, respectively, and meet at picnic grove 21. The 65-acre census area is roughly triangular in shape (see figure 7). Breeding species are those that spend the nesting season in Rock Creek Park and have been the focus of a breeding bird census conducted by volunteers since 1948. Appendix E contains an annual list of all birds identified during breeding bird surveys as potential breeding birds from 1993 through 2002.

Summer resident/potential breeding species at Rock Creek Park include red-eyed vireo (*Vireo olivaceus*), Acadian flycatcher (*Empidonax vireescens*), great crested flycatcher (*Myiarchus crinitus*), eastern phoebe (*Sayornis phoebe*), eastern wood-pewee (*Contopus virens*), blue-gray gnatcatcher (*Poliptila caerulea*), veery (*Catharus fuscescens*), wood thrush (*Hylocichla mustelina*), gray catbird (*Dumetella carolinensis*), ovenbird (*Seiurus aurocapillus*), and scarlet tanager (*Piranga olivacea*). Species found as year-round residents/breeding species (NPS n.d.a.; National Audubon Society n.d.) include great horned owl (*Bubo virginianus*), eastern screech owl (*Megascops asio*), and barred owl (*Strix varia*); red-shouldered hawk (*Buteo lineatus*); northern flicker (*Colaptes auratus*); the red-bellied (*Melanerpes carolinus*), downy

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(*Picoides pubescens*), hairy (*Picoides villosus*), and pileated woodpeckers (*Dryocopus pileatus*); blue jay (*Cyanocitta cristata*); American crow (*Corvus brachyrhynchos*); tufted titmouse (*Baeolophus bicolor*); Carolina chickadee (*Poecile carolinensis*); white-breasted nuthatch (*Sitta carolinensis*); Carolina wren (*Thryothorus ludovicianus*); American robin (*Turdus migratorius*); northern cardinal (*Cardinalis cardinalis*); and song sparrow (*Melospiza melodia*).



*Brown thrasher*

Many of the breeding birds found within Rock Creek Park nest on or near the ground. Common ground nesters include the ovenbird, worm-eating warbler (*Helmitheros vermivorus*), Louisiana waterthrush (*Seiurus motacilla*), and American woodcock (*Scolopax minor*). Other species nest in the shrub layer; these include the northern cardinal, gray catbird, Acadian flycatcher, mockingbird (*Mimus polyglottos*), wood thrush, Carolina wren, white-eyed vireo (*Vireo griseus*), American robin, chipping sparrow (*Spizella passerina*), American goldfinch (*Carduelis tristis*), and mourning dove (*Zenaida macroura*). The song sparrow, brown thrasher (*Toxostoma rufum*), rufous-sided towhee (*Pipilo erythrophthalmus*), veery, and common yellowthroat (*Geothlypis trichas*), nest on both the ground and in the shrub layer (K. Ferebee, pers. comm. 2007g). These species depend on understory shrubs and ground vegetation for constructing nests and for concealment when feeding, and can be adversely affected if deer browsing removes this vegetation.

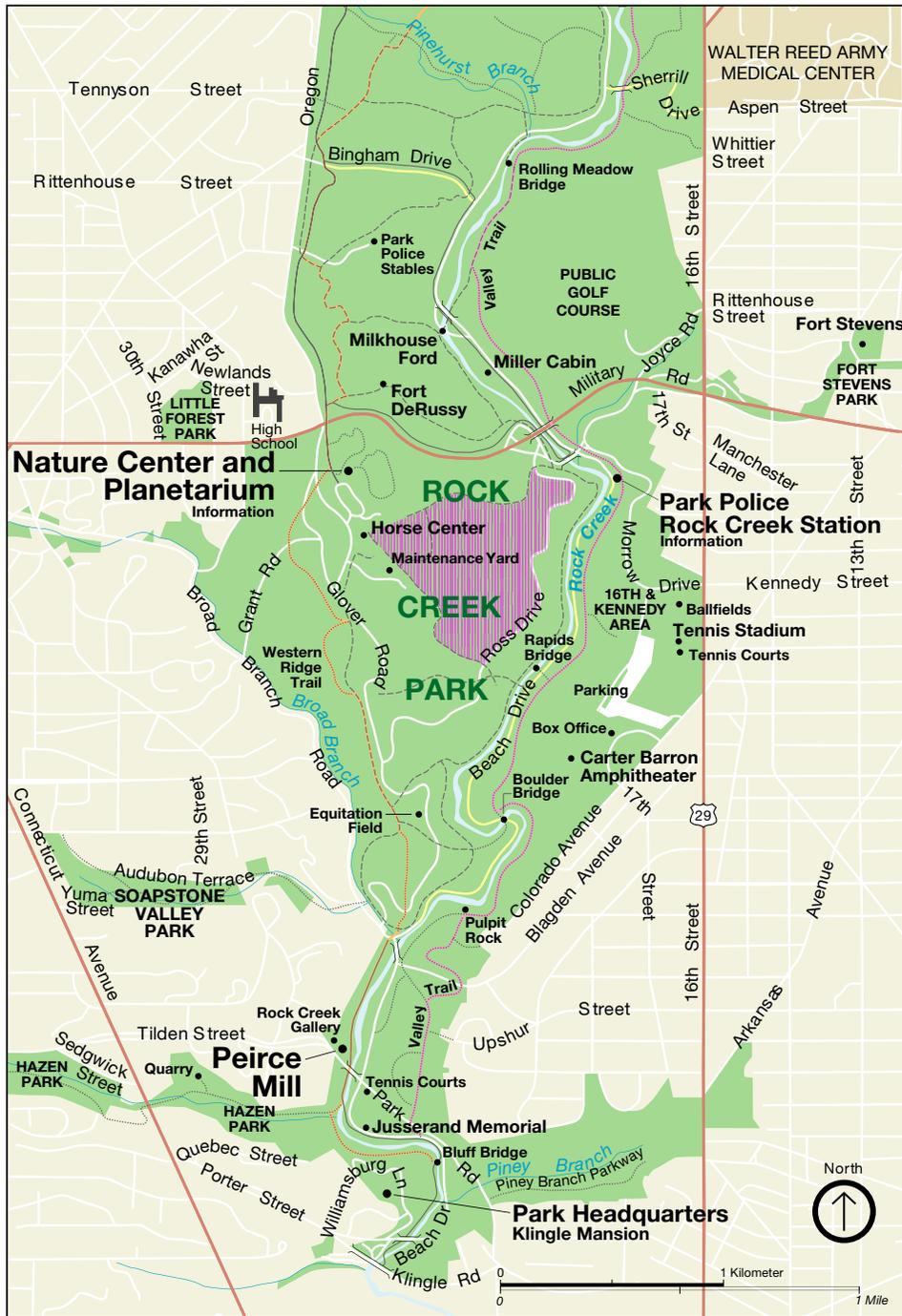
**Audubon Christmas Bird Count**—Wintering and resident species are surveyed annually during the Washington, D.C. National Audubon Christmas Bird Count. Volunteers count all species and individuals of birds encountered in a 15-mile-diameter circle on one day. A portion of the Washington, D.C. circle covers part of Rock Creek Park. Species identified during the Audubon Christmas bird counts averaged 27 species per year for the Nature Center section and 21 species per year for the Carter Barron section (National Audubon Society n.d.). Some of the species commonly found in the Nature Center and Carter Barron sections during the Audubon Christmas bird count include resident species, such as red-tailed hawk (*Buteo jamaicensis*), red-bellied woodpecker, downy woodpecker, blue jay, tufted titmouse, Carolina chickadee, Carolina wren, and northern mockingbird (*Mimus polyglottos*). Species that spend the winter and are present on the Audubon Christmas bird count (in the amphitheater and Nature Center sections) in most years include brown creeper (*Certhia americana*), golden-crowned kinglet (*Regulus satrapa*), dark-eyed junco (*Junco hyemalis*), and white-throated sparrow (*Zonotrichia albicollis*). Appendix E contains a list of all bird species identified during the annual Audubon Christmas bird counts from 1980 through 2002, including the average number of each species spotted.

## Fish

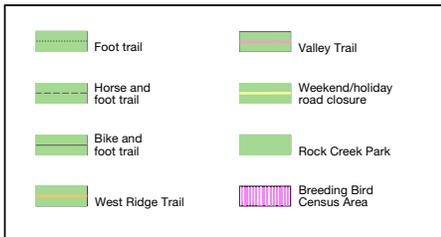
According to the park's *General Management Plan* (NPS 2005a), surveys by the District of Columbia have found approximately 35 species of fish in Rock Creek.

Resident native species include five shiners (*Notropis* spp.), two bullheads (*Ictalurus* spp.), and three sunfish (*Lepomis* spp.). Blacknose dace (*Rhinichthys atratulus*) are relatively common and can be found in the main stream and many tributaries.

Other resident species are introduced, including carp (*Cyprinus carpio*), bluegill (*Lepomis macrochirus*), and largemouth bass (*Micropterus salmoides*).



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## Rock Creek Park Washington, DC

Figure 7. Breeding  
Bird Census Area

Source: [www2.nature.nps.gov/stats/](http://www2.nature.nps.gov/stats/)



At least two native species, the blueback herring (*Alosa aestivalis*) and the alewife (*Alosa pseudoharengus*), migrate from saltwater up Rock Creek to spawn each spring (i.e., they are anadromous). An abandoned sewer line and an abandoned gaging station near Massachusetts Avenue that interrupted their migrations were removed from Rock Creek in 2001 (NPS 2005a). The recent removal of eight other barriers in Rock Creek and the installation of a fish bypass at the Peirce Mill Dam as part of the Woodrow Wilson Bridge mitigation are expected to allow these species to migrate from the mouth of the creek upstream to Needwood Lake in Montgomery County, Maryland (NPS 2005a).

The American eel (*Anguilla rostrata*) is a species found in Rock Creek that lives in either fresh or brackish water. Eels migrate to the Sargasso Sea to spawn (i.e., they are catadromous). The removal of barriers in Rock Creek as part of the Woodrow Wilson Bridge mitigation is expected to enhance the habitat for this species.

Urban pollution and stormwater runoff problems have adversely affected fish numbers and diversity in the park. Generally, the 16 tributaries of Rock Creek are more severely affected than the main channel. In a 1993 study by NPS staff, no fish were found in nearly half of the tributaries and only one had more than a single species present (NPS 2005a). Flooding and scouring during storms, pollution from runoff, and periodic low flows are likely contributing factors.

### Nonnative Species

Several nonnative species of wildlife also occur in Rock Creek Park, including free roaming cats (*Felis catus*), starlings (*Sturnus vulgaris*), and the gypsy moth (*Lymantria dispar*). Free-roaming domestic cats are particularly found near the park borders. Starlings compete with some cavity-nesting birds for nest sites. The gypsy moth has been present in the park for many years and, at times, has become sufficiently abundant to require aerial spraying to prevent deforestation and related impacts.

### CURRENT STATUS OF WILDLIFE AND THE ROLE OF DEER

There is more research on the effects of deer density on vegetation than on wildlife populations. However, a number of studies have shown distinct changes in bird abundance as a result of reducing deer density by exclosures (McShea and Rappole 2000). One researcher found that seedling richness began to decline with just 10 deer per square mile and that songbird habitat was negatively impacted with 20 to 39 deer per square mile within a cherry/maple forest (deCalesta 1997). Similarly, a nine-year study in the mid-Atlantic region found that a reduction in deer density changed the composition of forest bird populations (McShea and Rappole 2000). Three patterns of change were observed in bird populations within exclosures (where there were no deer): (1) species that preferred open understory (e.g., wood thrush) declined; (2) species that preferred a dense herbaceous ground cover (e.g., Carolina wren) immediately increased, but then decreased as herbaceous species were replaced by woody species; and (3) species that preferred a dense, woody understory (e.g., ovenbird) gradually increased.

The habitat most affected by heavy deer browsing is the herbaceous and woody vegetation in the forest understory. Deer can browse vegetation from ground level to an average of 60 inches (150 centimeters) above the ground, and this is the habitat that is primarily affected. Other wildlife also use this understory habitat.

Other species that compete with deer for available food include squirrels and mice (which feed on acorns and other food from trees) and rabbits (which feed on young woody stems and green vegetation) (McShea and Rappole 2000). Heavy deer browsing also results in lack of cover for small mammals. Flowerdew and Ellwood (2001) suggested that if rodent densities are lowered, avian and terrestrial predators are likely to suffer reduced breeding success, and tawny owls (*Strix aluco*) may prey more heavily on bank voles (*Myodes glareolus*) if their favored ground cover is reduced (S.Bates, pers. comm. 2008c).

Species that primarily depend on other habitats would be less affected by high deer numbers. Some frogs, snakes, salamanders, and turtles (e.g., wood frog, spotted salamander) live close to water during much of

their lives and are therefore less affected by deer. Similarly, heavy deer browsing would not directly change fish habitat. However, other species (e.g., box turtle) are dependent on vegetation, fruits, and insects found within the understory of the forest, and their habitat is affected by high deer numbers.

Species that would benefit from high deer numbers and resulting habitat changes are those that prey on deer (e.g., coyotes) or that feed on carrion (e.g., vultures and box turtles). Predators would also benefit from hunting other prey, such as mice and squirrels, in areas with less dense cover at ground level, thus allowing better views through the forest and less cover for prey to hide. However, as prey declines due to reduced cover, predators also decline.

The upper canopy of the forest has not changed noticeably to date as a result of high deer numbers (K. Ferebee, pers. comm. 2007e). Therefore, those species that depend on the upper canopy of the forest, such as woodpeckers and other birds that nest high in the trees, have not experienced any noticeable change in their habitat. As the forest ages, improved habitat may become available for cavity-nesting birds and birds that feed on insects as older trees die or become stressed from disease or infestations. However, in the long term with little to no regeneration, the dead trees will not be replaced by new trees, resulting in fewer trees that upper canopy species can use as habitat.

### **RARE, UNIQUE, THREATENED, OR ENDANGERED SPECIES**

The NPS is required under the *Endangered Species Act* (ESA) to ensure that federally listed species and their designated critical habitats are protected on lands within the agency's jurisdiction. In addition, the NPS considers state-listed or other rare species similarly in taking actions that may affect these species. An overabundance of deer and deer management actions have the potential to affect listed species as well as other wildlife.

### **FEDERAL AND STATE-LISTED AMPHIPODS**

Only one federally listed species, the endangered Hay's spring amphipod (*Stygobromus hayi*), is known to inhabit the park. The Hay's spring amphipod was discovered in five groundwater springs in Rock Creek Park in 1998. While Rock Creek Park does not have a formal management plan for the amphipod, conservation measures in the park restrict activities in areas around the springs or in their recharge areas.

The Hay's spring amphipod grows to 0.4 inches (10 mm) or less in length (Pavek 2002). It is colorless, eyeless, and has adaptive hairs for sensing currents and food. It has a life span of eight years or more and a low reproductive rate. *Stygobromus* amphipods spend the majority of their lives in groundwater below the surface, feeding on detritus. Amphipods are subject to a number of predators when they are at surface springs, such as stonefly larvae and salamanders, but probably have few if any predators below the surface.

Another rare species, Kenk's amphipod (*Stygobromus kenki*), also known as the Rock Creek groundwater amphipod, was identified in park springs (NPS 1997a). Kenk's amphipod is not currently listed under the *Endangered Species Act* and it is no longer being considered for future listing by the U.S. Fish and Wildlife Service (USFWS 2007b). In addition, three other *Stygobromus* species of amphipods that are listed by the state of Maryland as rare or uncommon have been located in or near the park (Maryland Department of Natural Resources 2003).

Threats to groundwater amphipods include alterations of groundwater flows, groundwater pollution, loss of detritus as a food source, and disturbance of spring sites. Common pollution problems for amphipods are nitrates in fertilizers, which can result in groundwater oxygen depletion, pesticides, and petroleum leaking from underground storage tanks. The relative abundance of rare amphipods in the park has been attributed to the long-term protection of groundwater quality afforded by the park.

**OTHER STATE-LISTED PLANT AND ANIMAL SPECIES**

Rare species are also identified by the District of Columbia, Maryland, and Virginia. The Virginia species are not known in the park and it is not likely that they will occur because of the separation from Virginia by the Potomac River, as well as the presence of different habitats. However, there are several plant species that have been or are currently listed as rare by Maryland Department of Natural Resources that have been documented (although rare) in Rock Creek Park. These plants, their state listing status, and their habitat preferences are listed in table 14 (K. Ferebee, pers. comm. 2007d). Several animal species with known occurrences in Rock Creek Park are listed as rare or uncommon by Maryland and are shown in table 15.

While the District of Columbia does not provide special protection for listed species, it accepts local state-designated plants and also identifies certain wildlife as species of concern. These animal species are called species of greatest conservation need and are listed in the District’s Wildlife Action Plan (District of Columbia 2006). Because of the habitat value provided by Rock Creek Park, many of these species could be found in the park. Habitats preferred by these species generally include springs, seeps, wetlands, and waterways and/or associated moist forested areas. Table 16 lists those species of greatest conservation need that could or do occur in the park.



*The cardinal flower (Lobelia cardinalis) is an uncommon plant in the park. It is not on the list of rare plants, but the park sometimes protects it with fencing.*

**TABLE 14. RARE PLANTS OF MARYLAND DOCUMENTED IN ROCK CREEK PARK**

State Listed Rare Species				
Latin Name	Common Name	Rank	Habitat	Palatable to Deer?
<i>Antennaria solitaria</i>	Single-headed pussytoes	S1-DC; S2-MD	Rich woods and clearings	Possibly (Seymour 1997)
<i>Arabis hirsuta</i>	Hairy rock cress	S1S2-VA; S?-DC	Moist to dry rocky woods and ledges	Yes (Crescent Bloom 2004a)
<i>Arisaema dracontium<sup>a</sup></i>	Green dragon arum	S1S3-DC	Low, rich soils, along streams	Unknown
<i>Aristolochia serpentaria</i>	Virginia snakeroot	SX-DC	Stream banks, floodplain, bottomland	Possibly (NYNHP 2008; gardening web sites)
<i>Doellingeria infirma (Aster infirmus)</i>	Cornel-leaf whitetop	S1S3-DC; S3-MD	Deciduous, inland, upland woodlands	Yes (Crescent Bloom 2004b; New England Wild Flower Society 1997)
<i>Carex hirtifolia</i>	Pubescent sedge	S1-DC; S3-MD	Dry to moist woods and fields	Yes (Crescent Bloom 2004c; Martin et al. 1951)
<i>Castanea dentata</i>	American chestnut	S1S2-DC; S2S3-MD	Well-drained forest	Yes (University of Illinois 2008)

State Listed Rare Species				
Latin Name	Common Name	Rank	Habitat	Palatable to Deer?
<i>Chrysogonum virginianum</i>	Gold star; green and gold	S?-DC; S3-MD	Rich woods, moist well drained to drier soils	No (Merrifield Garden Center 2008)
<i>Coreopsis verticillata</i>	Whorled coreopsis	S1S3-DC; S3-MD	Dry soils, open woodlands/roadsides	No (Penn State Cooperative Extension 2008; West Virginia University Cooperative Extension 2008; Backyard Gardener 2008a)
<i>Cyperus lancastris</i>	Lancaster sedge	S1S3-DC; SU-MD	Dry-mesic soils, floodplains, river banks	Unknown
<i>Kyllinga pumila</i>	Low kyllinga sedge	S1-DC/MD	Damp grasslands, shorelines, ditches	Unknown
<i>Desmodium glutinosum</i> <sup>a</sup>	Pointed-leaved tick-trefoil	S?-DC	Dry, rocky woods	Yes (Kansas Wildflowers & Grasses 2008)
<i>Eupatorium altissimum</i>	Tall boneset	S?-DC; S3-MD	Woods, thickets, favors disturbed areas	Unknown
<i>Gymnocladus dioica</i>	Kentucky coffee-tree	S1-MD	Bottomlands, rich soil along streams/rivers	No (California Dept of Fish and Game 2008; Jull 2001)
<i>Juglans cinerea</i>	Butternut	S1-DC; S2S3-MD	Fertile woods	Yes (Coladonato 1991; Natureserve 2008)
<i>Lycopodium clavatum</i>	Common clubmoss	S1S3-DC	Dry to moist woods or road banks	No (Plants for a Future 2008)
<i>Maianthemum canadense</i>	Two-leaved solomon's-seal	S1S3-DC	Moist to mesic humus rich soils	Yes (Rooney 2001; Russel et al. 2001)
<i>Melica mutica</i>	Narrow melic grass	S1S2-DC; S1-MD	Dry, open woodlands	Unknown
<i>Monarda clinopodia</i>	Basil balm	S1S3-DC; S3-MD	Low woods and thickets	No (Sylvanian Natives 2008;)
<i>Passiflora lutea</i>	Yellow passionflower	S1-DC	Low rocky moist woods; thickets	No (Lady Bird Johnson Wild Flower Center 2008; Sunlight Gardens 2008)
<i>Phyllanthus carolinensis</i>	Carolina leaf-flower	S1S3-DC; S3-MD	Poor, dry soils	Unknown

State Listed Rare Species				
Latin Name	Common Name	Rank	Habitat	Palatable to Deer?
<i>Physalis virginiana</i>	Virginia ground cherry	S1S3-DC; S3-MD	Dry; upland woods, fields	No (iVillage GardenWeb 2006)
<i>Pinus pungens</i>	Table mountain pine	S1-DC	Appalachians and foothills	Possibly; several members of the <i>Pinus</i> genus listed as deer-resistant, however, the palatability of this particular species is unknown (Jull 2001)
<i>Pyrola elliptica</i>	Elliptic shinleaf	SH-DC; S2-VA	Dry or moist woods	Yes (Crescent Bloom 2004d; Martin et al. 1951)
<i>Quercus imbricaria</i>	Shingle oak	S1S3-DC	Fertile woods	Possibly (Backyard Gardener 2008b; Ohio State University 2008)
<i>Quercus lyrata</i> <sup>a</sup>	Overcup oak	SE-DC	Coastal plains, swamp forest	Yes (Sullivan 1993; Gilman and Watson 1994)
<i>Rudbeckia fulgida</i>	Orange coneflower	S1S3-DC; S3-MD	Dry to wet soils, usually in shade	No (Bloomin on the East End 2008; High Country Gardens 2008; Easyliving Wildflowers 2008; University of Illinois Extension 2008)
<i>Sagina decumbens</i> <sup>a</sup>	Decumbent pearlwort	S1S3-DC	Wet places or dry, sandy soils	No (Gardening Guru 2007; University of California Cooperative Extension 2008)
<i>Sagittaria longirostra</i>	Long-beaked arrowhead	S1-DC; SU-MD	Wet areas	Unknown
<i>Scutellaria serrata</i>	Snowy skullcap	S1S3-DC; S3-MD	Rich, upland woods	No (iVillage GardenWeb 2006; Department of the Interior 2000)
<i>Silphium trifoliatum</i>	Three-leaved cup plant	S1-DC; S3-MD	Open areas, woodlands, and thickets	No (Martha's Bloomers 2008; iVillage GardenWeb 2006)
<i>Solidago hispida</i>	Hispid goldenrod	S1-DC; SH-MD	Dry soils of open woods and rocky slopes	No (Perry 2008; Iowa City 2008; Simons 2008).

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State Listed Rare Species				
Latin Name	Common Name	Rank	Habitat	Palatable to Deer?
<i>Spiranthes tuberosa</i>	Little ladies tresses	S1S3-DC; S3-MD	Dry woodlands and sandy soils	Yes (Conservation Management Institute of VA Tech 1996; Hilty 2006).
<i>Zizia aurea</i>	Golden alexanders	S1S3; S3-MD	Ditch margins, moist meadows, woods	No (McGregor 2008)

Status and rank definitions (Maryland [MD] Rank):

S1 = Highly State rare. Critically imperiled in Maryland because of extreme rarity (typically 5 or fewer estimated occurrences or very few remaining individuals or acres in the State) or because of some factor(s) making it especially vulnerable to extirpation.

S2 = State rare. Imperiled in Maryland because of rarity (typically 6 to 20 estimated occurrences or few remaining individuals or acres in the State) or because of some factor(s) making it vulnerable to becoming extirpated. Species with this rank are actively tracked by the Heritage & Biodiversity Conservation Programs.

S3 = Watch List. Rare to uncommon with the number of occurrences typically in the range of 21 to 100 in Maryland. It may have fewer occurrences but with a large number of individuals in some populations, and it may be susceptible to large-scale disturbances. Species with this rank are not actively tracked by the Heritage & Biodiversity Conservation Programs.

SH = Historically known from Maryland, but not verified for an extended period (usually 20 or more years), with the expectation that it may be rediscovered.

SX = Believed to be extirpated in Maryland with virtually no chance of rediscovery.

SU = Possibly rare in Maryland, but of uncertain status for reasons including lack of historical records, low search effort, cryptic nature of the species, or concerns that the species may not be native to the State. Uncertainty spans a range of 4 or 5 ranks as defined above. These species have been delisted by the state of Maryland but they are still considered rare in the park.

S? = The species has not yet been ranked.

SE = Established but not native to Maryland; It may be native elsewhere in North America.

Note: VA and DC rank definitions are similar to those used by Maryland.

a. Denotes species that have been delisted by U.S. Fish and Wildlife Service or Maryland Department of Natural Resources

**TABLE 15. RARE OR UNCOMMON ANIMALS OF MARYLAND THAT COULD BE FOUND IN ROCK CREEK PARK**

Common Name	Scientific Name	Maryland Status <sup>a</sup>	Native Habitat	Migratory Status
Appalachian spring snail	<i>Fontigens bottimeri</i>	Rare or uncommon; State rank: S2	Freshwater seeps	—
Gray petaltail dragonfly	<i>Tachopteryx thoreyi</i>	Rare or uncommon; State rank: S2	Forests, breed in seeps	—

Common Name	Scientific Name	Maryland Status <sup>a</sup>	Native Habitat	Migratory Status
Olive-sided flycatcher	<i>Contopus cooperi</i>	Maryland endangered; State rank: SHB	Within coniferous forest biome, most often associated with forest openings, forest edges near natural openings or human-made openings, or open to semi-open forest stands	Migrant
Mourning warbler	<i>Oporornis philadelphia</i>	Maryland endangered; State rank: Breeding S1	Thickets and semi-open areas with dense shrubs	Migrant
Blackburnian warbler	<i>Dendroica fusca</i>	Maryland threatened; State rank: Breeding S2	Mature coniferous woodlands or mixed woodlands, especially ones containing spruce and hemlocks	Migrant
Nashville warbler	<i>Vermivora ruficapilla</i>	Maryland species of concern; State rank: Breeding S2	Open mixed woods and bog habitats	Migrant
Yellow-crowned night-heron	<i>Nyctanassa violacea</i>	Rare; State rank: Breeding S2	Riparian	Unknown
Cerulean warbler	<i>Dendroica cerulean</i>	Proposed Federal Listing; State rank: Breeding S4	Mature deciduous forests	Migrant
Bicknell's thrush	<i>Catharus bicknelli</i>	Proposed Federal Listing; State rank: No status or rank	Dense balsam fir ( <i>Abies balsamea</i> ) and red spruce ( <i>Picea rubens</i> ) forests	Migrant

a Source for state rankings – S. Bates pers. comm. 2008a

**TABLE 16. SPECIES OF GREATEST CONSERVATION NEED WITHIN THE DISTRICT OF COLUMBIA**

Common Name	Scientific Name	Status within Washington D.C.
<b>Mammals</b>		
Eastern small-footed myotis	<i>Myotis leibii</i>	critically imperiled
Gray fox	<i>Urocyon cinereoargenteus</i>	vulnerable

*Affected Environment*

<b>Common Name</b>	<b>Scientific Name</b>	<b>Status within Washington D.C.</b>
Northern river otter	<i>Lutra canadensis</i>	critically imperiled
Southern bog lemming	<i>Synaptomys cooperi</i>	vulnerable
Southern flying squirrel	<i>Glaucomys volans</i>	secure
Virginia opossum	<i>Didelphis virginiana</i>	secure
Allegheny woodrat	<i>Neotoma magister</i>	possibly extirpated
American mink	<i>Mustela vison</i>	critically imperiled
Eastern chipmunk	<i>Tamias striatus</i>	secure
Eastern cottontail	<i>Sylvilagus floridanus</i>	secure
Eastern red bat	<i>Lasiurus borealis</i>	secure
<b>Reptiles</b>		
Common musk turtle	<i>Sternotherus odoratus</i>	secure
Bog turtle	<i>Clemmys muhlenbergii</i>	presumed extirpated
Corn snake	<i>Elaphe guttata guttata</i>	undetermined
Eastern box turtle	<i>Terrapene carolina</i>	vulnerable
Eastern garter snake	<i>Thamnophis sirtalis</i>	secure
Eastern hognose snake	<i>Heterodon platirhinos</i>	possibly extirpated
Eastern mud turtle	<i>Kinosternon subrubrum</i>	apparently secure
Spotted turtle	<i>Chrysemys guttata</i>	critically imperiled
Eastern ribbon snake	<i>Thamnophis sauritus</i>	secure
Eastern worm snake	<i>Carphophis amoenus amoenus</i>	secure
Eastern fence lizard	<i>Sceloporus undulates</i>	possibly extirpated
Five-lined skink	<i>Eumeces fasciatus</i>	secure
Northern black racer	<i>Coluber constrictor constrictor</i>	secure
Northern brown snake	<i>Storeria dekayi</i>	secure
Northern copperhead	<i>Agkistrodon contortrix</i>	critically imperiled

Rare, Unique, Threatened, or Endangered Species

Common Name	Scientific Name	Status within Washington D.C.
Eastern painted turtle	<i>Chrysemys picta picta</i>	secure
Northern ringneck snake	<i>Didophis punctatus edwardsii</i>	secure
Queen snake	<i>Regina septemvittata</i>	critically imperiled
Eastern redbelly turtle	<i>Pseudemys rubriventris</i>	secure
Rough green snake	<i>Opheodrys aestivus</i>	secure
Northern scarlet snake	<i>Cemophora coccinea copei</i>	possibly extirpated
Timber rattlesnake	<i>Crotalus horridus</i>	possibly extirpated
Wood turtle	<i>Clemmys insculpta</i>	possibly extirpated
<b>Amphibians</b>		
American toad	<i>Bufo americanus</i>	medium population abundance
Bullfrog	<i>Rana catesbeiana</i>	medium population abundance
Fowler's toad	<i>Bufo fowleri</i>	medium population abundance
Marbled salamander	<i>Ambystoma opacum</i>	low population abundance
Eastern mud salamander	<i>Pseudotriton m. montanus</i>	low population abundance
Northern cricket frog	<i>Acris crepitans</i>	low population abundance
Northern dusky salamander	<i>Desmognathus fuscus</i>	low population abundance
Northern spring peeper	<i>Pseudacris crucifer</i>	medium population abundance
Northern two-lined salamander	<i>Eurycea bislineata</i>	medium population abundance
Pickrel frog	<i>Rana palustris</i>	medium population abundance
Northern red salamander	<i>Pseudotriton ruber ruber</i>	low population abundance
Redback salamander	<i>Plethodon cinereus</i>	medium population abundance
Red spotted newt	<i>Notophthalmus viridescens</i>	low population abundance
Spotted salamander	<i>Ambystoma maculatum</i>	medium population abundance
Upland chorus frog	<i>Pseudacris feriarum feriarum</i>	low population abundance
Wood frog	<i>Rana sylvatica</i>	low population abundance

Affected Environment

Common Name	Scientific Name	Status within Washington D.C.
<b>Fish</b>		
American shad	<i>Alosa sapidissima</i>	severely reduced, but rebounding
Greenside darter	<i>Etheostoma blennioides</i>	low population abundance
Silver jaw minnow	<i>Ericymba buccata</i>	low population abundance
Warmouth	<i>Lepomis gulosus</i>	low population abundance
Alewife	<i>Alosa pseudoharengus</i>	low population abundance, currently stable
Blueback herring	<i>Alosa aestivalis</i>	low population abundance, currently stable
Atlantic sturgeon	<i>Acipenser oxyrinchus</i>	Federal status: threatened, extirpated from District of Columbia
American eel	<i>Anguilla rostrata</i>	low population abundance
Central stoneroller	<i>Campostoma anomalum</i>	low population abundance
Bowfin	<i>Amia calva</i>	extremely low population abundance
Hickory shad	<i>Alosa mediocris</i>	rebounding
Shortnose sturgeon	<i>Acipenser brevirostrum</i>	Federal status: endangered
<b>Birds</b>		
Bobolink	<i>Dolichonyx oryzivorus</i>	undetermined
Acadian flycatcher	<i>Empidonax virescens</i>	passage migrant
American bittern	<i>Botaurus lentiginosus</i>	local migrant
American black duck	<i>Ana rubripes</i>	undetermined
American woodcock	<i>Scolopax minor</i>	undetermined
Bald eagle	<i>Haliaeetus laucocephalus</i>	migrant and breeder
Black-crowned night-heron	<i>Nycticorax nycticorax</i>	migrant and breeder
Broad-winged hawk	<i>Buteo playtpterus</i>	imperiled
Brown creeper	<i>Certhia americana</i>	resident, local migrant, breeder
Brown thrasher	<i>Toxostoma rufum</i>	vulnerable
Cerulean warbler	<i>Dendroica cerulean</i>	undetermined
Chimney swift	<i>Chaetura pelagica</i>	secure

Common Name	Scientific Name	Status within Washington D.C.
Wilson's snipe	<i>Gallinago delicata</i>	undetermined
Eastern meadowlark	<i>Sturnella magna</i>	critically imperiled
Eastern towhee	<i>Pipilo erythrophthalmus</i>	secure
Field sparrow	<i>Spizella pusilla</i>	imperiled
Grasshopper sparrow	<i>Ammodramus savannarum</i>	undetermined
Great horned owl	<i>Bubo virginianus</i>	imperiled
Yellow-crowned night heron	<i>Nyctanassa violacea</i>	highly rare

## CULTURAL LANDSCAPES

An overabundance of deer and resultant deer browsing could adversely affect the cultural landscapes within Rock Creek Park, as could the erection of fences and large exclosures. Cultural landscapes, as defined by The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes, consist of "a geographic area (including both cultural and natural resources and the *wildlife or domestic animals* therein) [emphasis added] associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values" (NPS 1996b). The NPS uses 13 typically assessed features to determine if a landscape is significant. There are four general types of cultural landscapes: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes. The most common forms of cultural landscapes within Rock Creek Park are historic sites, historic designed landscapes, and historic vernacular landscapes. A historic site is a landscape significant for its association with a historic event, activity, or person (e.g., battlefields). A historic designated landscape, which includes parks and estates, is a landscape that was consciously designed or planned out by a landscape architect, master gardener, architect, or horticulturist. A historic vernacular landscape is a landscape that has evolved over time through use by the people whose activities and occupancy shaped it. Function of this site plays a significant role in these types of landscapes (NPS 1996b).

Created by an act of Congress in 1890, Rock Creek Park encompasses the last major natural landscape in the District. Many areas comprising the park were little modified by human interaction prior to its creation as a park. Since that time, the park has balanced the preservation and maintenance of the valley's natural and cultural resources with the recreational and transportation requirements of modern Washington while incorporating the highest cultural and aesthetic values. As such, Rock Creek Park is considered a significant cultural and historic landscape.

In 1997, the NPS began a cultural landscape inventory of Rock Creek Park. A cultural landscape inventory (CLI) identifies and documents the characteristics of a cultural landscape that make it significant and worthy of preservation. The CLIs permit the NPS to collate and evaluate information on the location, historical development, and features of the cultural landscapes that will assist park managers in their planning, programming, recording treatment, and management decisions.

The results of that inventory concluded that Rock Creek Park met the criteria for listing in the National Register as a historic designed landscape. As part of its ongoing efforts to identify and properly manage its significant cultural resources, the NPS has initiated the identification, documentation, and appropriate treatment of numerous cultural landscapes at Rock Creek Park. As a result of these efforts, the NPS has

determined that cultural landscapes exist at the following Rock Creek Park units comprising the study area for this plan/EIS:

- Rock Creek Park
- Rock Creek Tributary Parks (North Portal, Pinehurst Parkway, Soapstone Valley Park, Klingle Valley Parkway, Melvin Hazen Parkway, Normanstone Parkway)
- Dumbarton Oaks Park
- Montrose Park
- Peirce Mill
- Linnaean Hill
- Rock Creek and Potomac Parkway
- Glover-Archbold Park
- Whitehaven Parkway
- Palisades Park
- Little Forest Park
- Fort Circle Parks (Barnard Hill, Battery Kemble, Fort Bayard, Fort Bunker Hill, Fort Reno, Fort Slocum, Fort Stevens, Fort Totten, Fort DeRussy)

Most of these have not been fully inventoried or evaluated for the National Register of Historic Places. Of the above listed cultural landscapes, CLIs have been prepared for the following units:

- Linnaean Hill (including the Peirce-Klingle Mansion) (NPS 2003a) – In 1997, the Linnaean Hill landscape was identified as a component landscape of Rock Creek Park (Reservation 339). The landscape is the property of Joshua Peirce Klingle that was transferred to the federal government after the creation of the park in 1890 and is distinctive from the rest of Reservation 339 because of the physical history of the site and the character of the area.
- Peirce Mill (NPS 2003b) – In 1997, the Peirce Mill landscape was identified as a component landscape of Rock Creek Park (Reservation 339). The landscape is identified as the property owned by Peirce Shoemaker that was transferred to the federal government after the creation of the park in 1890 and is distinctive from the rest of Reservation 339 because of the physical history of the site and the character of the area.

In addition, cultural landscape reports have been published for:

- Dumbarton Oaks Park (NPS 2000a) – The need to document the Dumbarton Oaks Park historic landscape became apparent in 1985 when the NPS recognized that the garden was an important designed landscape that was being managed as a natural, rather than a cultural resource. The landscape report was created to provide guidance for stabilizing existing resources such as focal points and waterway features. This effort led to the 1997 *Preservation Maintenance Plan for Dumbarton Oaks Park*, which details cultural landscape maintenance.
- Montrose Park (NPS 2004d) – Montrose Park is also important as an early-twentieth century example of the adaptation of a country estate as a community park. In addition, Montrose Park is significant as a remnant of a nineteenth-century estate adapted as an early-twentieth-century park to serve the community of Georgetown. The park retains the character of its early years and period of significance (1911–1919), with such features as the topography, large trees, tennis

courts, Lodge, Summerhouse, Pergola, and Ropewalk still playing an important role in its landscape character.

### **ROCK CREEK PARK AND ROCK CREEK AND POTOMAC PARKWAY**

Created by an act of Congress in 1890, Rock Creek Park encompasses the last major natural landscape in the District. The area comprising the park was little modified by human interaction prior to its creation as a park. Since that time, the park has balanced the preservation and maintenance of the valley's natural and cultural resources with the recreational and transportation requirements of modern Washington while incorporating the highest cultural and aesthetic values. As such, Rock Creek Park is considered a significant cultural and historic landscape.

In 1997, the NPS began a cultural landscape inventory of Rock Creek Park. The results of that inventory concluded that Rock Creek Park met the criteria for listing in the National Register as a historic designed landscape. In addition, the inventory determined that two component landscapes of the park, Linnaean Hill (including the Peirce-Klingler Mansion) and the Peirce Mill contribute to the significance of the Rock Creek Park cultural landscape, and thus comprise individually eligible landscape elements (NPS 1998).

### **GLOVER-ARCHBOLD PARK AND WHITEHAVEN PARKWAY**

Cultural landscape inventories have not been conducted for either Glover-Archbold Park or Whitehaven Parkway units of Rock Creek Park.

### **TRAFFIC CIRCLES AND OTHER SMALL PARCELS**

Chevy Chase Circle is the only Rock Creek Park managed traffic circle or other small parcel that has a CLI. In 2005, the NPS prepared a draft CLI for Chevy Chase Circle. The results of the inventory determined that Chevy Chase Circle met the criteria for listing in the National Register as a historic designed landscape associated with architect Edward Donn, Jr., the Garden Club of America, and local community development. The circle is also significant for its associations with Senator Francis G. Newlands, the City Beautiful and picturesque suburbs movements, and the development of Chevy Chase. The inventory identified three principal design episodes at the circle that reflected its establishment as a memorial in 1933 and improvements undertaken in ca. 1956 and ca. 1990 (NPS 2005b).

## **SOUNDSCAPES**

### **NATURAL AND HUMAN NOISE LEVELS**

The main issue of concern relating to soundscapes and noise is that certain deer management actions, mainly use of firearms and dart guns, have the potential to cause disturbance to the natural soundscape of the park and surrounding properties. Natural soundscapes encompass all the natural sounds that occur in parks, including the physical capacity for transmitting those natural sounds and the interrelationships among park natural sounds of different frequencies and volumes (NPS *Management Policies 2006* [NPS 2006, sec. 4.9]). The NPS works to preserve, to the greatest extent possible, the natural soundscapes of parks. The frequencies, magnitudes, and durations of acceptable levels of unnatural sound will vary throughout a park, being generally greater in developed areas (NPS *Management Policies 2006* [NPS 2006, sec. 4.9]).

Noise can be defined as an unwanted sound, such as one that is loud, unpleasant, unexpected, or undesired. Sounds are described as noise if they interfere with an activity or disturb the person hearing them. Sound is measured in a logarithmic unit called a decibel (dB). Noise levels are most commonly expressed in dB. The human ear is not equally sensitive to all sound frequencies; therefore, the A-weighted decibel scale (dBA), which is calibrated to the human's ear response, is often used when analyzing noise levels. Table 17 illustrates common sounds and their associated exposure concern.

*Affected Environment*

Nearly all agencies and organizations with authority over noise-producing sources (including the World Health Organization and the National Research Council) use 55 dB as the threshold for defining noise day-night sound levels in urban areas (Schomer 2001).

The threshold of perception of the human ear is approximately 3 dB, and a 5-dB change is considered to be clearly noticeable. As shown in table 18, a 10-dB change would be perceived to be twice as loud (MN Pollution Control Agency 1999). When decibels are doubled, the sound does not become twice as loud. For most people a 10-dB increase in the measured sound level is perceived as being twice as loud, and a 10-dB decrease is perceived as half as loud (endpcnoise.com n.d.).

**TABLE 17. COMMON NOISE SOURCES AND LEVELS**

Source	Decibel Level (dB)	Exposure Concern
Leaves rustling	20	Normal safe levels
Soft whisper	30	Normal safe levels
Quiet office; crickets	40	Normal safe levels
Average home; refrigerator; washing machine; bird calls	50	Normal safe levels
Conversational speech	65	Normal safe levels
Highway traffic	75	May affect hearing in some individuals depending on sensitivity and exposure length
Noisy restaurant	80	May affect hearing in some individuals depending on sensitivity and exposure length
Average factory	80 to 90	May affect hearing in some individuals depending on sensitivity and exposure length
Pneumatic drill, thunder	100	May affect hearing in some individuals depending on sensitivity and exposure length
Automobile horn	120	May affect hearing in some individuals depending on sensitivity and exposure length
Jet plane	140	Noises at or over 140 dB may cause pain
Gunshot blast	140	Noises at or over 140 dB may cause pain
Centerfire rifle shot	160	Noises at or over 140 dB may cause pain

Sources: U.S. Department of the Interior n.d.; Musani n.d.; Galen Carol Audio n.d.; Dumond 2000; League for the Hard of Hearing 2003; Rossman 2006.

dB = decibels

**TABLE 18. PERCEPTIONS OF INCREASES IN DECIBEL LEVEL**

Amount of Change	Decibel Level (dB)
Imperceptible change	1
Barely perceptible change	3
Clearly noticeable change	5
About twice (or half) as loud	10
Fourfold change	20

Source: MN Pollution Control Agency 1999

Many factors affect how an individual responds to noise. Primary acoustical factors include loudness, frequency, and duration, but other non-acoustical factors also play a role in how an individual responds to sounds. These factors include the ambient noise level, time of day and year, location, and socioeconomic conditions, as well as if the receptor perceives the noise as being dangerous or preventable (Suter 1991).

## **NOISE ATTENUATION**

A number of environmental factors mitigate noise emissions in the environment, including absorption of sound by the air and the effect of barriers (structures), hills, and trees on the emitted noise. However, the most important of these factors is likely the distance between the source and the receiver (OPTI 2000).

### **Distance**

Noise levels depend on the distance from the noise source and the attenuation of the surrounding environment. As a sound wave travels through space, the intensity of the sound wave decreases with increasing distance from the source. When the distance from a point source is doubled (over a hard surface with no intervening vegetation), the sound level decreases 6 dBA (MN Pollution Control Agency 1999; Komanoff et al. 2000; OPTI 2002). For example, if a sound level were 95 dB at 50 feet, it would be 89 dB at 100 feet, and 83 dB at 200 feet. If the surface is “soft,” the decrease with distance can increase. Caltrans (1998) reports that “soft” sites with soft dirt, grass, or scattered shrubs or trees would experience a decrease in noise levels of 7.5 dB with doubling of distance from a point source, and that thicker vegetation strips can reduce noise by up to 10 dB over what would be predicted without the vegetation present.

### **Air Absorption**

As sound passes through the atmosphere it collides with the air molecules, converting some of the energy into heat, which decreases the sound energy. The amount of energy that the atmosphere absorbs varies with the weather conditions and the frequency of the sound. The atmosphere can reduce sounds by as much as 3 dBA for every 100 feet, depending on weather conditions (OPTI 2000).

### **Barriers and Hills**

Barriers, such as buildings and other structures, and hills can also attenuate sound in the environment. As sound waves “bend” around obstructions, they lose energy. Therefore, people usually do not hear sounds from sources that are behind hills or buildings. The amount of attenuation provided by an obstruction depends on the how much the sound waves bend. This attenuation is greatest closest to the source, but is less effective at greater distances (OPTI 2000).

### **Trees**

Vegetation can help decrease noise, although not as effectively as barriers. Vegetation must be so high, wide, and dense that it cannot be seen through, and taller than the noise source in order to be effective (FHWA 2000; OPTI 2000). Many areas at Rock Creek Park are heavily vegetated, other areas are more open habitats with sparse understory due to heavy deer browsing.

## **NOISE LEVELS AT ROCK CREEK PARK**

One of the natural resources of Rock Creek Park is the natural soundscape, which includes all of the naturally occurring sounds of the park, such as calling birds, wildlife, cascading and flowing water, as well as the quiet associated with the hiking and horse trails. Noise standards and guidelines applicable to activities in Rock Creek Park include those established by the NPS, federal guidance, the National Capital Planning Commission, and the District of Columbia.

The Rock Creek Park system includes not only the main park, but also numerous additional parks within an urban environment, such as Glover-Archbold and Battery Kemble, scattered throughout the District, encompassing a total of approximately 3,000 acres. Sources of noise within Rock Creek Park units and surrounding areas are those typical of an urban area and include recreational activities, motor vehicle operations, and the noises associated with residential development in an urban setting (e.g., lawn mowers). The park system with the main unit of Rock Creek Park and the Rock Creek and Potomac Parkway contains an extensive roadway network that is the primary source of noise. Commuters frequently use park roads during rush hour periods. Automobile traffic occurs primarily on the surrounding roadway network, including heavily traveled 16<sup>th</sup> Street NW to the east and entrance and access roads within the park boundary and surrounding areas. A single automobile produces noise levels in the range of 70 dBA near the vehicle, while moderately heavy traffic may produce noise levels in the range of 85 to 90 dBA near the roadway (Miyara 1998). Automobile traffic is also present adjacent to other units of Rock Creek Park, particularly traffic circles and small triangle parks located throughout the city. The NPS-managed circles act in part to manage traffic and are surrounded on all sides by District of Columbia city streets. The Glover-Archbold and Whitehaven units are located between 44<sup>th</sup> and 37<sup>th</sup> streets in the northwest section of the District and are surrounded almost entirely by a residential area. The lower portion of the Glover-Archbold borders Georgetown University and Georgetown Hospital. Noises around these units would be the same as those in the vicinity of Rock Creek Park and Rock Creek and Potomac Parkway.

In 1996, the NPS performed a study to characterize noise environments in Rock Creek Park (NPS 1997b). The extensive roadway network is the primary source of noise in the park. The study selected 26 noise-monitoring locations and recorded traffic noise levels at these locations with references to distance to the nearest road. In general, this study found that the lowest noise levels in the park were found at the golf course, about 200 to 225 feet from the Rock Creek and Potomac Parkway, at 58 to 63 dB equivalent sound level, and highest on the jogging trail south of Calvert about 10 feet from the parkway (79 dB equivalent sound level) (NPS 1997b, supplemented by K. Ferebee, pers. comm. 2008a). This study also found noise levels to be constant throughout the day, with peak and off-peak levels differing by 4 dB or less. Areas in the park where noise levels met or exceeded Federal Highway Administration noise abatement criteria included picnic areas south of Military Road within 60 feet of Beach Drive, visitor facilities within 110 to 125 feet of Rock Creek and Potomac Parkway, and segments of recreational trails within 100 feet of Beach Drive and the parkway (NPS 2005a).

In addition, in 1992, the NPS evaluated noise sources at 15 locations near the tennis center (NPS 1993). Background noise levels at the tennis center, or noise levels when no events are underway, were measured at 55 dB (calculated day/night levels as specified by the American Standards Institute). The data for noise levels emanating from the tennis stadium during tennis events indicated that levels rarely violate the D.C. property line noise standard of 55 dB for times after 9:00 p.m. or 60 dB for times before 9:00 p.m. (NPS 1993).

The two currently operating wireless telecommunication facilities within the main Rock Creek Park unit do generate some level of noise, affecting the park's soundscape. Each facility has a cooling unit, which generates a noise level of 73 dBA at 5 feet from the unit operating at approximately 2- or 3-minute intervals, daily. Additionally, each facility has a generator, which is tested once per week for 40 minutes. The generators emit noise levels similar or slightly higher than the noise levels produced by the cooling units. The noise levels emitted by these facilities comply with all applicable regulations including the NPS, EPA, and the District of Columbia (NPS 2003e).

#### **FIREARM NOISE**

Firearms produce an intensely loud noise, which can be characterized as impulse noise that has the characteristics of an explosive burst. Peak sound levels from rifles and pistols similar to those that could be used in lethal management actions can range from about 150 to 165 dB (Musani n.d.).

Noise suppressors may be used in conjunction with sharpshooting to reduce the impact of sound from a firearm. Commercially available rifle suppressors offer suppression that ranges from 25 to 40 dBA, with most closer to 30 dBA. In addition, distance, topography, and vegetation would also affect the level of noise experienced from firearm use.

#### **NOISE LEVELS AND PERCEIVED ANNOYANCE**

Noise, by definition, is unwanted sound. It can be an infringement on one's sense of privacy, as well as a source of frustration when the noise is beyond a person's control. Noise has the ability to interfere with a broad range of human activity (i.e., conversation, sleeping, relaxing, listening to television/radio, enjoyment of property, enjoyment of solitude), which ultimately causes annoyance. According to the EPA Levels Document (EPA 1974), approximately 17% of the population will be highly annoyed at an day-night average sound level (Ldn) of 55 dB, and over 40% of the population will be highly annoyed if the Ldn exceeds 70 dB (the maximum safe level the EPA has identified to protect against hearing loss) (EPA 1981). However, Schultz (Schultz 1978) correlated the results from 19 social surveys of annoyance, which resulted in slightly different results than what is depicted in the EPA Levels Document. Schultz concluded that, on average, approximately 4% of the population will be highly annoyed by noise at or below a level of an Ldn of 55 dB; 16% will be highly annoyed by noise at a level of an Ldn of 65 dB; 25% will be highly annoyed by noise at an Ldn of 70 dB; and 37% will be highly annoyed as the noise level reaches an Ldn of 75 dB.

Several factors have been found to influence community reaction to noise. These factors include (Noise Pollution Clearinghouse n.d.):

- duration of intruding noises and frequency of occurrence
- time of year (windows open or closed)
- outdoor noise level in community when intruding noises are not present
- history of prior exposure to the noise source
- attitude toward the noise source
- presence of pure tones or impulses

The particular time of day or year when the sound occurs is important; a few intrusions late at night, at meal times, or during times of relaxation and leisure may produce more annoyance than a constant flow of intrusive sound when people are fully occupied with other activities (Truax 1999).

Certain sounds arouse a negative response because of unpleasant associations surrounding them and what they represent. In some cases, sound annoyance may be traced to actual physical characteristics of the sound, namely loudness, noisiness, or high pitch. Sound phobias and taboos may also reflect social values and personal attitudes towards the sound maker (Truax 1999).

#### **VISITOR USE AND EXPERIENCE**

Deer and deer management actions can have many effects on the visitor use and experience in the park. Of concern are the effects on the natural surroundings from overbrowsing, the effect of deer removal, and the effects on visitors using the park from the various proposed management actions that could cause temporary closures or disturbances.

#### **VISITATION**

Founded as one of the country's first federal parks, Rock Creek Park is one of the largest forested urban parks in the nation, supporting an average of more than 2 million recreational visitors per year. In 2007,

park visitation equaled 2,061,366 visitors (NPS 2008a). Another 12 million people use the park annually as commuters (NPS 2003e). Figure 8 shows the popular visitor use areas within Rock Creek Park.

Visitation to Rock Creek Park has increased over 250% since 1973, growing from about 559,000 recreational visits in 1973 to almost 2,000,000 in 2007 (NPS 2007a, 2008a). While this was a result of a mostly steady increase over the past 24 years, rapid growth occurred in the 1980s when recreational visitation to Rock Creek Park almost doubled, and then stabilized throughout the 1990s. In 1980 there were 1,060,000 recreational visitors. By 1989, this number had risen to 2,050,000 recreational visitors. After this growth, visitation has tended to remain relatively stable at around 2 million visitors per year, with a slight upward trend since about 1996 and fluctuations from year to year, as shown in figure 9 (NPS 2007a).

Rock Creek Park records visitor use numbers for Reservation 339 (the main unit of the park) and its tributaries and Rock Creek and Potomac Parkway only. Yearly visitor counts are not available for the remaining Rock Creek Park units. For example, within Reservation 339 in 2006, visitation to the park's major points of interest included (Gunther, pers. comm. 2007):

- Old Stone House – 73,854
- Peirce Mill – 1,062
- Nature Center – 30,813
- Carter Barron Amphitheater – 58,064

Historically, the majority of recreational visits to Rock Creek Park occur evenly over the warmer months of spring, summer, and early fall, and drop slightly in the late fall and winter (NPS 2005a). Many visitors are park neighbors, who access the park from their backyards or neighboring public areas. Non-recreational visits, which include those from commuters or others passing through the park, are distributed evenly throughout the year, with an average of 25% of total visits occurring each season. This is particularly true on the Rock Creek and Potomac Parkway where traffic counts show little variation from month to month (NPS 2004h). Table 19 shows that visitation at Rock Creek Park is highest in June, July, August, and October and lowest in February (NPS 2008a).

Since 1989, while visitation has remained relatively stable, the number of visits to the park's interpretive centers has decreased. Budget shortfalls have reduced the number of visitor services, resulting in many visitors to Rock Creek Park possibly never knowing that they are in a national park. Many visitors may never have contact with park rangers or receive any basic orientation (NPS 2005a).

# Rock Creek Park Units District of Columbia

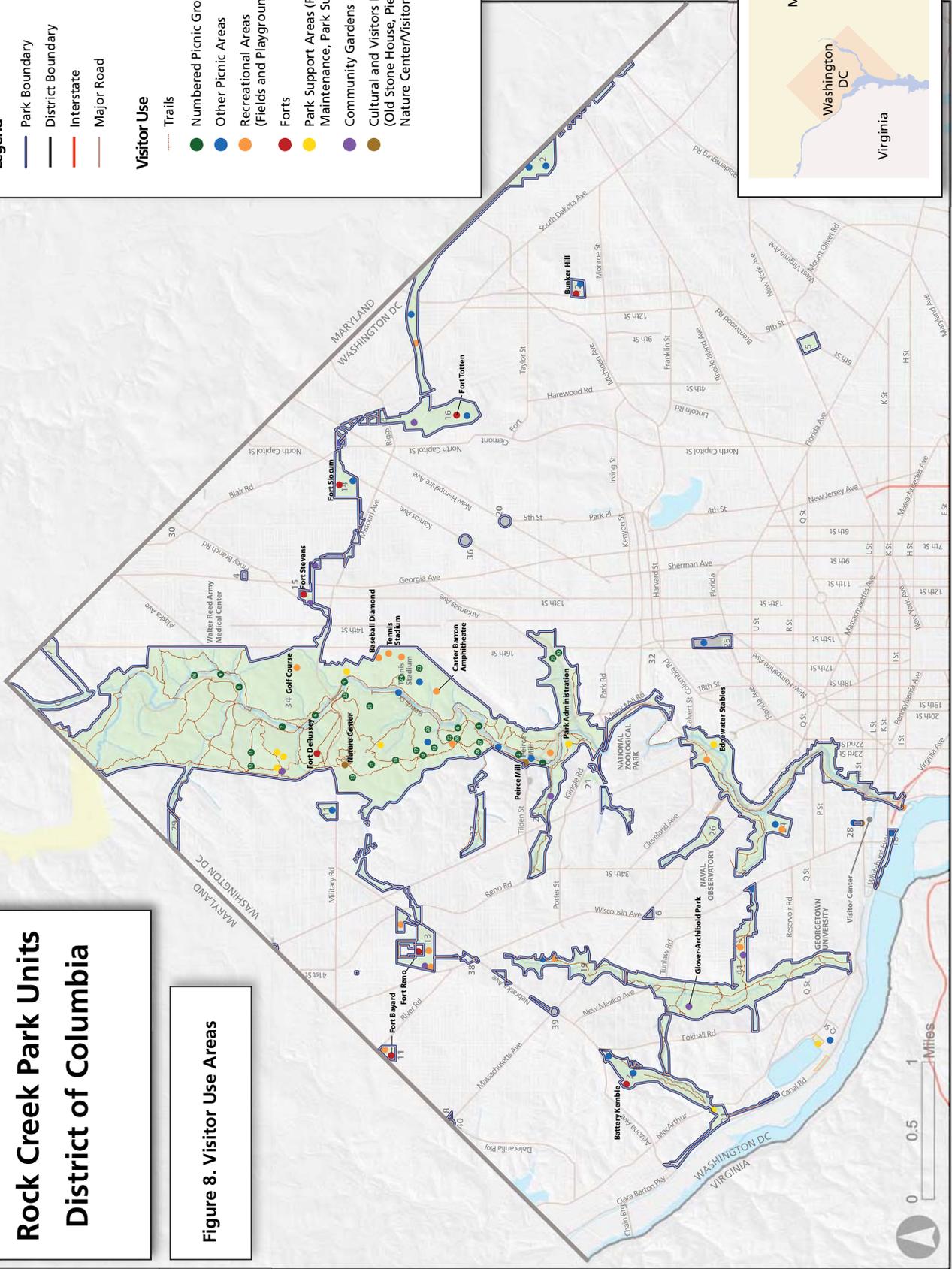
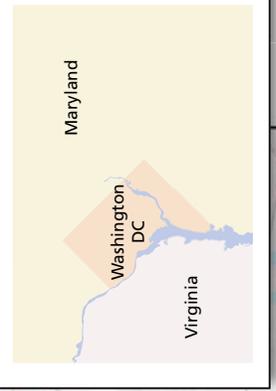
Figure 8. Visitor Use Areas

## Legend

- Park Boundary
- District Boundary
- Interstate
- Major Road

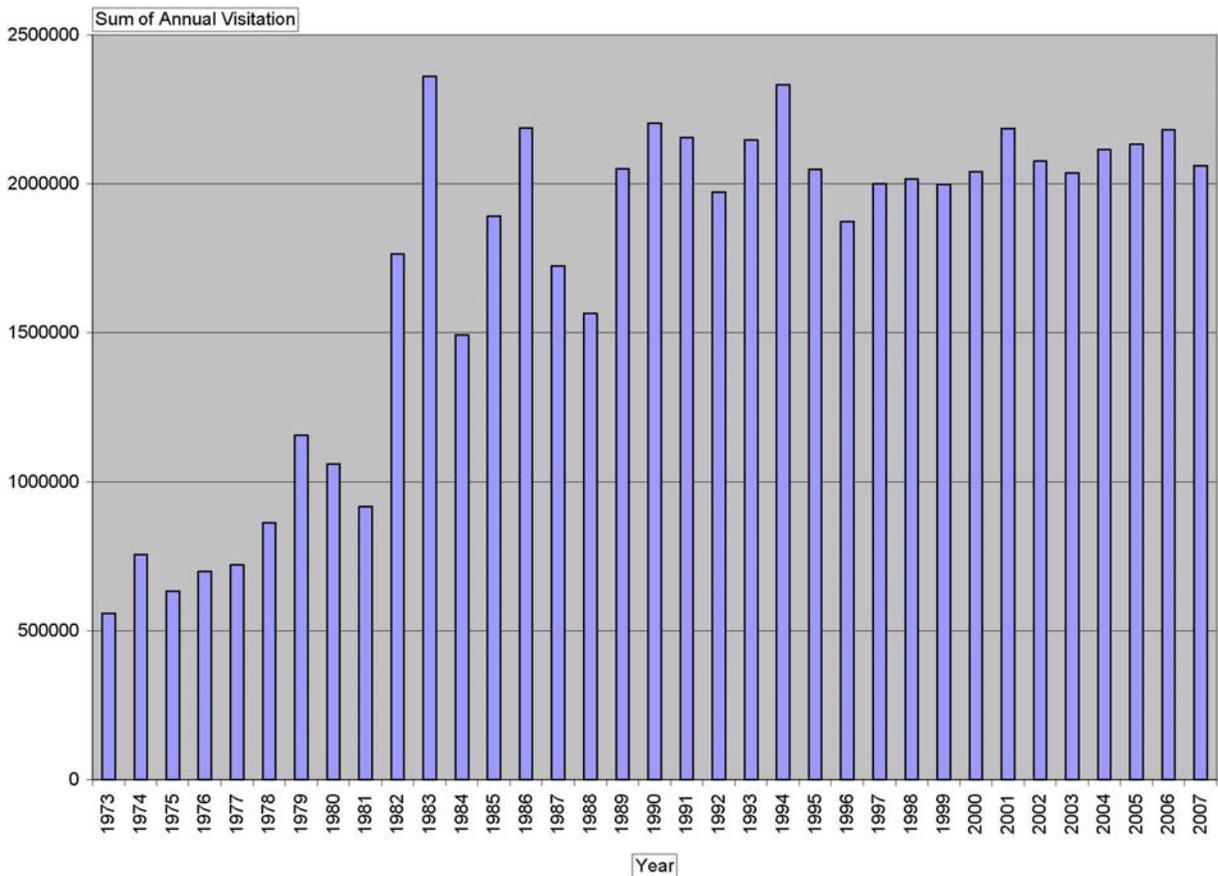
## Visitor Use

- Trails
- Numbered Picnic Groves
- Other Picnic Areas
- Recreational Areas (Fields and Playgrounds)
- Forts
- Park Support Areas (Park Rangers, Maintenance, Park Support Staff)
- Community Gardens
- Cultural and Visitors Information Areas (Old Stone House, Pierce Mill, and Nature Center/Visitor Center)





**FIGURE 9. ANNUAL VISITATION AT ROCK CREEK PARK**



**TABLE 19. MONTHLY RECREATIONAL VERSUS NON-RECREATIONAL USE OF ROCK CREEK PARK**

Month	Year	Recreational Visits	Non-recreational Visits	Total Visits
January	2007	148,848	1,053,461	1,202,309
February	2007	130,994	950,186	1,081,180
March	2007	144,271	1,051,747	1,196,018
April	2007	189,851	1,017,322	1,207,173
May	2007	187,135	1,053,461	1,240,596
June	2007	212,914	1,017,322	1,230,236
July	2007	206,620	1,051,747	1,258,367
August	2007	210,057	1,053,461	1,263,518
September	2007	162,788	1,015,607	1,178,395
October	2007	185,499	1,053,461	1,238,960
November	2007	155,280	1,019,036	1,174,316
December	2007	127,109	1,050,032	1,177,141
	<b>Totals:</b>	2,061,366	12,386,843	14,448,209

Source: NPS 2007b.

**VISITOR ACTIVITIES**

Rock Creek Park offers a variety of recreation options, including paved multi-use trails, an extensive system of hiking and horseback riding trails, and the Rock Creek Horse Center for public horseback riding and horse boarding. The park also includes an 18-hole public golf course, tennis courts, picnic areas, community gardens, and other recreational areas such as sports fields and playgrounds. Other activities include canoeing and kayaking on Rock Creek and interpretive programs at the Rock Creek Nature Center and Planetarium, Pierce Mill complex, and Old Stone House. The park also manages the Carter Barron Amphitheater, which is a 4,000-seat outdoor theater featuring summer musical and theatrical performances. A visitor use survey conducted in the summer of 1999 (Littlejohn 1999) found that the most common activity reported by park visitors was jogging/hiking/walking (44%), followed by bicycling (18%), relaxing/sunbathing and walking the dog (both at 17%), attending concerts (15%), nature study (13%), picnicking (11%), and golfing (10%). All other activities were recorded at less than 10%. Figure 8 shows the locations of some of these popular visitor use areas and activity centers in the park.

Visitors to Rock Creek Park are primarily local residents of the Washington, D.C. metropolitan area and many who live adjacent to the park can readily access the park for jogging, walking, and dog walking (K. Ferebee 2008a). However, because it is a national park, people from across the country and around the world visit the park. The 1999 study found that people visit the park for a wide variety of reasons, including exercise (61%), escaping the city environment (47%), time with family and/or friends (37%), and solitude (30%). Table 20 lists the reasons that respondents mentioned for visiting the park.

**TABLE 20. REASONS FOR VISITING ROCK CREEK PARK**

Reason	Percent Reporting (%) <sup>a</sup>
Exercise	61
Escaping the city environment	47
Time with family or friends	37
Solitude	30
Enjoy natural history	14
Learn about nature/history	10
Visit a nature center	10
Connect with the past	7
Commute to work	6
Other <sup>b</sup>	29

a. Respondents could indicate more than one reason for visiting, so numbers will exceed 100%.

b. "Other" includes attending a concert, walking the dog, golfing, gardening, enjoying nature, eating lunch, commuting home, visiting the planetarium, and studying.

Visitors were also asked to rate the importance of selected features or qualities of the park. Scenic beauty was ranked very high, with 94% ranking it extremely or very important (73% considering it extremely important and 21% very important). Other rankings that were high included recreational opportunities (93% extremely or very important), clean air (90% extremely or very important), and clean water (86%

extremely or very important). Native plants and animals were ranked as extremely or very important by 68% of the respondents (44% extremely important and 24% very important).

The length of a visitor's stay depends on the purpose of the visit. Overall, the majority of visitors (59%) to Rock Creek Park stay two hours or less (Littlejohn 1999). Many people visit Rock Creek Park on a regular basis; 52% of those surveyed visit the park weekly (Littlejohn 1999).

Some of key visitor activities or visitor facilities in the park are described below.

### **Birding**

Rock Creek Park is a popular site in the Washington, D.C. metropolitan area for birding (bird watching). Birding is a growing recreational activity that more than doubled in popularity from 1983 to 2001 (Cordell and Herbert 2002). Some of the preferred areas for birding in Rock Creek Park include the areas around the nature center, stables, maintenance yard, picnic areas 17 and 18, and, in general, the western ridge of the park. Birders visit the park mostly in the spring and fall during bird migration and during the summer bird breeding season (NPS 2005a).

### **Fishing**

Fishing is another activity enjoyed by visitors to Rock Creek Park. Anglers need to have a District of Columbia fishing license to fish. Fishing is allowed from Piney Branch south to the mouth of the creek. Typical catches include bass, catfish, and herring, although herring are only present in the spring when the fish are running upstream. Fishing is not allowed in the original reservation of Rock Creek Park (Reservation 339).

### **Biking and Hiking**

Biking and hiking are also popular activities in the park. Beach Drive between Military and Broad Branch roads is closed to cars from 7 a.m. Saturday to 7 p.m. Sunday and on holidays for biking, hiking, jogging, and rollerblading (NPS 2008c). There are 11 miles of bike trails not on roads, and about 29 miles of hiking trails (K. Ferebee, pers. comm. 2008e).



### **Tennis**

The Rock Creek Park tennis center surrounds the William H.G. Fitzgerald Tennis Stadium, home of the Legg Mason Tennis Classic, which draws an annual attendance of 60,000 during the week-long tournament. A second tournament is sometimes held each year, with approximately half the attendance of the Legg Mason tournament. The courts are open year-round from 7:00 a.m. to 11:00 p.m. and are used by approximately 90,000 people annually. The amphitheater season extends from May through September, making the area around the tennis center very active during the summer months. During tournaments, the area surrounding the tennis center is covered with tents and other temporary structures associated with the events.

### **Nature Center**

The Rock Creek Park Nature Center and Planetarium, located north of the maintenance yard, is open Wednesday through Sunday from 9:00 a.m. to 5:00 p.m. and is the major information center and focal

point for activities related to the park's natural and cultural history. Guided nature walks and curriculum-based environmental education programs take place daily at the nature center. A wheelchair-accessible, self-guiding nature trail is located near the center.

### **Horseback Riding**

The Rock Creek Horse Center is open to the public Tuesday through Sunday and offers trail rides, riding lessons, pony rides, boarding facilities, and summer day camp sessions. The horse center averages 21,250 visitors per year with the highest use periods occurring from April through October. Trails extending from the horse center provide access to horse riding trails throughout the park. The main access trail extends southeast from the horse center toward Ross Drive and Rock Creek just to the east of the maintenance yard. This is the most heavily used horse trail in the park.

### **Golf**

The Rock Creek Park golf course, located north of the tennis center and maintenance yard, is a 4,798-yard, par-65 public course noted for its hilly and challenging terrain. The course is open every day from dawn to dusk and includes a golf school, a golf shop, putting green, and a snack bar. The highest use period at the golf course, on average, is April through October.

### **Community Gardens**

As well as providing facilities for sports and recreation, the park also contains a number of community gardens (see figure 8). Eight community gardens are tended within the park. Of these gardens, four are fenced to protect crops from deer browsing. Gardens that do not require fences are in areas where deer do not freely roam (K. Ferebee, pers. comm. 2007e).

### **Motorized Recreation**

A popular visitor experience on weekdays is motorized travel on park roads. The principal roadways within the park are the Rock Creek and Potomac Parkway and Beach Drive. The Rock Creek and Potomac Parkway portion of the park road network extends approximately 2.5 miles from the Theodore Roosevelt Bridge in the core of the District of Columbia, north to Calvert Street. The parkway is a four-lane, paved, limited access road with a posted speed limit of 35 miles per hour (District of Columbia 2001a, b). It is heavily used, with daily traffic volumes of 40,000 to 55,000 vehicles per day (NPS 2005a).



The Beach Drive portion of the park road network extends from Calvert Street, approximately 6.5 miles north to the Maryland state line. This road is a two-lane, paved road with a posted speed limit of 25 miles per hour. Commuters and others use Beach Drive as a pleasant way to traverse the city in a north/south direction, even if they do not leave their cars for more direct contact with the outdoors. Based on a traffic study conducted in 2004, approximately 2.5 to 3 million visitors per year drive on the Beach Drive segments north of Broad Branch Road and Joyce Road. South of Blagden Avenue, more than 7.5 million drivers travel on Beach Drive annually (Parsons 2004). More than 9

million drivers per year take Beach Drive south of Klinge Road (District of Columbia 2001a, b). Travel time analyses in the 2004 traffic study showed that some of the automobile travel through the park on Beach Drive on weekdays is not time effective, which suggests that some drivers use Beach Drive for the aesthetic quality of the experience.

Other park roads are less heavily traveled. Based on average daily traffic volumes from the District of Columbia and the 2004 traffic study, use includes the following:

- Wise Road – 1.3 million vehicles per year
- Bingham Drive – 285,000 vehicles per year
- Ross Drive – 125,000 vehicles per year north of the Glover Road intersection and 290,000 vehicles per year south of this intersection on Glover Road

Wise Road and Bingham Drive can provide cross-park connections, but use of these routes may also be based on the quality of the experience traveling through the park. Many routes are more efficient than the north/south trending Glover Road and Ross Drive, indicating that motorized use of these roads is related to enjoyment of the drive (NPS 2005a).

## **VISITOR AND EMPLOYEE HEALTH AND SAFETY**

Deer management actions all have safety implications for employees and visitors, especially if firearm use is considered. Deer-vehicle collisions are of particular concern to residents and commuters. The NPS is committed to providing appropriate, high-quality opportunities for visitors and employees to enjoy parks in a safe and healthy environment. Further, the NPS will strive to protect human life and provide for injury-free visits.

The general management planning process identified the following optimum conditions related to visitor use and experience that influence health and safety:

- a safe healthful environment is provided for visitors and employees; management actions strive to protect human life and provide for injury-free visits
- park visitors assume a substantial degree of risk and responsibility for their own safety when visiting areas that are managed and maintained as natural, cultural, or recreational environments
- effective law enforcement occurs as part of a cooperative community effort; the park encourages and assists park neighbors in the development of cooperative crime prevention and detection programs

Health and safety applies to Rock Creek Park visitors, local residents, and Rock Creek Park employees.

## **VISITOR HEALTH AND SAFETY**

A visitor accident or incident is defined as an accidental event affecting any non-NPS employee that results in serious injury or illness requiring medical treatment, or in death. Park rangers and employees post public notices on bulletin boards around the park and on the park website in order to ensure that visitors to Rock Creek Park are properly informed regarding safety concerns. The park will produce press releases if a situation requires public notification. Visitors can also gain information about safety measures and protocols by speaking to park rangers (K. Ferebee, pers. comm. 2007e).

Rock Creek Park visitor safety incidents are based on U.S. Park Police data because Rock Creek Park does not have its own emergency management system or law enforcement staff. In 2005, there were 85 visitor incidents within the park. In 2006, the reporting system was changed to reflect how many incidents occurred with visitor injuries. In 2006, there were 100 injured visitors; in 2007, 71 visitors were injured (Gunther, pers. comm. 2007, 2008).

The majority of incidents within Rock Creek Park are a result of vehicle accidents. A primary safety issue for visitors and local residents related to this plan involves injuries from deer/vehicle collisions.

**DEER/VEHICLE COLLISIONS**

Deer/vehicle collisions are a threat to human safety and are one of the predominant sources of deer mortality. In past studies, the number of deer/vehicle collisions has been correlated to both traffic volume and greater deer abundance. However, a working group within the Metropolitan Washington Council of Governments found that although deer/vehicle collisions have increased in the park, traffic volumes have not increased. Traffic data from 1995 and 2003 were compared with the correlating deer/vehicle collision numbers. Traffic volumes remained basically the same or decreased, while deer/vehicle collisions increased, indicating that the number of deer may be an important factor in the increased number of accidents occurring (Metropolitan Washington Council of Governments 2006).

Deer ranges are largest in winter and early spring, and there is a greater chance of a collision during these periods. The greatest number of reported animal crashes occur in November, and the second highest in October, which is deer mating season. In addition, deer often travel in family groups, causing more concern for motorists.

Rock Creek Park has surveyed dead deer since the early 1980s, and in 1989 the park recorded the first deer struck and killed by a vehicle. Data collected indicate an upward trend in deer/vehicle collisions from 1989 to 2007. An average of 42 deer/vehicle collisions resulting in the death of the deer were recorded since 2003, with a high of 52 reported in 2006 (K. Ferebee, pers. comm. 2007a). Deer/vehicle collisions within the park are most common along Military Road, Oregon Avenue, Beach Drive, and Rock Creek and Potomac Parkway.

**EMPLOYEE HEALTH AND SAFETY**

Park staff are proactive about protecting the safety of employees. The park has implemented a tailgate meeting every Monday morning to review safety issues with maintenance employees. Because maintenance is the department that experiences the most injuries, daily emails are sent to all employees regarding safety issues and reminders. Rock Creek Park has implemented an employee safety goal of 7 injuries for the 2008 fiscal year (Newman, pers. comm. 2007). Table 21 shows recent years’ injury rates.

**TABLE 21. EMPLOYEE INJURY RATES FOR RECENT YEARS**

Fiscal Year	Number of Injuries	Continuation-of-pay Hours (paid during sick leave)
2005	5	411
2006	7	796
2007	6	440

Most injuries or accidents are usually sustained by maintenance staff and park rangers, who often perform manual work outdoors. The most widespread injuries were maintenance activity-related, such as back and knee injuries. No injuries have occurred related to deer management activities performed to date (Champagne, pers. comm. 2007); however, NPS staff would be exposed to additional potential safety risks if deer management activities were added to their work routine.

**SOCIOECONOMIC RESOURCES**

The main socioeconomic issue addressed by this plan is the potential for an overabundance of deer to browse landscape vegetation on neighboring properties and cause economic damage. Rock Creek Park runs through the center of the District of Columbia, which has a population of 572,059 and an average population density of 9,471 people per square mile (NeighborhoodInfoDC, 2007a). The 1,700-acre park contributes to the varied landscape of Washington, D.C., providing access to natural areas and many associated recreational opportunities, such as horseback riding, hiking, cycling, and picnicking.

The District of Columbia is the area within which the effects of any of the alternatives are most likely to be felt. The implementation of various deer management techniques in Rock Creek Park would most directly affect losses to landscaping by neighboring properties as the result of deer browsing and deer traffic. The majority of the park is surrounded by residential development (see figure 10). Therefore, damages to landscaping as the result of deer browse and trampling, and the subsequent effect on property values, are of importance in this plan/EIS.

There are 21 census tracts that border or are contained within Rock Creek Park as described in table 22. Although there is substantial variation in household income and home values, the majority of these selected census tracts show household income and home values above the average for the District of Columbia. The average median value of owner-occupied units in the census tracts adjacent to Rock Creek Park was approximately \$331,000 in 2000, more than double the average for the District as a whole. Average median household income was approximately \$66,000 in 2000, more than 60% higher than that of the rest of the district. Furthermore, most tracts also show increased rates of homeownership, whether for single-family homes, row houses, condominiums, or co-ops. These tracts vary in character, from primarily residential areas, to those that incorporate commercial development.

**TABLE 22. DISTRICT OF COLUMBIA CENSUS TRACT DATA**

	Population, 2000	Median Household Income, 2000	Median Value for Owner- occupied Units, 2000	Percent of All Housing Units Owner- occupied, 2000
<b>District of Columbia</b>	572,059	\$40,127	\$157,200	41
<b>Census Tract #</b>				
1	4,674	\$92,540	\$479,000	53
4	1,501	\$129,133	\$699,100	68
5.01	2,774	\$65,521	\$256,600	18
5.02	3,062	\$66,815	\$451,000	46
6	4,969	\$89,507	\$412,900	64
13.01	3,747	\$68,417	\$587,900	31
13.02	6,350	\$58,790	\$151,600	30
14.02	3,925	\$84,105	\$340,100	68
15	5,649	\$107,917	\$411,800	88
16	4,030	\$94,624	\$327,000	90
18.03	3,066	\$34,565	\$188,000	20
20.01	2,435	\$32,853	\$318,000	33
20.02	3,781	\$47,619	\$164,800	67
26	2,184	\$85,180	\$383,900	71
27.01	5,742	\$35,147	\$256,200	22
27.02	6,052	\$45,428	\$301,300	32
39	4,643	\$42,532	\$152,900	26
40.01	3,474	\$59,008	\$272,900	44
41	2,570	\$88,170	\$450,000	49
55	4,696	\$59,609	\$186,900	34
56	5,946	\$39,286	\$164,800	35

Data Source: U.S. Census Bureau 2007; NeighborhoodInfo DC 2007c

The damages that deer may inflict upon landscaping and its subsequent relationship to property values and cost to property owners are discussed below.

### **LANDSCAPING AND PROPERTY VALUES**

The median property value of owner-occupied units in the District of Columbia was \$157,200 as of the 2000 census. Between 1995 and 2005, areas around Rock Creek Park units experienced an increase in property values ranging from 2.7% (the area around the northern half of the main Rock Creek Park) to 5.8% (the area around the southern portion of the Rock Creek Park and Potomac Parkway). In the area around Glover-Archbold Park and Whitehaven Parkway, home values increased by 5.2% during that time period (Neighborhoodinfo DC 2007a). Although home prices are increasing, sales of single-family homes throughout the city have declined overall and were down 11.6% in the third quarter of 2006 from the prior year (Neighborhoodinfo DC 2007b).

Landscaping can have a significant impact on property values, enhancing the resale value of a property by up to 15%, with a treed lot selling for 7% to 14% more than a lot without trees (Nuss 2000). Furthermore, landscaping expenditures are often easily recovered when selling, with 100% to 200% of landscaping costs typically recovered (Taylor 2003). Therefore, improvements to landscaping may be seen as a successful way to improve property values.

Unfortunately, deer can often have a highly destructive effect on landscaping. Their diet experiences seasonal variation, which is typically a function of what is available. Browse, which refers to trees, shrubs, and vines, makes up a substantial part of the diet of the average deer. As habitat dwindles due to development pressure and as deer populations grow, deer may turn to surrounding residential areas for food, particularly in late fall, winter, and early spring, when other food sources may be scarce. An average adult deer consumes approximately 6 to 10 pounds of food per day during late spring, summer, and fall (McDonald and Hollingsworth 2007), which may result in increased pressure on surrounding landscaped areas from deer browsing if available natural habitat cannot support the population. In many residential areas surrounding protected areas, such as Rock Creek Park, deer cause virtually year-round damage to landscaping, which can be costly to replace. Currently, the District Department of the Environment considers overbrowsing to be a serious conservation threat (DDOE 2006).

Deer damage shrubs and landscape vegetation by eating the buds, leaves, flowers, and twigs, and by rubbing on the bark. In home gardens, deer often eat leaves, flowers, stems, or other edible parts. Other less frequent damage includes trampling of plants and damage to trees and shrubs caused by antler rubbing (West Virginia University 1985). Damage typically extends to an average of 6 feet, which is as high as deer can reach. Nearby Fairfax County, Virginia, estimates annual damage to landscaping resulting from deer at approximately \$1 million (Fairfax County Park Authority 2004).

Rock Creek Park began compiling a list of people who inquired about the impacts of deer on neighboring landscaping in the early 1990s. This list served as a mailing list and did not track the number of complaints or inquiries the park received on the subject. Calls are received each year about deer issues and the majority involved concerns about deer consuming landscaping plants or road kill clean-up. There have been no reported incidences of deer aggression towards park visitors or park neighbors. This list has not been regularly updated and staff at Rock Creek Park Headquarters continue to handle any complaints, but do not keep records (Armstead, pers. comm. 2007).

### **PARK MANAGEMENT AND OPERATIONS**

Deer management actions, even the dissemination of information about deer and their effects on the environment, require time and money, and all alternatives considered would have effects on staffing and operating budgets. The staff of Rock Creek Park is currently organized into three operating divisions: Administration, Resource Management and Visitor Services, and Maintenance. There are 48 full-time employees.

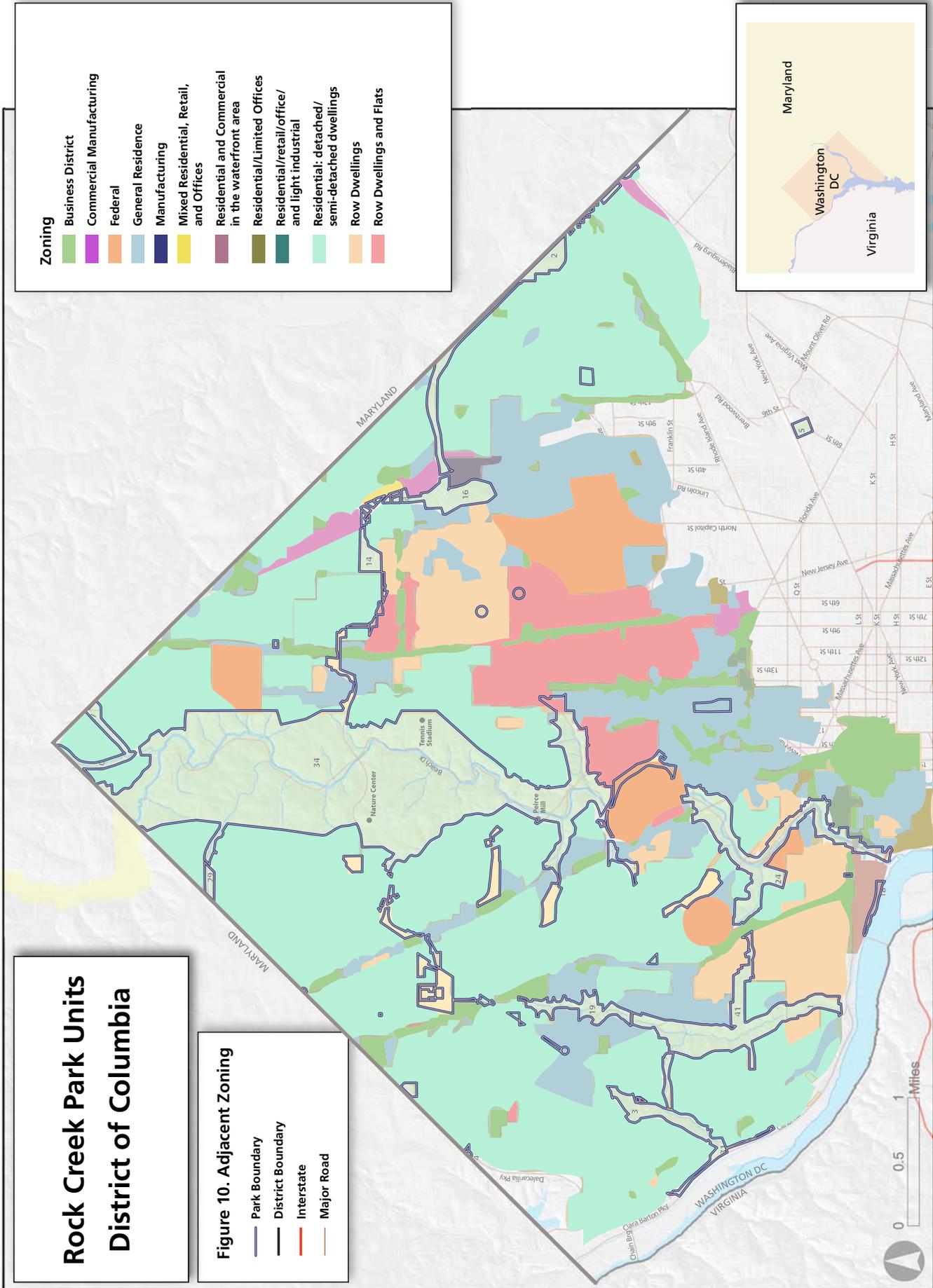
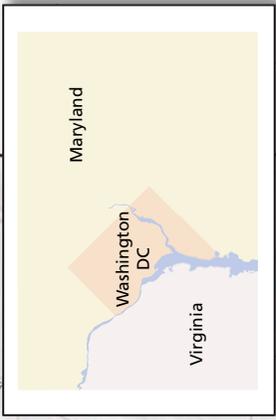
# Rock Creek Park Units District of Columbia

Figure 10. Adjacent Zoning

-  Park Boundary
-  District Boundary
-  Interstate
-  Major Road

## Zoning

-  Business District
-  Commercial Manufacturing
-  Federal
-  General Residence
-  Manufacturing
-  Mixed Residential, Retail, and Offices
-  Residential and Commercial in the waterfront area
-  Residential/Limited Offices
-  Residential/retail/office/and light industrial
-  Residential: detached/semi-detached dwellings
-  Row Dwellings
-  Row Dwellings and Flats





The permanent staff is augmented by a seasonal or temporary workforce, which changes from year to year due to funding variations. Typically, this seasonal workforce has included 1 to 2 park rangers, 1 biological technician, and 8 to 10 laborers and maintenance workers. Three to four volunteers from the Student Conservation Association augment park staff (K. Ferebee, pers. comm. 2007d). In 2007 there were 19 seasonal or temporary employees at the park, for a total of 64 employees. Seasonal employees are common from the spring through the fall and are allowed to work a total of 1039 hours annually (K. Ferebee, pers. comm. 2008g).

The 2005–2007 operating budget for Rock Creek Park is detailed in table 23. The budget for the Resource Management and Visitor Services portion of the total budget is also given. Operating budgets may vary annually (Champagne, pers. comm. 2007).

**TABLE 23. ROCK CREEK PARK OPERATING BUDGET**

<b>Year/Division</b>	<b>Operating Budget</b>
<b>2005</b>	
Total Operating Budget	\$6,639,300
Resource Management and Visitor Services	\$1,067,697
<b>2006</b>	
Total Operating Budget	\$6,782,700
Resource Management and Visitor Services	\$1,031,232
<b>2007</b>	
Total Operating Budget	\$7,172,100
Resource Management and Visitor Services	\$1,139,139

Source: Champagne, pers. comm. 2007

**RESOURCE MANAGEMENT AND VISITOR SERVICES**

**Natural Resource Management**

Rock Creek Park currently has two full-time employees with duties solely in natural resource management. The natural resource management staff devotes about 10% to 15% of their time to deer management activities, which include erecting and maintaining small exclosures, conducting annual fall spotlight surveys to determine population trends and densities, moving carcasses killed by vehicle collisions, assisting D.C. Animal Control with injured animals, and responding to questions from visitors and neighbors (K. Ferebee, pers. comm. 2007d).

Other duties of the natural resource management staff include water quality monitoring and mitigation of problems affecting these resources, park wildlife population monitoring and management, vegetation management including control of invasive plants, wildland fire management, integrated pest management, and trails management.

The NPS Center for Urban Ecology assists the park resource management staff by providing services related to Distance Sampling and deer management statistics. The center staff also provides technical assistance on other park programs including water quality monitoring, vegetation monitoring, air quality monitoring, invasive plant control, and integrated pest management.

### **Compliance and Boundary Management**

One permanent full-time park ranger is responsible for project compliance in the park to include preparing environmental assessments, writing right-of-way and special-use permits, and monitoring permit compliance by contractors. This ranger is also responsible for the park boundary management program (K. Ferebee, pers. comm. 2007d).

### **Cultural Resources Management**

One full-time employee at the park has duties solely devoted to managing the park's cultural resources. The park manages many properties that are listed in the National Register of Historic Places, as well as several sites that are eligible for listing. The park manages several Civil War sites and many other sites of historical significance.

### **Education and Interpretation**

Education and interpretation are a large part of the visitor services offered by this division. The staff provide many educational and interpretive programs focused on the park's natural and cultural history for school groups, families, and adults. Several programs are presented on the wildlife found in the park, including white-tailed deer and the role they play in the park's ecosystem. Three urban wildlife kits (deer, turtle, owl), designed for pre-kindergarten through grade 3, are available for loan from the Rock Creek Park Nature Center. Each kit contains a teacher's guide, materials, books, and objects for hands-on lessons focusing on adaptations and habitats. The wildlife kits are borrowed an average of four times each year (based on receipts from 1998–2005). Teachers keep the kit for three to five weeks. The deer kit has 16 suggested lessons and teachers often create additional activities. Checking the kits in and out requires minimal staff time. Each teacher may teach as many as 10 to 12 lessons for different classes using the kits (Illige, pers. comm. 2005).

In addition, park staff and the superintendent have spoken at community association meetings and town hall meetings regarding deer issues in the park. Six "Oh Deer" interpretive programs are given during the year. Other deer management activities currently undertaken by Rock Creek Park include assisting D.C. Animal Control with injured animals (e.g., darting animals, euthanizing injured animals), responding to neighbors' questions about the deer population (e.g., how to keep deer out of yards, preventing browse of landscaping vegetation), and disseminating information about the deer population.

The park manages three main visitor contact points: Nature Center and Planetarium, Peirce Mill complex, and Old Stone House. The Nature Center functions as the park's main visitor center where the majority of the public programs are presented; however, programs and visitor assistance are available at the other sites. The park is an integral part of the Bridging the Watershed Program, which educates local school groups on the importance and function of the watersheds in the Washington, D.C. metro area.

### **MAINTENANCE**

Of Rock Creek Park's 29 full-time maintenance employees, few perform general maintenance tasks specifically related to deer management, and no maintenance staff employees are currently assigned to perform deer management tasks, such as applying repellents or erecting small exclosures. As described previously, the natural resource management staff conduct these activities. Maintenance staff will occasionally remove a deer carcass from a park road.

The primary responsibility of the Maintenance Division is to provide for the general upkeep and maintenance of all park buildings and infrastructure, including the visitor center, tennis stadium, large amphitheater, 30 picnic groves, approximately 50 miles of foot, horse, and bike trails, 20 miles of park roadways, and numerous buildings, some of which are historic. Park maintenance staff are also responsible for maintaining all utilities that service park buildings and other park facilities (K. Ferebee, pers. comm. 2007d).

#### **ADMINISTRATION AND PARK MANAGEMENT**

This division consists of the Park Superintendent and Assistant Superintendent, as well as the Administrative Officer and other support staff. The primary responsibility of the Superintendents is the day-to-day management of overall park operations. The Administrative Officer oversees personnel, purchasing, budget, and contracting activities.

Currently there is one park ranger who manages the park's community gardens and prepares permits for special park uses. Many of the community gardens are experiencing pressure from deer browse, which has required the erection of fencing to protect plots. The park administration staff is consulted on deer and pest issues related to the community gardens (K. Ferebee, pers. comm. 2007f).

The Park Police provide law enforcement on all lands administered by Rock Creek Park. They also provide for visitor safety, respond to emergencies, enforce traffic laws, enforce the Code of Federal Regulations, and preserve the natural and cultural resources entrusted to the NPS. The Park Police will respond to traffic accidents involving wildlife and will humanely dispatch injured animals when required.



## ENVIRONMENTAL CONSEQUENCES

This “Environmental Consequences” chapter analyzes both beneficial and adverse impacts that would result from implementing any of the alternatives considered in this *White-tailed Deer Management Plan / Environmental Impact Statement*. This chapter also includes a summary of laws and policies relevant to each impact topic, definitions of impact thresholds (e.g., negligible, minor, moderate, and major), methods used to analyze impacts, and the analysis methods used for determining cumulative impacts. As required by the Council on Environmental Quality (CEQ) regulations implementing the *National Environmental Policy Act* (NEPA), a summary of the environmental consequences for each alternative is provided in table 12 which can be found in “Chapter 2: Alternatives.” The resource topics presented in this chapter, and the organization of the topics, correspond to the resource discussions contained in “Chapter 3: Affected Environment.”

### SUMMARY OF LAWS AND POLICIES

Three overarching environmental protection laws and their implementing policies guide the actions of the National Park Service (NPS) in the management of the parks and their resources — the *Organic Act of 1916*, NEPA and its implementing regulations, and the *Omnibus Management Act*. For a complete discussion of these and other guiding authorities, refer to the section titled “Related Laws, Policies, Plans, and Constraints” in “Chapter 1: Purpose of and Need for Action.” These guiding authorities are briefly described below.

The *Organic Act of 1916* (16 United States Code [USC] 1), as amended or supplemented, commits the NPS to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations.

The *National Environmental Policy Act of 1969* is implemented through regulations of the CEQ (40 Code of Federal Regulations [CFR] Parts 1500–1508). The NPS has, in turn, adopted procedures to comply with these requirements, as found in Director’s Order 12 (NPS 2001) and its accompanying handbook.

The *Omnibus Management Act* (16 USC 5901 et seq.) underscores the NEPA provisions in that both acts are fundamental to park management decisions. Both acts provide direction for connecting resource management decisions to the analysis of impacts and communicating the impacts of those decisions to the public, using appropriate technical and scientific information. Both acts also recognize that such data may not be readily available and they provide options for resource impact analysis should this be the case. Section 4.5 of Director’s Order 12 adds to this guidance by stating, “when it is not possible to modify alternatives to eliminate an activity with unknown or uncertain potential impacts, and such information is essential to making a well-reasoned decision, the National Park Service will follow the provisions of the CEQ regulations (40 CFR 1502.22).” In summary, the Park Service must state in an environmental assessment or impact statement (1) whether such information is incomplete or unavailable; (2) the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific adverse impacts that is relevant to evaluating the reasonably foreseeable significant adverse impacts; and (4) an evaluation of such impacts based on theoretical approaches or research methods generally accepted in the scientific community. Collectively, these guiding regulations provide a framework and process for evaluating the impacts of the alternatives considered in this draft EIS.

### GENERAL METHODOLOGY FOR ESTABLISHING IMPACT THRESHOLDS AND MEASURING EFFECTS BY RESOURCE

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

## *Environmental Consequences*

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

These elements are described in the following sections.

### **GENERAL ANALYSIS METHODS**

The analysis of impacts follows CEQ guidelines and Director's Order 12 procedures (NPS 2001) and is based on the underlying goal of supporting forest regeneration and providing for long-term protection, conservation, and restoration of native species and cultural landscapes at Rock Creek Park. This analysis incorporates the best available scientific literature applicable to the region and setting, the species being evaluated, and the actions being considered in the alternatives.

As described in chapter 1, the NPS created an interdisciplinary science team to provide important input to the impact analysis. For each resource topic addressed in this chapter, the applicable analysis methods are discussed, including assumptions and impact intensity thresholds.

### **ASSUMPTIONS**

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

#### **Analysis Period**

Goals, objectives, and specific implementation actions needed to manage deer at Rock Creek Park are established for the next 15 years; therefore, the analysis period used for assessing impacts is up to 15 years. The impact analysis for each alternative is based on the principles of adaptive management, which would allow the NPS to change management actions as new information emerges from monitoring the results of management actions and ongoing research throughout the life of this plan.

#### **Geographic Area Evaluated for Impacts (Area of Analysis)**

The geographic study area (or area of analysis) for this plan includes Rock Creek Park in its entirety. The area of analysis may extend beyond the park's boundaries for some cumulative impact assessments. The specific area of analysis for each impact topic is defined at the beginning of each topic discussion.

#### **Duration and Type of Impacts**

The following assumptions are used for all impact topics (the terms "impact" and "effect" are used interchangeably throughout this document):

- *Short-term impacts* — Impacts would last from a few days up to three years following an action
- *Long-term impacts* — Impacts would last longer than three years up to the life of the plan (approximately 15 years)
- *Direct impacts* — Impacts would occur as a direct result of deer management actions

- *Indirect impacts* — Impacts would occur from deer management actions and would occur later in time or farther in distance from the action

### Future Trends

Visitor use and demand are anticipated to remain relatively steady over the life of the plan, similar to what has been recorded for the past 10 years. The number of yearly visitors to Rock Creek Park has hovered at about 2 million visitors per year over the past 10 years, with a very slight upward trend since about 1996 (see figure 9 in chapter 3). There are no new facilities, access, or operations planned during the planning period that would affect visitation, and no substantial changes are envisioned in the population of the metropolitan area surrounding the park. In the absence of notable anticipated changes, it is expected that annual visitation over the life of the plan remain at about 2 million visitors per year, with slight variations from year to year.

### Impact Thresholds

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

## CUMULATIVE IMPACTS ANALYSIS METHOD

The CEQ regulations to implement NEPA require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions” (40 CFR 1508.7). As stated in the CEQ handbook, “Considering Cumulative Effects” (CEQ 1997), cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on effects that are truly meaningful. Cumulative impacts are considered for all alternatives, including alternative A.

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects and plans at Rock Creek Park and, if applicable, the surrounding area. Table 24 summarizes these actions that could affect the various resources at the park, along with the plans and policies of both the park and surrounding jurisdictions, which were discussed in chapter 1. Additional explanation for most of these actions is provided in the narrative following the table.

The analysis of cumulative impacts was accomplished using four steps:

#### *Step 1* — Identify Resources Affected

Fully identify resources affected by any of the alternatives. These include the resources addressed as impact topics in chapters 3 and 4 of the document.

#### *Step 2* — Set Boundaries

Identify an appropriate spatial and temporal boundary for each resource. The temporal boundaries are noted at the top of table 24 and the spatial boundary for each resource topic is listed under each topic.

#### *Step 3* — Identify Cumulative Action Scenario

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Determine which past, present, and reasonably foreseeable future actions to include with each resource. These are listed in table 24 and described below.

### *Step 4 — Cumulative Impact Analysis*

Summarize impacts of these other actions (x) plus impacts of the proposed action (y), to arrive at the total cumulative impact (z). This analysis is included for each resource in chapter 4.

TABLE 24. CUMULATIVE IMPACT SCENARIO

Impact Topic	Study Area	Past Actions	Current Actions	Future Actions (15 years)
Temporal boundaries for all resources are from the mid-1960s when deer were first sighted in Rock Creek Park to 15 years from the completion of the Draft White-tailed Deer Management Plan / Environmental Impact Statement (plan/EIS), unless otherwise noted.				
Vegetation	Rock Creek Park and adjacent land owners	Increasing deer population Adjacent property landscaping Park operations and maintenance (especially landscaping and exotic plant control) Boundary encroachment / urban development Pests and disease— gypsy moths ( <i>Lymantria dispar</i> ) and chestnut blight Vandalism (fire) Dumping Illegal camping Off-trail users/social trails Visitor uses Scientific research	Same as past actions plus: Pests and disease – dogwood anthracnose, gypsy moth management—monitoring	Same as current actions plus: Reconstruction of Rock Creek Park and Potomac Parkway Asian longhorned beetle, emerald ash borer
Soils and Water Quality	Rock Creek Park and Rock creek watershed	Urban development Impervious surface run-off Off-trail users / social trails Dumping Illegal camping Sewer overflows Park maintenance and operations Visitor uses Agricultural discharge in headwaters Flood events	Same as past actions plus: Headwater improvements	Same as current actions plus: Reconstruction of Rock Creek Park and Potomac Parkway Combined sewer overflow improvements (D.C. Water and Sewer Authority)
Wetlands and Floodplains	Rock Creek Park	Urban development Off-trail users / social trails Dumping Park maintenance and operations Visitor uses Flood events	Same as past actions	Same as current actions plus: Reconstruction of Rock Creek Park and Potomac Parkway

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Impact Topic	Study Area	Past Actions	Current Actions	Future Actions (15 years)
Temporal boundaries for all resources are from the mid-1960s when deer were first sighted in Rock Creek Park to 15 years from the completion of the Draft White-tailed Deer Management Plan / Environmental Impact Statement (plan/EIS), unless otherwise noted.				
Wildlife and Wildlife Habitat (including deer)	Rock Creek Park and typical deer movement outside park	<ul style="list-style-type: none"> <li>Increasing deer population</li> <li>Urban development</li> <li>Park management and operations</li> <li>Rabies, West Nile virus</li> <li>Illegal camping</li> <li>Poaching</li> <li>Dumping</li> <li>Traffic/Vehicle collisions</li> <li>Visitor uses</li> <li>Exotic plant control</li> <li>Off-trail users / social trails</li> <li>Nonnative wildlife / unrestrained pets</li> <li>Range expansion (large mammals)</li> <li>Fish passage improvements</li> <li>Scientific research</li> </ul>	<ul style="list-style-type: none"> <li>Same as past action, plus epizootic hemorrhagic disease (deer), testing for</li> <li>Chronic wasting disease</li> </ul>	<ul style="list-style-type: none"> <li>Same as past actions plus:</li> <li>Possible rabies vaccine trials</li> <li>More development – Metropolitan Branch Trail</li> <li>Chronic wasting disease (deer)</li> <li>West Nile virus</li> </ul>
Rare, Unique, Threatened or Endangered Species	Rock Creek Park	<ul style="list-style-type: none"> <li>Exotic plant control</li> <li>Adjacent property landscaping</li> <li>Park landscaping</li> <li>Vandalism (fire)</li> <li>Dumping</li> <li>Illegal camping</li> <li>Traffic/Vehicle collisions</li> <li>Visitor uses</li> <li>Off-trail users / social trails</li> <li>Boundary encroachment</li> <li>Increasing deer population</li> <li>Gypsy moth management</li> <li>Nonnative wildlife / unrestrained pets</li> <li>Range expansion (large mammals)</li> <li>Fish passage improvements</li> <li>Groundwater pollution</li> <li>Scientific research</li> </ul>	<ul style="list-style-type: none"> <li>Same as past actions plus:</li> <li>dogwood anthracnose, gypsy moth management—monitoring</li> </ul>	<ul style="list-style-type: none"> <li>Same as current actions plus:</li> <li>Hydrologic regime changes</li> <li>Asian longhorned beetle (<i>Anoplophora glabripennis</i>), West Nile virus</li> </ul>

Impact Topic	Study Area	Past Actions	Current Actions	Future Actions (15 years)
Temporal boundaries for all resources are from the mid-1960s when deer were first sighted in Rock Creek Park to 15 years from the completion of the Draft White-tailed Deer Management Plan / Environmental Impact Statement (plan/EIS), unless otherwise noted.				
Cultural Landscapes	Rock Creek Park	Park development and maintenance Archeological survey Spread of exotic species Telecommunications facilities development Mountain/motor bikes on earthworks Vandalism (fire) Urbanization Chestnut blight and gypsy moths	Same as past actions	Same as current actions
Soundscapes	Rock Creek Park and adjacent landowners	Park maintenance and operations, including landscaping work Traffic Helicopter use Flight paths over park Emergency services Special and community events	Same as past actions	Same as past actions plus: increased traffic Reconstruction of Rock Creek Park and Potomac Parkway
Visitor Use and Experience	Rock Creek Park	Deer – increase in population Park management and operations including trails, interpretative programs Rabies, Lyme disease, West Nile virus Illegal camping Poaching Dumping Exotic plant control Traffic/Vehicle collisions Off-trail users / social trails Nonnative wildlife / unrestrained pets Urban development	Same as past actions plus: Shrinking green space surrounding park Parking	Same as present plus: Reconstruction of Rock Creek Park and Potomac Parkway Possible rabies vaccine trials Tree canopy trail Trail reconstruction/improvements
Visitor and Employee Health and Safety (including adjacent landowners)	Rock Creek Park and adjacent landowners	Vehicle collisions Urbanization Crime U.S. Park Police operations	Same as past actions	Same as past actions

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Impact Topic	Study Area	Past Actions	Current Actions	Future Actions (15 years)
Temporal boundaries for all resources are from the mid-1960s when deer were first sighted in Rock Creek Park to 15 years from the completion of the Draft White-tailed Deer Management Plan / Environmental Impact Statement (plan/EIS), unless otherwise noted.				
Socioeconomics	Adjacent landowners	Landscaping impacts Exotic plants (from park) Increase in deer population Damage from other pests/animals	Same as past actions	Same as past actions
Park Management and Operations	Rock Creek Park	Park management, maintenance, and operations U.S. Park Police operations Budgetary constraints Traffic	Same as past actions plus: Archeological survey Changes in recreation	Same as current plus: Possibly new U.S. Park Police station

## CUMULATIVE IMPACT SCENARIO

### ROCK CREEK PARK PLANS, POLICIES, AND ACTIONS

**Park Plans and Policies.** The Rock Creek Park General Management Plan (NPS 2005a), Natural Resources Management Plan (NPS 1996a), Draft Long Range Interpretive Plan (NPS 2003), Draft Invasive Exotic Plant Management Plan (NPS 2004a), various cultural landscape reports, and the Fort Circle Park General Management Plan (NPS 2004b) are all park planning documents that include policies, goals, or desired conditions, that, when implemented, could contribute to the cumulative effects on the resources addressed by this plan. These plans are described in the chapter 1 under “Relationship to Other Planning Documents for Rock Creek Park.”

**Park Operations and Maintenance.** Past, present, and future park operation and maintenance activities have the potential to impact numerous resource areas. Activities that would be considered include, but are not limited to:

- hazard tree removal
- exotic plant control
- routine maintenance along roads and picnic grounds
- trail maintenance
- various cultural and natural resource management actions
- interpretive and educational programs
- landscape maintenance (e.g., mowing and trimming)
- volunteer activities (stream and park cleanups)
- future telecommunication facilities

**Vehicle Collisions.** Starting in 1981, Rock Creek Park began collecting data on wildlife roadkill in Rock Creek Park. The first deer roadkill was recorded in 1989. Because heavy commuter and local use of park roadways, wildlife and deer/vehicle collisions are likely to continue within Rock Creek Park.

**Traffic.** Rock Creek Park contains a number of park roads that serve as local commuter routes. Beach Drive, which bisects the length of the park from the Maryland state line to the Rock Creek and Potomac Parkway, was designed as an internal park touring road to provide recreational access to the valley. Today, Beach Drive is a multiuse resource within the park that functions as a north-south commuter route during the week. On weekends and holidays, portions of Beach Drive are closed to vehicular traffic and used as a recreational area by pedestrians, bicyclists, and others participating in nonmotorized activities. Rock Creek and Potomac Parkway serves as a travel corridor that connects Beach Drive and Rock Creek Park with Potomac Park.

### Visitor Uses

Visitor use itself can contribute to impacts to resources. Examples include active recreation uses, including golf, tennis, horseback riding, as well as trail use.

**Horseback Riding.** Rock Creek Park contains horse stables, as well as horseback trails throughout the park. Horseback riding has the potential to increase or introduce nonnative species through animal feed or animal wastes, as well as create trail erosion from heavy use.

**Rock Creek Park Golf Course.** The Rock Creek Park golf course is a 4,798-yard, par-65 public course noted for its hilly and challenging terrain. Park staff have noted that the golf course is an area of high deer density.

**Multiuse Trail Rehabilitation.** Rock Creek Park currently has plans to rehabilitate a section of multiuse trail from Peirce Mill to Potomac Park. This project will include some widening and realignment. An environmental assessment is currently being completed for this project.

**Special and Community Events.** Events and facilities in and around Rock Creek Park contribute to the soundscape experienced by visitors and wildlife. These include a tennis center and amphitheatre, which host numerous special events during the year, mainly during the summer months, which can add to the noise within the park. The amphitheater season extends May through September and shares parking with the tennis center. Special events include the Legg Mason tennis tournament and weekly summer events at Carter Barron. In addition to special events within the park, special events are held by park neighbors. Rock Creek Park is bordered by a number of public uses including schools, churches, embassies, and other similar institutions.

**Telecommunications Facilities.** There are currently two telecommunication towers permitted within Rock Creek Park in Reservation 339, one at the tennis center and one at the maintenance yard. The NPS has developed a telecommunications facilities management plan to assist the park in future decision making regarding potential wireless telecommunications facilities permit applications.

**Dumping.** Illegal dumping does occur within the park. This takes many forms including the dumping of landscaping waste, which increases the potential for introduction of nonnative species into the park. Dumping of other commercial waste and household waste has the potential to impact sensitive species if the dumping occurs in areas where that habitat is available. Dumping into park water bodies (i.e., illegal drain connections, draining of residential pools, spills) can also affect water quality within the park.

**Vandalism.** Rock Creek Park is the occasional subject of vandalism, including fire. Intentionally set fires have the potential to destroy large areas of vegetation if the events are frequent or large.

**Illegal Camping.** Illegal camping occurs throughout the park. Human disturbance in areas where illegal camping occurs includes displacement of wildlife, potential poaching, and vegetation removal.

**Off-Trail Users and Social Trails.** While there are many established trails, paths, and other use areas in Rock Creek Park, visitors often venture away from designated use areas into the undisturbed forested areas of the park to be nearer the creek or other feature. Some visitors create "shortcuts" between existing trails or to access the park from neighboring properties. If an area is accessed enough, an informal path may develop, becoming a social trail. Off-trail users in the park include geocaching clubs, running clubs, and dog walking. Off-trail users can trample vegetation, potentially during periods critical to the survival of the plants.

**Nonnative Wildlife / Unrestrained Pets.** In addition to native wildlife, Rock Creek Park is home to nonnative wildlife. Species include English sparrows (*Passer domesticus*), European starlings (*Sturnus vulgaris*), and feral dogs (*Canis lupus familiaris*) and cats (*Felis catus*). Nonnative species compete with native wildlife and/or present indirect competition through utilization of similar habitats. Unrestrained pets cause similar problems, contributing to the potential harassment of native park wildlife. For example, off-leash dogs can run through vernal pools disturbing sediments, which can cover amphibian eggs and interrupt breeding behavior.

**Mountain/Motor Bikes on Earthworks.** The Fort Circle Parks contain many earthworks and unauthorized recreational use of the earthworks as ramps for mountain and motorbikes negatively affects the resource by contributing to erosion.

**Plant Pests and Disease.** Several pests or disease can cause adverse impacts to vegetation throughout the park. Since the mid-1970s, the most prevalent pest concern at Rock Creek Park has been **gypsy moth**,

which the park controlled through spraying in 1989 and 1990 and now monitors. Currently, and in the future, additional concerns include **dogwood anthracnose**, **emerald ash borer** (*Agrilus planipennis*), and the **Asian longhorned beetle**.

**Deer and Wildlife Disease (Rabies, West Nile virus, Lyme disease, Chronic Wasting Disease, Epizootic Hemorrhagic Disease).** Park habitat and wildlife are influenced by a number of wildlife diseases. In the 1980s, there was an outbreak of **rabies** in raccoons (*Procyon lotor*) living in the park. Rabies vaccine trials have been proposed in the future, but would require additional compliance by the park before implementation. **West Nile virus**, an established factor in avian mortality, has been identified in more than 100 bird species. Many long distance neotropical migrant species are not only affected by the disease, but contribute to the spread of the virus along migration routes. Migratory birds moving through the region may be infected by West Nile virus, and there are documented cases within the region and the park. **Lyme disease** is carried by ticks that are hosted by deer and other animals. **Epizootic hemorrhagic disease** (EHD) has been found at the National Zoo and other places near the park. A future concern related to deer health in Rock Creek Park includes the possibility of occurrence of Chronic Wasting Disease (CWD), as described more fully in the “Affected Environment” section of this plan/EIS.

**Range Expansion (Large mammals).** Coyote (*Canis latrans*) sightings continue to be reported to park staff, as recently as spring 2008. Coyotes have been seen in several areas of the park and in adjacent neighborhoods. A black bear (*Ursus americanus*) was seen in Rockville in June 2007, and in 2001 a black bear was struck by a vehicle on the Baltimore-Washington Parkway.

**Fish Passage Improvements.** As a part of the Woodrow Wilson Bridge project, man-made barriers to fish movement in Rock Creek Park were recently removed. The project, which began in December 2003, removed or bypassed several man-made barriers that had prevented herring and other migratory fish from returning to upriver spawning areas. In Rock Creek Park, six fish barriers were removed or modified, while two more were remedied in the adjacent National Zoological Park and a fish ladder was constructed at the Peirce Mill dam. Ongoing maintenance and monitoring at the fish ladder continue.

**Flood Events.** Rock Creek floods out of its banks once a year on average. About every five years the creek experiences a large flood event. The last major flood was in June 2006, which caused extensive damage in the park. The worst flood ever recorded in the park was caused by Hurricane Agnes in 1972 (Ferebee, pers. comm. 2008b).

**Hydrologic Regime Changes.** Hydrologic regime change is a potential future event; as the creek erodes and the channel deepens itself, the hydrologic regime could be altered.

**Groundwater Pollution.** Groundwater pollution has occurred in the past through point sources such as illegal dumping and may occur in the future. There have been leaking underground heating oil storage tanks in and adjacent to the park that have had some effect on groundwater. There are many potential sources of groundwater pollution within the urban development that surrounds the park, and it is possible that something could happen at any time to contaminate groundwater.

**Parkwide Archeological Survey.** Rock Creek Park has completed a parkwide archeological survey. This will provide information necessary to manage the park’s historic resources effectively and develop information and material to interpret the history and prehistory of the park.

**Scientific Research.** Rock Creek Park frequently receives applications for research permits to conduct scientific studies in the park. Permits issued in the past include research on water quality, plant surveys, and wildlife. Requests for scientific research studies are processed as received. These requests are expected to continue into the future.

**Reconstruction of Rock Creek and Potomac Parkway.** Rock Creek Park will be reconstructing the Rock Creek and Potomac Parkway from P Street to Calvert Street and Beach Drive from the Parkway to

the Maryland/District of Columbia boundary line to eliminate unsafe driving conditions by reconstruction and rehabilitation. An Environmental Assessment was completed in 2006.

#### **LOCAL/STATE PLANS, POLICIES, AND ACTIONS**

**Deer Management Plans and Programs of Neighboring Jurisdictions.** Neighboring jurisdictions have implemented deer management plans and actions (Montgomery County) or have functions that address control of animals and disease prevention (District of Columbia). These are described in the chapter 1 under “Current Deer Management at Rock Creek Park and in Surrounding Jurisdictions.”

**Landscaping on Adjacent Properties and within the Park and the Spread of Invasive Exotic Plant Species.** Many residential land uses are located along the boundary of Rock Creek Park. On some of these residential properties nonnative vegetation has been planted for landscaping and these exotic plants have spread into Rock Creek Park. Likewise, some of the Rock Creek Park administered units are designed landscapes that include exotic vegetation, which has the potential to expand from outside the designed unit into Rock Creek Park’s natural landscapes. Exotic vegetation, when introduced in the park, can compete with native vegetation. Historical plant species that are part of the cultural landscape can be impacted and in some cases replaced by these exotic species as well.

**Urban Development and Boundary Encroachment.** Rock Creek Park is located in a highly-urbanized area that has undergone much development since the mid-1970s and will continue to develop in the foreseeable future. Some of this development has occurred along the boundaries of Rock Creek Park, and at times on small portions of Rock Creek Park land. For example, Tregaron Estates, a 20-acre wooded parcel adjacent to Reservations 365 and 635, has been proposed for subdivision development. Urbanization of the area has limited, and will continue to limit, the amount of green space and wildlife habitat available in the area, putting more pressure on Rock Creek Park’s resources and displacing some wildlife. Bordering neighbors have complained about deer browse on landscape vegetation. Other concerns with urbanization include an increasing amount of impervious surfaces, which would lead to an increase in stormwater runoff.

**D.C. Water and Sewer Authority (WASA) Combined Sewer Overflows Including Planned Improvements.** Approximately one-third of the District of Columbia is served by combined sewers, including the parts of Rock Creek Park south of Piney Branch. When the capacity of a combined sewer is exceeded during storms, the excess flow, a mixture of sewage and stormwater runoff known as combined sewer overflow (CSO), is discharged into Rock Creek and other tributary waters, affecting water quality. The District of Columbia’s National Pollutant Discharge Elimination System permit requires the preparation of a Long-Term Control Plan (LTCP) to control CSO discharges to the area waterways. In response to public comments, the final LTCP proposed significant reductions in CSO discharges. WASA is waiting for regulatory agency approval on the final LTCP. In addition, WASA’s 10-year capital improvement program through fiscal year 2010 addresses wastewater treatment, CSO, stormwater, and sanitary sewer, as well as water service. WASA also has plans to improve some drainage conditions, including separating the combined sewer in Piney Branch to reduce the amount of raw sewage entering the Piney Branch Tributary, and mitigating the stormwater flow into Dumbarton Oaks Park by capturing the flow before it enters the park and piping it around the park. The flow would be discharged at a point below the park to reduce stormwater erosion.

**Agricultural Activity in Rock Creek Headwaters.** The headwaters of Rock Creek are located in Montgomery County, Maryland. Historically, discharges from agricultural activities in the creek headwaters have affected downstream waters. Currently, and in the reasonably foreseeable future, Montgomery County is implementing measures to reduce these impacts and improve water quality through use of buffers and other measures.

**Flight Paths Over Park.** These flights include helicopter use, including the presidential helicopter, military plane overflights, and the flight path for Ronald Reagan National Airport, a small portion of

which is located over Glover-Archbold Park and Reservation 404. According to the regional airports website (Metropolitan Washington Airports Authority 2008), there are about 775 flights in and out of the airport daily (based on July 2008 figures). Some of these extend over the Palisades neighborhood, which includes Glover-Archbold Park. According to the Chair of the Airport Noise Committee of the Palisades Neighborhood Association, depending on wind direction and velocity, the neighborhood is overflown by about 400 jet airplane arrivals or departures on weekdays and 300-350 on Saturdays and Sundays (Pavek, pers. comm. 2008).

**U.S. Park Police.** The current Rock Creek District 3 Station is in Rock Creek Park; park police patrol 1,800 acres of Rock Creek Park and adjacent parks, such as Meridian Hill, Glover-Archbold Park, Fort Totten (and other Fort Circle Parks), portions of the C&O Canal, and the newly acquired Capitol Crescent Trail located along a portion of the Potomac River. Depending on funding, a new station may be located outside the park or inside the park at an area known as H3 Park Police Horse Stables, where wood chipping activities currently occur. Also located within Rock Creek Park along the Rock Creek and Potomac Parkway is Edgewater Stables, where U.S. Park Police horses are kept.

**Metropolitan Branch Trail.** The District of Columbia is currently in the process of planning and implementing the Metropolitan Branch Trail, an 8-mile, multiuse trail that runs from Silver Spring, Maryland to Union Station in the District. The trail will provide a direct access route to seven of the Washington Area Metro Red Line stations and will connect to the Washington area's trail network at the Capital Crescent Trail and the East Coast Greenway. Part of the trail is proposed to cross NPS-owned land at Fort Totten.

## IMPAIRMENT ANALYSIS METHOD

Chapter 1 describes the related federal acts and policies regarding the prohibition against impairing park resources and values in units of the national park system. According to *NPS Management Policies 2006*, an action constitutes an impairment when an impact “would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values” (NPS 2006, sec. 1.4.5). To determine impairment, the NPS must evaluate “the particular resources and values that would be 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 question and other impacts” (NPS 2006, sec. 1.4.5).

National park system units vary based on their enabling legislation, natural and cultural resources present, and park missions; likewise, the activities appropriate for each unit and for areas in each unit also vary. For example, an action appropriate in one unit could impair resources in another unit. Thus, this document analyzes the context, duration, and intensity of impacts of the alternatives, as well as the potential for resource impairment, as required by Director's Order 12 (NPS 2001). As stated in the *Management Policies 2006* (sec. 1.4.5), an impact on any park resource or value may constitute an impairment, but an impact would be more likely to constitute an impairment to the extent that 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
- identified as a goal in the park's general management plan or other relevant NPS planning documents

The following process was used to determine whether the various deer management alternatives had the potential to impair park resources and values:

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- *Step 1* — The enabling legislation and the park’s General Management Plan (2005a) were reviewed to ascertain its purpose and significance, resource values, and resource management goals or desired conditions.
- *Step 2* — Resource management goals were identified.
- *Step 3* — Thresholds were established for each resource of concern to determine the context, intensity, and duration of impacts, as defined earlier in this chapter under “Impact Thresholds.”
- *Step 4* — An analysis was conducted to determine if the magnitude of impact would constitute an “impairment,” as defined by *NPS Management Policies 2006* (NPS 2006).

The impact analysis includes findings of impairment of park resources for each of the management alternatives. Visitor use, park operations and management, and socioeconomic environment are not considered resources per se, although they are dependent on the conservation of park resources. Impairment findings are not included as part of the impact analysis for these topics.

## VEGETATION

### GUIDING REGULATIONS AND POLICIES

The NPS *Organic Act of 1916* and the NPS *Management Policies 2006* (NPS 2006) direct parks to provide for the protection of park resources. The *Management Policies 2006* state that “the Service will not attempt to solely preserve individual species (except threatened or endangered species) or individual natural processes; rather, it will try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and genetic and ecological ecosystems” (NPS 2006, sec. 4.1). The policies further state, “The Service will not intervene in natural biological or physical processes, except ... to restore natural ecosystem functioning that has been disrupted by past or ongoing human activities, or when a park plan has identified the intervention as necessary to protect other park resources, human health and safety, or facilities” (NPS 2006, sec. 4.1).

With regard to the restoration of natural systems, the NPS “will reestablish natural functions and processes in parks” and it “will seek to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated” (NPS 2006, sec. 4.1.5).

Rock Creek Park’s General Management Plan (2005a) includes the following desired conditions that pertain to vegetation:

- native species populations that have been severely reduced ....are restored where feasible and sustainable
- invasive species are reduced in number and areas, or eliminated from natural areas of the park

### ASSUMPTIONS, METHODOLOGY, AND INTENSITY THRESHOLDS

Maps showing vegetation cover within Rock Creek Park, communications with NPS staff, and past monitoring data were used to identify baseline conditions within the study area. Available information on the condition and composition of the vegetation in the park was compiled. The primary component of the forest that provides the best indicator of successful forest regeneration is the number of tree seedlings observed and their ability to reach heights above the average deer browsing height (60 inches or 150 centimeters). Thresholds identified for taking management action were based on recent research conducted in habitat similar to that at Rock Creek Park and are based on a certain number of seedlings per monitored plot to indicate the degree of regeneration, as described under “Thresholds for Taking Action” in chapter 2. Therefore, the intensity level for major impacts to woody vegetation was based on a similar threshold, assuming that 67% or more of the monitored plots should have 51 or more seedlings to maintain or achieve good forest regeneration at low (desired) deer densities. But, current deer densities are at high levels. This requires that 67% or more of the plots have 153 tree seedlings. The remainder of the impact thresholds were defined qualitatively, based on professional judgment and observations of vegetation cover.

### IMPACT THRESHOLDS FOR WOODY AND HERBACEOUS VEGETATION

- Negligible:** A reduction in vegetation cover would occur, but the change would be so small that it would not be of any measurable or perceptible consequence. Observed seedling density would indicate that very good regeneration was occurring.
- Minor:** A reduction in vegetation cover would occur, but it would be small, localized, and of little consequence. Observed seedling density would represent that fair to good regeneration was occurring.

**Moderate:** Some reduction in vegetation cover would occur, and it would be measurable and of consequence to the resource, but localized. Observed seedling density would represent that poor regeneration was occurring.

**Major:** A noticeable reduction in vegetation cover would occur. The change would be measurable and would result in a possible permanent consequence to the resource. Observed seedling density would represent that little to no regeneration was occurring. Based on Stout's research, 67% or more of the monitored plots would have fewer than 51 seedlings at low deer densities per plot (appendix A).

## AREA OF ANALYSIS

The area of analysis for assessing impacts on vegetation is all of Rock Creek Park. The area of analysis for cumulative impacts is the park and adjacent lands encompass typical deer movement outside the park boundary.

## IMPACTS OF THE ALTERNATIVES

### ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)

#### Analysis

Park staff would continue monitoring the deer population and conducting activities to protect rare and unique plant species and landscaping, such as installation of small area protective caging and limited application of repellents.

**WOODY VEGETATION.** As described in chapter 3, the park has been monitoring woody vegetation growth within the park for over 17 years, with 27 long-term plots established in 1990. In 2000, paired plots (fenced plots paired with unfenced plots) were constructed. Monitoring results have shown that the mean tree seedling stocking rates or weighted measure declined substantially from 1991 through 2003, and all yearly action thresholds were below the 67% stocking rate recommended by Stout's research (appendix A). None of the plots that were measured in 2003 had at least 153 seedlings per plot, which is considered the minimum for successful forest regeneration under high deer densities. Preliminary data from the open long-term plots (2007) show that the stocking rate for 2007 was at  $2.26 \pm 0.32\%$ , well below the recommended 67% stocking rate (Hatfield 2008). Under alternative A, it is expected that the deer population would continue at high densities (albeit with yearly fluctuations) and deer would continue to graze on plants to the extent that seedling densities would remain at or below these levels. Any periodic deer population declines would not be low enough or last long enough for forest regeneration to occur or vegetation to fully recover. Based on the most recent monitoring results and the expected high numbers of deer over the life of the plan, alternative A would have long-term, major adverse impacts on woody vegetation due to the amount of deer browsing and the associated reduction in numbers of stems per plot documented by monitoring.

The park has previously caged woody plant species to protect them from deer browsing, including some planted restoration areas and landscaped areas. These caged areas would continue to be maintained. New caging would be used on a limited basis for any newly identified rare species or for landscaping or plantings sensitive to deer browsing. This action would have long-term beneficial impacts on the plants or areas that were protected by prohibiting deer browsing. However, the impact on the majority of park vegetation that was not caged (as well as on vegetation outside the park boundary that is not caged and is

palatable to deer) would continue to be adverse, long term, and major because no measures would be taken to limit or control deer population size or growth under this alternative.

Under this alternative, repellents would continue to be used on a limited basis on landscape plantings. The effectiveness of repellents generally decreases as deer density increases and/or other food availability decreases. Therefore, this action would have short-term, beneficial impacts on plants treated with repellents, but as the deer numbers increased or the food availability in the park decreased, the effectiveness of repellents could be expected to decline. Similar to caging, the impact on the majority of the vegetation within the park that was not treated with repellents would continue to be adverse, long term, and major.

Monitoring vegetation plots and maintaining caged areas would result in very limited trampling of vegetation as staff traveled to and around any caged areas that are not located along trails. However, such impacts would be temporary, as these activities typically take only a few days per year, and the amount of vegetation affected by these actions would be minimal, as they would occur in only a few areas. Therefore, the impact of these activities would be short term, adverse, and negligible.

**HERBACEOUS VEGETATION.** Under alternative A, the impacts to herbaceous vegetation would be similar to those described for woody vegetation, because no action would be taken to control deer numbers. Based on observations and research conducted within the park, deer browsing has already caused noticeable changes to herbaceous vegetation, including a substantial reduction in plant cover in unfenced plots that can be directly attributed to deer browse (see discussion in Affected Environment - Vegetation). Vegetation outside the park boundary has also been adversely affected to varying degrees, depending on the species. Not controlling the growth of the deer population would result in adverse, long-term, major impacts on herbaceous vegetation, as deer browsing would be expected to cause noticeable changes to the abundance and diversity of herbaceous vegetation throughout the area of analysis.

Activities such as monitoring, caging construction and maintenance, or the application of repellents would not result in any measurable or perceptible change in herbaceous vegetation, resulting in adverse, short-term, negligible impacts. Vegetation within small caged areas would benefit from this level of protection over the long term, and repellent use would have a short-term benefit; however, such benefits would be limited to the small areas of the park.

### **Cumulative Impacts**

Adverse impacts to vegetation within and surrounding the park have occurred and will continue to occur from several actions not related to park operations. Increasing urban development in the areas surrounding the park has resulted in encroachment into park lands and removal of vegetation in limited areas, and adjacent property landscaping has been and continues to be a source of exotic plants that can spread into the park and displace native vegetation, causing long-term minor localized adverse impacts. Acts of vandalism, dumping, illegal camping, and off-trail use, have all had minor localized adverse impacts on vegetation due to trampling and burying of vegetation, or spreading of noxious weed seeds, and will continue to do so in the future. Past fires have affected some areas, which have regrown, but with more nonnative species. Past actions within the park, such as construction of facilities and roads, have resulted in removal of vegetation and adversely affected forest resources to a minor extent in limited areas. Gypsy moths and chestnut blight have had a large, relatively widespread adverse impact in the past, but the park's efforts to control gypsy moths, and other plant diseases and pests, have reversed some of the adverse effects of pests and would continue to benefit forest resources and their ability to naturally regenerate in the future. The park's exotic plant management efforts would also benefit park vegetation in the long term. The future reconstruction of Rock Creek Parkway and continued park maintenance operations would have long-term minor adverse impacts on vegetation, limited to the areas affected. Nearly all off-trail visitor uses affect vegetation to some extent, but some activities like horseback riding, dog walking, and hiking can lead to more social trails and spread of exotic plants. Scientific research such

as vegetation monitoring benefits park vegetation by supplying information needed for management decisions, but even the use of area for monitoring plots limits natural growth in those areas. All of these activities, when combined with the major impacts of continued pressure on forest vegetation (woody and herbaceous) and the limited natural regeneration expected under alternative A because of continued deer browsing, would result in cumulative impacts that would be adverse, long term, and major, since deer would continue to restrict forest regeneration.

### **Conclusion**

Under alternative A, the deer population would remain in excess of the recommended density for forest regeneration and would likely continue to gradually increase with annual fluctuations over the life of the plan, adversely impacting both woody and herbaceous vegetation. As long as the deer population remained in excess of recommended densities for forest regeneration, overall impacts would include decreased plant cover, increased exotic plants, and greatly reduced forest regeneration. Some benefits would be gained from management actions, such as maintaining small caged areas and applying repellents in selected areas; however, the benefits gained would not protect or affect the majority of the park. Although periodic declines in deer population would likely occur due to disease or lack of available food, population records indicate that past population declines have not dropped low enough or lasted long enough for forest regeneration to occur or vegetation to fully recover. The impacts of large numbers of deer browsing on a very large percentage of the park's woody and herbaceous vegetation and consequently limiting natural regeneration would be adverse, long term, and major. Past, present, and future actions, when combined with the continued pressure on forest regeneration expected under this alternative, would result in adverse, long-term, major cumulative impacts.

Current conditions in the park indicate severe adverse impacts on vegetation resources, based on the lack of regeneration found through monitoring. The park's enabling legislation states that the park is to provide for the "preservation from injury or spoliation of all timber, animals, or curiosities within said park, and their retention in their natural condition, as possible." The importance of vegetation is also recognized in the GMP goals for the park, including to "preserve and perpetuate for this and future generations the ecological resources of the Rock Creek valley within the park in as natural condition as possible..." Since alternative A would not reverse the expected long-term continued growth in the deer population, and damage to vegetation would likely continue, it is expected that impairment of vegetation resources would occur over the long term.

### **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

#### **Analysis**

Under this alternative, a combination of several non-lethal actions would be implemented to protect forest resources and reduce deer numbers in the park. Actions include the use of large-scale exclosures and reproductive control of does, including both sterilization and reproductive control (assuming it is feasible).

**WOODY VEGETATION.** The repellents and small caged areas described under alternative A would continue to be used under alternative B. Large fenced exclosures would be constructed under alternative B to allow forest regeneration to occur within enclosed areas of the park that would not be accessible to deer. Approximately 14 exclosures of various configurations to fit the landscape, each encompassing from 7 to 25 acres, would be used throughout the park. The exclosures would eliminate deer presence within a total of 167 acres or about 5% of the park. Protecting these areas from deer browsing would allow native woody species to grow higher than heights reached by deer (60 inches or 150 centimeters) after about 10 years, at which time the exclosures would be moved, and another 5% of the park's vegetation would be enclosed. Although much of the most recent new growth (including seedlings) would be browsed once the surrounding exclosures are moved, many seedlings would be above the height reached by deer and

would not succumb to browsing. Therefore, this action would have a beneficial, long-term impact on up to about 10% of the woody vegetation in the park after 15 years (the life of the plan): 5% inside the existing exclosures at 15 years, and 5% in the original exclosures, which has grown above deer reach. Since 5% to 10% of the forested area would need to be fenced at any one time (Bowersox, pers. comm. 2005) to meet the park's regeneration goals, the actions under alternative B would meet this minimum by protecting 5% at any one time. However, the effect of no browsing protection on woody species in the remaining undeveloped areas of the park would be similar to alternative A. It is expected that monitoring over the life of the plan would continue to show that 67% or more of the long-term unfenced plots would have less than 51 seedlings per plot, resulting in an adverse, long-term, major impact.

Constructing, maintaining, and monitoring the 14 large exclosures would have some impact to the woody vegetation within the park due to the trampling of small tree seedlings and the incidental removal of existing woody vegetation. Even though fences would be located to avoid most trees, some trees would likely need to be removed during construction. Additionally, tree branches within 5 feet of either side of the fence would be removed to avoid branches hitting the fence in high winds or existing dead branches falling on the fence, thus minimizing future maintenance requirements. The area affected during construction would be about 10 acres (0.003%) of the park (45,540 total linear feet for all perimeters  $\times$  10-foot-wide cleared area = 455,400 square feet or 10.45 acres). Given the small size of the affected area in relation to the size of the park (about 3,000 acres), and the limited nature of the action, the impact of exclosure construction and maintenance would be adverse, long term, and negligible. Trampling during fence construction and removal of deer from within fenced areas, as well as during monitoring, would have adverse, short-term, negligible impacts, because construction and monitoring would average only a few days per year and affect only a few areas, resulting in very small changes to the herbaceous vegetation that would be very small.

Implementing reproductive control, as described in chapter 2, would have several impacts on vegetation. Sterilization would involve capturing does and taking them to a mobile field station set up to perform the surgical procedure. This would involve setting up a bait station where the deer would congregate to allow for easier trapping or darting, and carrying deer to the field station for the operation. Baited areas would be small, the bait would not remain long, and any uneaten bait would be removed after does had been collected. Construction of bait stations and transporting deer carcasses to the field station could temporarily disturb or trample some vegetation; however, the area of impact would be small, and the baiting and capture procedure would last approximately 45 days. Temporary holding pens may need to be constructed if more does are captured than can be treated in one day, and these would involve minor fence construction and trampling of any vegetation within the pen areas. Assuming reproductive control was used after year 5, impacts to vegetation would be similar, since this would also require setting up bait stations and trapping or darting deer. Impacts to vegetation in the areas around the bait piles and reproductive control operations would be adverse, short term (a few hours to a few days in any location), localized, and negligible.

The effect of reproductive control on the deer population and thus deer browsing could be beneficial. However, the time required for the population to be reduced could be several years; researchers disagree on the amount of time needed to reduce a population size using reproductive controls (Hobbs et al. 2000; Nielsen et al. 1997; Rudolph et al. 2000). The actual amount of time needed to observe a decrease would depend on a number of factors, such as the type of treatment, its effectiveness in stopping reproduction, the size of the population at the time of initial treatment, the actual mortality rate, and the percentage of the population that was treated. Other factors, such as untreated deer moving into the park and treated deer leaving the park, would also influence the time required to achieve reduced numbers. The benefit of this action would be in proportion to the population reduction, with the greatest benefit achieved when the population was lowered to the point where successful forest regeneration could occur. Hobbs et al. described a model where if 90% of the breeding does in the park were effectively treated annually, mortality would need to exceed the number of surviving offspring from the 10% of untreated does to

achieve a population reduction. An average mortality rate in urban/suburban deer populations is 10% (Hobbs et al. 2000). Based on these factors, it is expected that reproductive control could stop population growth, but the park would not be able to reach its initial deer density goal within the life of this management plan using current technology; therefore, forest regeneration would not be expected outside the large exclosures during the life of this plan. A longer time frame would be needed to see results from current reproductive control technology.

**HERBACEOUS VEGETATION.** Under alternative B, the impacts to herbaceous vegetation would be similar to those described for woody vegetation. The primary impact would result from not taking immediate action to control deer numbers. As described for alternative A, deer browsing has already caused noticeable changes to the herbaceous vegetation, based on observations and research conducted within the park. Providing no immediate reduction or control on the deer population would result in adverse, long-term, major impacts, because deer browsing would continue to cause noticeable changes to the abundance and diversity of herbaceous vegetation throughout the park. Exclosures would provide a beneficial, long-term impact on herbaceous vegetation in about 5% of the park at any one time; however, these benefits would be limited to the park areas that were treated. Reproductive controls would cause the deer population to decline slowly; however the regeneration of herbaceous vegetation outside exclosures is not expected to occur within the life of this plan under alternative B. Therefore, the impact of this action would remain adverse, long term, and major.

Activities such as monitoring, fence construction and maintenance, and administering reproductive control agents would not result in any measurable or perceptible change in the herbaceous vegetation, resulting in adverse, short-term, negligible impacts.

### **Cumulative Impacts**

The same past, present, and future actions described under alternative A would also occur under alternative B. Management actions identified in alternative B, where approximately 5% to 10% of the park's vegetation would be protected from browsing, combined with reproductive control, could reduce the deer density after more than 15 years of implementation and would provide some beneficial impacts over the long term, but not immediately. Large exclosures would give small patches of forest the opportunity to regenerate and reproductive control would eventually help reduce the size of the deer herd, resulting in beneficial impacts that would combine with the beneficial effects of research, exotic plant control, and disease and pest control. However, adverse effects from increased development and other cumulative adverse actions, in conjunction with continued deer browsing pressure on the majority of the woody and herbaceous vegetation and delayed reduction in the deer population, would not be offset by the beneficial effects of proposed actions. Therefore, cumulative impacts to vegetation under this alternative would be adverse, long term, and moderate to major.

### **Conclusion**

Under alternative B, overall approximately 5% of the herbaceous vegetation and up to 10% of the woody vegetation in the park would benefit from constructing exclosures over the life of this plan. Remaining woody and herbaceous vegetation within the park would continue to be adversely affected by deer browsing over the long term until reproductive controls became effective and the population decreased. However, since the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to woody and herbaceous vegetation would be adverse, long term, and major as the young woody vegetation and herbaceous ground cover decreased in quantity and diversity in the majority of the park. Past, present, and future activities, when combined with the continued pressure on woody and herbaceous vegetation expected under this alternative, would result in long-term, moderate to major adverse cumulative impacts.

Alternative B would provide continued protection of certain areas of the park over the long term, would meet the minimum of protecting 5% to 10% of the park at any one time (Bowersox, pers. comm. 2005), and would introduce reproductive controls that could reduce deer numbers gradually over an extended period of time. Therefore, it is not expected that impairment of vegetation resources would occur under this alternative.

## **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

### **Analysis**

Under alternative C, the deer herd would be reduced through sharpshooting and capture and euthanasia, when appropriate.

**WOODY VEGETATION.** The repellents and small caged areas described under alternative A would continue to be used under alternative C. No additional caging or repellent use would occur under this alternative. Immediately reducing the deer population would allow natural forest regeneration to occur.

Under this alternative, it is estimated that up to 193 deer (approximately 50% of the herd) would be removed during the first year of sharpshooting in the park. Roughly 50% of the population would be removed in subsequent years until the initial density goal (15 deer per square mile) was achieved, which would occur at the end of year 3 if the beginning deer population was at 2007 levels. It is expected with rapidly reduced deer browsing pressure (dropping from 82 deer per square mile to closer to 15 deer per square mile) would allow the number of tree and shrub seedlings to increase and survive to maturity, providing the necessary growth for natural forest regeneration. The closer the deer density got to 15 deer per square mile, the higher the chance of achieving successful forest regeneration (Bowersox et al. 2002; Horsley et al. 2003; Stout 1999; Marquis et al. 1992).

The conclusion is supported by the long-term unfenced vegetation plot data from the park. As described under alternative A, mean tree seedling stocking rates declined substantially from 1991 through 2003, and none of the plots that were measured in 2003 had at least 153 seedlings per plot at high deer densities. The most recent data from the 26 plots (2007) show that 0 plots had more than 153 seedlings (high deer densities) present, 3 plots had no seedlings present, and 21 plots had less than 10 seedlings each. Providing rapid deer herd reduction and control would result in beneficial long-term impacts on woody vegetation, because deer browsing would be substantially reduced, allowing the abundance and diversity of woody vegetation throughout the park to recover. It is expected that after approximately 10 years, monitoring would show that more than 67% of the plots would have more than 51 seedlings per plot (low deer density, action threshold). Therefore, existing adverse long-term impacts would be reduced from major to moderate and eventually minor levels, with impacts decreasing in intensity over time as regeneration progressed.

A number of other actions would occur as part of sharpshooting, as described in more detail in chapter 2, which would further affect vegetation in limited areas. These actions include setting up bait stations, occupying shooting areas, and dragging deer to locations for processing and transport. Baited areas would be small, the bait would not remain long, and any uneaten bait would be removed after annual sharpshooting efforts had been completed. Sharpshooting might take place from elevated positions, which would require portable tree stands to be temporarily hung in trees. Such portable stands do not damage the tree (no nails or screws) and would not have an adverse impact to woody vegetation. Removing deer carcasses from the kill site could require dragging over vegetation, which would temporarily trample some woody vegetation. All of these actions (bait stations, shooting stations, and dragging deer) would result in some trampling of woody vegetation; however, the area of impact would be small (less than 1% of park vegetation). The impact of trampling under this alternative would be adverse, short term, and negligible.

It is the park's intention to donate as much of the meat as possible to local charitable organizations. If this is done, there would be little waste to be buried or disposed of at an appropriate processing facility. If meat cannot be donated, carcasses may be disposed of in a burial pit that would be constructed in a developed area that has already been disturbed. Disposal pits would be approximately 8 feet wide, 8 feet long, and 5 feet deep. They would be dug prior to direct reduction activities and covered and fenced to prevent entry. Soil removed from the pits would remain onsite and would be covered to prevent erosion. Although these disposal sites could result in the removal of some vegetation, sites would be selected in areas outside historic districts, previously disturbed, and free of trees. Therefore, the impact on woody vegetation would be adverse, short term, and negligible.

Actions related to the capture and euthanasia of deer, which would generally be used in circumstances where sharpshooting would not be appropriate due to safety concerns (e.g., proximity of nearby residences or other occupied facilities), would be similar to those described for sharpshooting in that deer would be removed from the park through lethal means. The difference would be the way in which deer were captured and killed. This method would require physically capturing and handling deer before euthanizing them. Up to 10 deer annually might be taken under this method. Limited trampling would occur with the setting up of traps (rather than setting up bait stations), resulting in adverse, short-term, negligible impacts. Given that this method could be used at any time of the year, and that only up to 10 deer would likely be removed annually, the waste or carcasses would be buried onsite in a previously disturbed area. This would have no noticeable impact on woody vegetation in the park.

**HERBACEOUS VEGETATION.** Under alternative C, the impacts to herbaceous vegetation would be the same as what was described for woody vegetation. The primary impact within the park would be the result of immediate action taken to control deer numbers. It is expected with rapidly reduced deer browsing pressure, the changes previously observed in herbaceous vegetation would start to reverse, as was found in a number of exclosure studies conducted in the park. Immediately reducing and controlling the growth of the deer population would result in beneficial, long-term impacts on herbaceous vegetation, which could regenerate over time with decreased deer browsing.

Using bait stations, dragging deer carcasses, setting traps, shooting deer, burying waste and/or carcasses, monitoring, and maintaining fences, would not result in any measurable or perceptible change in herbaceous vegetation. These activities would result in adverse, short-term, negligible impacts.

### **Cumulative Impacts**

The same past, present, and future activity impacts described under alternative A would also occur under alternative C. Quickly reducing the park's deer population would provide beneficial, long-term effects, with adverse impacts being reduced to negligible or minor levels over time. These effects, combined with other beneficial effects, would result in cumulative impacts that would be primarily beneficial. These beneficial impacts would somewhat offset the adverse effects from increased development and other cumulative adverse actions. Therefore, cumulative impacts to vegetation under this alternative would be mostly beneficial and long term.

### **Conclusion**

Enhancing natural forest regeneration by quickly reducing deer browsing pressure under alternative C, and by maintaining a smaller deer population through direct reduction, would result in beneficial, long-term impacts because both woody and herbaceous vegetation throughout the park could thrive and recover where effects have been noted. Over time as natural forest regeneration occurred, adverse, long-term, major impacts that could be expected if the deer herd continued unchecked would be reduced to minor levels. Under alternative C, less than 1% of the park's woody or herbaceous vegetation would be affected by trampling at bait stations, shooting sites, trapping locations, or disposal sites. Therefore, adverse impacts of these actions would be short term and negligible. Past, present, and future activities,

when combined with the reduced pressure on woody and herbaceous vegetation and subsequent forest regeneration, would result in beneficial, long-term cumulative impacts. Vegetation resources would not be impaired under this alternative.

#### **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

##### **Analysis**

Under alternative D, direct reduction as defined in alternative C would be implemented to reduce the size of the deer herd; once the goal of 15 to 20 deer per square mile was obtained and natural forest regeneration could occur, reproductive control and direct reduction (if needed) would be used to maintain the deer population at the reduced level.

**WOODY VEGETATION.** The repellents and small caged areas described under alternative A would continue to be used under alternative D, but no additional caging or repellent use would occur under this alternative. As described for alternative C, up to 193 deer (approximately one-half) would be removed during the first year of sharpshooting in the park. Roughly 50% of the population would be removed in subsequent years until the target density goal of 15 deer per square mile was achieved. It is expected with rapidly reduced deer browsing pressure (dropping from about 82 deer to about 15 deer per square mile) the number of tree and shrub seedlings would increase, and the number of seedlings surviving to sapling stage would also increase, providing the necessary growth for natural forest regeneration. The closer the deer density was to 15 to 20 deer per square mile, the higher the chance to achieve successful forest regeneration (Bowersox et al. 2002; Horsley et al. 2003; Stout 1999; Marquis et al. 1992).

Providing immediate reduction and control of the deer population would result in beneficial, long-term impacts on the woody vegetation, because deer browsing would be substantially reduced and the abundance and diversity of woody vegetation throughout the park could thrive and recover. As described for alternative C, it is expected that after approximately 10 years monitoring would show that more than 67% of the plots had more than 51 seedlings per plot (low deer density action threshold – see appendix A). As fair to good regeneration began to occur, the adverse impact level would be reduced from major to moderate and eventually minor.

As described for alternative C, a number of other actions would occur as part of implementing sharpshooting, such as setting up bait stations, occupying shooting areas, and dragging deer carcasses to locations for processing and transport. All of these actions would result in some trampling of woody vegetation; however, the area of impact would be small (less than 1% of vegetation), and the impact would be adverse, short term, and negligible given the small size of the affected area and the short duration of the impact. As forest regeneration increased, more woody stems might be affected by each action; however, the overall amount of vegetation affected would still be small, and the impact would be short term and negligible.

During the sharpshooting process, any waste and/or carcasses of removed deer that would need to be disposed of onsite could result in the removal of some woody vegetation. However, sites selected for disposal would be in previously disturbed areas and free of trees. Therefore, the impact on woody vegetation would be adverse, short term, and negligible.

The actions related to capture and euthanasia could result in trampling of vegetation because of setting up traps (rather than setting up bait stations), with adverse, short-term, negligible impacts. Given that this method could be used at any time of the year, and that only up to 10 deer would be removed by this method, the waste and/or carcasses would likely be buried onsite in a previously disturbed area where woody vegetation would not need to be removed or left to decompose naturally on the surface, so there would be no impact on the woody vegetation in the park.

Reproductive controls would be implemented after direct reduction efforts had initially reduced the population size to maintain the desired deer population level. However, the success of implementing

reproductive controls on a deer population that has undergone several years of direct reduction efforts would depend on technological advances, the sensitivity of deer to humans, methods used by the sharpshooters, changes in immigration with reduced deer density, and general deer movement behavior (Porter et al. 2004; Naugle et al. 2002). It should be expected that getting close enough to administer remote injections would become increasingly difficult after direct reduction efforts due to deer behavior changes in response to previous human interaction. If reproductive control could be successfully implemented, deer numbers could be kept low and impacts on vegetation would be adverse, long term, and minor.

Assuming a park deer population at a density of 15 deer per square mile when reproductive controls were initiated in year 4, there would be a maximum of 69 deer in the park (approximately 4.69 square miles). Assuming that 65% of the deer are does, there would be 45 does in the population. The majority of the does (90%, or 41 does) would need to be treated so that they could be identified for retreatment in successive years. It is estimated that up to 5 deer per day could be treated (taking about 8 days), given the increased effort to locate deer with lower deer numbers. The population would continue to be monitored for growth. If the deer population increased during the reproductive control application under this alternative or if reproductive control was not available, periodic direct reduction would be initiated to maintain the population density at the identified goal.

Some of the actions involved in implementing reproductive control (similar to implementing constructing fences and sharpshooting) could result in trampling of woody vegetation; however, these actions would last only a few hours to a few days in any location, and the adverse effect on vegetation would be negligible.

Assuming that reproductive controls could be used at a parkwide level to maintain the deer population size, impacts on woody vegetation would be beneficial and long term because a substantial reduction in deer browsing would allow the abundance and diversity of woody vegetation throughout the park to recover.

**HERBACEOUS VEGETATION.** The impacts to herbaceous vegetation under alternative D would be the same as those described for woody vegetation. The primary impact would be the result of actions taken to immediately reduce deer numbers, thus quickly reducing deer browsing pressure and allowing adverse effects on herbaceous vegetation to be gradually reversed, as found in a number of enclosure studies conducted in the park. Using direct reduction and/or reproductive controls to maintain the lowered deer population would allow herbaceous vegetation to continue regeneration through the life of the plan. Long-term impacts on herbaceous vegetation from reduced deer browsing would be beneficial.

Activities such as using bait stations, dragging deer carcasses, setting traps, shooting or treating deer, monitoring, or maintaining fences would not result in any measurable or perceptible change in herbaceous vegetation, so impacts would be adverse, short term, and negligible.

### **Cumulative Impacts**

The same past, present, and future activity impacts described under alternative A would also occur under alternative D. Rapidly reducing the deer population would relieve browsing pressure on the majority of the park's vegetation, providing long-term beneficial impacts and reducing adverse impacts to minor levels. Some adverse impacts would affect woody and herbaceous vegetation as a result of trampling due to setting bait stations, occupying shooting locations, removing deer carcasses, and using traps. However, these impacts would be isolated, affecting less than 1% of the park, resulting in adverse, short-term, negligible impacts.

Rapid deer density reduction would give the forest the opportunity to thrive and regenerate, resulting in beneficial impacts that would combine with other beneficial effects, resulting in cumulative impacts that would be primarily beneficial. These beneficial impacts would somewhat offset the adverse effects from

increased development and other cumulative adverse actions. Therefore, cumulative impacts to vegetation under this alternative would be mostly beneficial and long term.

**Conclusion**

Enhancing natural forest regeneration by quickly reducing deer browsing pressure under alternative D, and by maintaining a smaller deer population through the use of reproductive control (and direct reduction if needed) would result in beneficial, long-term impacts because both woody and herbaceous vegetation could thrive and recover throughout the park. Over time as natural forest regeneration occurred, adverse, long-term, major impacts would be reduced to minor levels. Under alternative D, less than 1% of the park's woody or herbaceous vegetation would be affected by trampling at bait stations, shooting sites, trapping locations, or disposal sites. Therefore, adverse impacts of these actions would be short term and negligible. Past, present, and future activities, when combined with the reduced pressure on woody and herbaceous vegetation (forest regeneration) expected under this alternative, would result in beneficial, long-term cumulative impacts. Vegetation resources would not be impaired under this alternative.



## SOILS AND WATER QUALITY

### GUIDING REGULATIONS AND POLICIES

The *Clean Water Act* (33 USC 1251 et seq.) protects and restores the quality of natural waters through the establishment of nationally recommended water quality standards. Under the oversight of the U.S. Environmental Protection Agency (EPA), states administer provisions of the *Clean Water Act* by establishing water quality standards and managing water quality. According to EPA regulations, water quality standards must (1) designate uses of the water; (2) set minimum narrative or numeric criteria sufficient to protect the uses; and (3) prevent degradation of water quality through antidegradation provisions.

As described in chapter 3, in administering the *Clean Water Act*, the District of Columbia has identified Rock Creek and its tributaries for all five beneficial use classes and also as “Special waters of the District of Columbia.” It is intended that the water quality of such designated waters be maintained and not allowed to degrade.

In supporting federal and state regulations the NPS *Management Policies 2006* state that the NPS will “take all necessary actions to maintain or restore the quality of surface waters and groundwaters within the parks consistent with the *Clean Water Act* and all other applicable federal, state, and local laws and regulations” (NPS 2006, sec. 4.6.3). The policies also instruct park units to prevent, to the extent possible, the unnatural erosion, physical removal, or contamination of the soil, or its contamination of other resources (NPS 2006, sec. 4.8.2.4).

Rock Creek Park’s General Management Plan (2005a) includes the following desired condition that pertains to water quality: surface waters and groundwater are protected or restored such that water quality as a minimum meets all applicable District of Columbia water quality standards.

### ASSUMPTIONS, METHODOLOGY, AND INTENSITY THRESHOLDS

Impact intensities for soils and water quality were derived from the available soils information and park staff observations of the effects on soils from loss of vegetation and from water quality observations by park staff. The only aspect of water quality that is being assessed is turbidity, which is primarily affected by sedimentation related to lack of ground cover, assuming that removal of vegetation could result in increased soil erosion, nonpoint runoff, and stream flows. The thresholds for the intensity of an impact are defined as follows.

- Negligible:** Impacts to soils and water quality would not be detectable or measurable. Water quality would be within historical conditions.
- Minor:** Soil impacts would be detectable and occur within a small area. Resulting changes in soil erosion rates would cause only detectable and localized impacts to water quality that are within historical or baseline water quality conditions and flows.
- Moderate:** Impacts to soils would be readily apparent and result in impacts to soil character over a relatively wide area. Resulting changes in soil erosion rates could cause occasional and temporary alterations to historical or baseline water conditions during some storm events.

**Major:** Impacts to soils would be readily apparent and widespread. Resulting changes in soil erosion rates would cause frequent alterations in the historical or baseline water quality conditions over a large area.

## **AREA OF ANALYSIS**

The area of analysis for assessment of impacts of the various alternatives is the park. For cumulative impacts, the area of analysis is the Rock Creek watershed, which includes the main stream and tributaries in the park and their respective drainage basins.

## **IMPACTS OF THE ALTERNATIVES**

### **ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)**

#### **Analysis**

Since no measures would be implemented to actively reduce the size of the deer population under alternative A, loss of vegetative cover would continue to increase as a result of the expected continued high numbers of deer and associated deer browsing. Park staff would continue activities to protect native plants, such as creating small caged areas; however, such small exclosures would do little to protect against soil erosion and may cause deer to browse elsewhere, reducing cover in small areas and exposing soils to erosion. Installation and maintenance of small caged areas would result in negligible adverse impacts to soils. Although the loss of vegetative ground cover park-wide from deer browsing is not currently documented as a problem relating to soils and water quality, it is expected that the deer population would increase or remain at high levels under alternative A over the life of the plan, albeit with periodic decreases that could occur due to variables, such as herd health or weather conditions in any particular year. The expected loss of vegetative ground cover from increased deer browsing over time could eventually result in increased sedimentation and high turbidity if exposed soils are washed away and into surrounding water bodies by heavy rainfall. This would especially affect the smaller tributaries and around seeps and springs, which have less volume of water to dilute the additional sediment load. Therefore, alternative A would result in adverse, long-term, negligible to minor impacts on the soils and water quality of the park.

#### **Cumulative Impacts**

Cumulative impacts on soil and water quality would arise not only from activities within the park, but would also be heavily influenced by past, present, and future actions in the areas adjacent to the park. In particular, adverse effects have occurred and continue to occur from the increase in urban development surrounding the park and in upstream areas. As a result, impervious surface runoff and nonpoint pollution that causes siltation and high levels of turbidity and other pollutants in Rock Creek and its tributaries has increased. This has resulted in short- and long-term minor to moderate adverse impacts. The smaller tributaries are especially susceptible to short-term episodes of high siltation and higher impacts because of their lower size and flows. Sewer overflows and leaks have periodically caused short-term minor to moderate adverse impacts on water quality. The District's LTCP to control CSO discharges to the area waterways proposes significant reductions in CSO discharges, as does WASA's 10-year capital improvement program through fiscal year 2010. WASA also has plans to improve some drainage conditions, including separating the combined sewer in Piney Branch to reduce the amount of raw sewage entering the Piney Branch Tributary and mitigating the stormwater flow into Dumbarton Oaks Park by capturing the flow before it enters the park and piping it around the park. The flow would be discharged at a point below the park to reduce stormwater erosion. All these actions would have long-term beneficial impacts on water quality and soil erosion.

Historically, discharges from agricultural activities in the creek headwaters have also affected downstream waters, causing long-term minor to moderate adverse impacts including effects of siltation. Currently, and in the reasonably foreseeable future, Montgomery County is implementing measures to reduce these impacts and improve water quality through use of buffers and other measures, resulting in long-term beneficial impacts on water quality.

Other actions within the park have contributed to soil erosion and stream sedimentation. Off-trail uses, illegal camping, various visitor uses, and park operations and maintenance activities can result in small areas of disturbed soils, causing localized negligible to minor soil erosion and associated adverse impacts on soils and water quality of nearby waters. Dumping can affect water quality, with the impact depending on the type and amount of material dumped, but mostly short-term negligible impacts. Future actions that could cause adverse impacts include utility development and construction of the parkway, which could have adverse, short- and long-term, negligible to minor adverse impacts on soils and water quality.

All of these activities, when combined with the negligible to minor impacts from continued deer browsing and trampling expected under alternative A, would result in cumulative impacts that would be adverse, long term, and minor.

## **Conclusion**

Adverse, long-term, negligible to minor impacts on soils and water quality could result from soil erosion and sedimentation due to loss of vegetation from increased deer browsing, assuming continued high numbers of deer and possible growth in the population over the life of the plan. Past, present, and future activities both inside and outside the park, when combined with the continued pressure on forest resources expected under this alternative, would result in adverse, long-term, minor impacts on soil and water quality. There would be no impairment of park soils or water resources under alternative A.

## **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

### **Analysis**

Several non-lethal actions under alternative B would be implemented in combination to protect forest resources and reduce the park's deer population. Actions include the use of large-scale exclosures and reproductive control of does.

Under alternative B, approximately 14 exclosures, each encompassing 7 to 25 acres, would be used throughout the park to exclude deer from those areas for at least 10 years. This would allow reforestation within the exclosures, so they would be relocated after 10 years to a new area. The use of large exclosures could have both beneficial and adverse impacts on park soils and water quality. Revegetation within the exclosures would help minimize the potential for soil erosion in approximately 5% of the park at any one time. However, exclosures alone would not decrease overall deer browsing pressure within the park, and the benefits of the exclosures might initially be offset by adverse impacts in other areas or result in a change in browsing patterns. The exclosures would be spaced so as to prevent the funneling of deer into certain areas, and they would be relocated periodically. However, deer displaced from the exclosures might still concentrate in other areas of the park. This could have adverse impacts in those areas by further increasing the loss of vegetative ground cover, resulting in increased soil erosion and sedimentation into park streams. Adverse impacts would be long term and minor, gradually shifting to beneficial as more and more of the forest regenerated due to protection afforded by the exclosures.

Continued use of small cages and repellents would probably have little impact mitigating soil erosion and may cause deer to concentrate browsing elsewhere, resulting in increased loss of vegetation in those areas, which could in turn result in localized increased soil erosion and adverse impacts to water quality at negligible levels.

Impacts of reproductive controls would be limited. Short- to long-term negligible to minor adverse impacts could occur from use of temporary holding pens that may need to be constructed if more does are captured than can be treated in one day. Use of these would involve trampling of any vegetation within the pen areas, which could expose soils to erosion. The use of reproductive control could reduce the deer population to a limited extent if it was successfully implemented. Even if all does targeted were treated, reproductive control would take several years to take effect, with a best case scenario of a 5% reduction in population over several years after 90% of the does were treated. However, any reduction in the deer population would help decrease the loss of vegetation due to deer browsing, reduce soil erosion, and would be beneficial in the long term to water quality.

### **Cumulative Impacts**

The cumulative impacts under alternative B would be similar to those under alternative A, because the same past, present, and future activities are expected under both alternatives. The beneficial long-term impacts on soil and water quality of alternative B would slightly offset some of the adverse cumulative impacts; however, the majority of the watersheds for the park's creeks lie outside the park, where impacts might or might not be mitigated. Therefore, actions under alternative B would offset only a very small part of the overall cumulative impacts, which would continue to be adverse, long term, and minor.

### **Conclusion**

Adverse, long-term, minor impacts to soils and water quality could occur if deer displaced by the fenced enclosures concentrated in other areas of the park, resulting in increased loss of vegetation in those areas and a potential increase in soil erosion. These impacts would gradually shift to beneficial in the long term as reforestation occurred in the large enclosures, potentially reducing soil erosion. Beneficial long-term impacts would also result from decreased vegetation loss and associated erosion and sedimentation from exposed soils, as reproductive control of the deer population would gradually reduce deer numbers over time. Cumulative impacts would be adverse, long term, and minor due to the large portion of the creeks' watersheds that are outside the park boundary, and beneficial long-term impacts occurring inside the park would offset cumulative impacts only slightly. There would be no impairment of park soils or water resources under alternative B.

## **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

### **Analysis**

Sharpshooting and capture and euthanasia, where appropriate, would be used to immediately reduce the number of deer within the park and to maintain sustainable deer population of 15 to 20 deer per square mile after the third year of implementation. A smaller deer herd would allow reforestation to occur throughout the park and for woody and herbaceous vegetative cover to recover, because deer browsing pressure would be decreased. Regrowth of vegetative ground cover would reduce the potential for soil erosion and sedimentation of park streams, resulting in beneficial, long-term impacts on soils and water quality.

Continued use of small cages and minimal use of repellent would probably have little impact mitigating soil erosion and may cause deer to concentrate browsing elsewhere, resulting in increased loss of vegetation in those areas, a negligible adverse effect.

### **Cumulative Impacts**

The cumulative impacts from alternative C would be similar to those for alternatives A and B, but with a slightly greater beneficial effect from the immediate reduction of deer numbers and the maintenance of a smaller sustainable deer population (15 to 20 deer per square mile) after the fourth year of implementation. However, as with alternative B, the beneficial impacts of this alternative would only

slightly offset some of the cumulative adverse impacts, since the majority of the watersheds affected lie outside the park where impacts may or may not be mitigated. Therefore, the combined actions of alternative C with other past, present, and future activities would result in adverse, long-term minor impacts.

### **Conclusion**

Beneficial, long-term impacts on soils and water quality would result from immediately reducing the number of deer in the park and maintaining a sustainable population of 15 to 20 deer per square mile after the third year of implementation. Vegetative ground cover would be able to reestablish itself, helping reduce soil erosion and sediment loading in the park's creeks. Cumulative impacts would be adverse, long term, and minor due to the large portion of the creeks' watersheds occurring outside the park boundary; the beneficial, long-term impacts of alternative C would offset cumulative impacts only slightly. There would be no impairment of park soils or water resources under alternative C.

### **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

#### **Analysis**

Under alternative D, direct reduction would be used to initially reduce the number of deer within the park and reproductive control of does (and direct reduction if needed) would then be used to maintain a sustainable population of approximately 15 to 20 deer per square mile after the third year of implementation. The reduction and long-term maintenance of a small herd would allow vegetative ground cover to reestablish itself throughout the park and potentially reduce soil erosion, providing beneficial, long-term impacts on the soils and water quality of the park.

Continued use of small cages and repellents would probably have little impact mitigating soil erosion and may cause deer to concentrate browsing elsewhere, resulting in increased loss of vegetation in those areas, a negligible adverse effect. Therefore, overall impacts under alternative D would be beneficial and long term.

#### **Cumulative Impacts**

Cumulative impacts to soils and water quality under alternative D would be very similar to those described for alternative C, with the beneficial, long-term effects on soils and water quality resulting from the relatively rapid reduction of deer numbers and the long-term maintenance of a smaller deer herd over the life of the plan. However, as with alternative C, these beneficial effects would only slightly offset the other adverse cumulative impacts occurring outside the park boundary, where the majority of the park watersheds occur. Adverse activities on adjacent lands might or might not be mitigated. Overall the cumulative impacts would be adverse, long term, and minor.

### **Conclusion**

Impacts on soil and water quality would be beneficial and long term as a result of immediately reducing the number of deer in the park and maintaining a population of 15 to 20 deer per square mile after the third year of implementation. Vegetative ground cover would be able to reestablish itself, helping mitigate any soil erosion and sediment loading into the park's creeks. Cumulative impacts would be adverse, long term, and minor due to the large portion of the creeks' watersheds that occur outside the park boundary, where adverse actions might or might not be mitigated; the beneficial, long-term impacts of the alternative D actions in the park would only slightly offset cumulative impacts outside the park. There would be no impairment of park soils or water resources under alternative D.



## WETLANDS AND FLOODPLAINS

### GUIDING REGULATIONS AND POLICIES

As described in chapter 1, two federal executive orders (EO), EO 11990 (Protection of Wetlands) and EO 11988 (Floodplain Management) direct federal agencies to avoid adverse impacts to floodplains and wetlands. Director's Order 77-1 establishes policies, requirements, and standards for implementing EO 11990, while Director's Order 77-2 applies to all NPS proposed actions that could adversely affect the natural resources and functions of floodplains. This order states that when it is not practicable to locate or relocate development or inappropriate human activities to a site outside and not affecting the floodplain, the NPS will prepare and approve a Statement of Findings (SOF), in accordance with procedures described in Procedural Manual 77-2: Floodplain Management, and take all reasonable actions to minimize the impact to the natural resources of floodplains. Similarly, if adverse impacts to wetlands would occur from a proposed project, a SOF is prepared, unless the actions are accepted for various reasons provided in Procedural Manual 77-1, section 4.2(A). As described more fully below in the analysis, the actions proposed to manage the deer population would not adversely impact wetlands or floodplains, and no SOF were required for this project.

NPS *Management Policies 2006* specifically address wetlands and floodplains in sections 4.6.4 and 4.6.5, respectively. The policies provide protective provisions for wetlands and floodplains that reiterate the language in the DOs discussed above (NPS 2006).

### ASSUMPTIONS, METHODOLOGY, AND IMPACT THRESHOLDS

National Wetland Inventory (NWI) wetland maps and Federal Emergency Management Agency (FEMA) floodplain maps and communications with NPS staff were used to identify baseline conditions for the analysis.

The thresholds for the intensity of an impact on wetlands and floodplains are defined as follows:

- Negligible:** The structure and function of wetlands or floodplains would not be affected; effects would either be nondetectable, or, if detected, would be considered slight and localized. No measurable or perceptible effects on size, integrity, or connectivity of wetlands would occur.
- Minor:** Effects on the structure or function of wetlands or floodplains would be measurable, although the effects would likely be small and localized. A small effect on size, integrity, or connectivity of wetlands would occur; however, the overall viability would not be affected. If left alone, an adversely affected wetland would recover and the impact would be reversed. No mitigation measures associated.
- Moderate:** Effects on the structure or function of wetlands or floodplains would be measurable, but would be relatively localized. The impact would be sufficient to cause a measurable effect on either the size, integrity, connectivity of wetlands or would result in a permanent loss or gain in wetland acreage, but not to large areas. Mitigation could be required and if implemented, would likely be successful.

**Major:** Effects on the structure or function of wetlands or floodplains would be readily measurable, would have substantial consequences, and would be observable over a relatively large area. The character of the floodplain would be changed so that the functions typically provided by the floodplain would be substantially changed. The impact would result in a measurable effect on wetland size, integrity, and connectivity or a permanent loss or gain of large wetland areas. The character of the wetland would be changed so that the functions typically provided by the wetland would be substantially altered. Mitigation would be required and its success could not be assured.

## IMPACTS OF THE ALTERNATIVES

### ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)

#### Analysis

Loss of vegetative cover under alternative A would continue to increase as a result of the expected continued high numbers of deer and associated deer browsing, since no measures would be implemented to actively reduce the size of the deer population. Since the deer population would increase or remain at high levels under alternative A over the life of the plan, continued loss of vegetative ground cover and a change in the floodplain forest composition and structure would be expected from increased deer browsing over time in these wetland areas. In forested wetlands, there are some species that are browsed by deer (e.g., young tulip poplar [*Liriodendron tulipifera*] and most herbaceous plants), but other common species (e.g., sycamore [*Platanus occidentalis*]) are not as palatable as some of the upland species (e.g., white oak (*Quercus alba*) and beech (*Fagus grandifolia*); USFS 2008). Based on the past impacts and the expected high numbers of deer over the life of the plan, alternative A would have long-term, moderate adverse impacts on wetland woody and herbaceous vegetation due to the amount of deer browsing.

Small wet areas (springs and seeps and vernal pools) could also be adversely affected by high deer density, if deer trample these areas while passing through or seeking water sources, causing siltation and erosion in these areas, or if the more intense browsing reduces pool vegetation cover or opens up the canopy, which could allow these pools to dry up faster. Impacts would likely be very localized and minor to moderately adverse, depending on the amount of deer present in specific areas.

The park has previously caged woody plant species to protect them from deer browsing, including several in riparian areas that may be small wetlands. These caged areas would continue to be maintained, and construction and maintenance of these caged areas would have negligible adverse impacts in the area of construction. New caging would be used on a limited basis for any newly identified rare species or plantings sensitive to deer browsing. This action would have long-term beneficial impacts on the plants or areas in wetlands that were caged by prohibiting deer browsing. However, the impact on the remainder of park vegetation that was not caged would continue to be adverse, long term, and moderate to major because no measures would be taken to limit or control deer population size or growth under this alternative.

No occupancy, modification, or development of floodplains is expected under alternative A, other than the small caging described above. The removal of ground vegetation through deer browsing could have the potential to increase stormwater runoff and flood events, but this would likely have a negligible to minor adverse impact on overall floodplain functioning.

## **Cumulative Impacts**

Cumulative impacts on wetlands and floodplains would occur from many of the same actions both inside and outside the park that would affect water quality and vegetation, as previously described. Upstream and surrounding urban development has increased impervious surface runoff that can cause periodic washouts and/or siltation of smaller wetland areas in tributaries and increase flooding, and this is expected to continue into the future. Rock Creek has experienced a large flood event about every five years, and the last major flood (June 2006) caused extensive damage in the park, so impacts to floodplain function have been periodic, but continuing over the long term, moderate and adverse. Most wetland vegetation that naturally occurred along Rock Creek has been eliminated and replaced with seeded and transplanted species as the land was developed, resulting in long-term, minor to moderate adverse impacts. The number of vernal pools in the park today has been reduced from the pre-urbanization era because of past draining or filling activities, stream bed scouring from increased runoff that has resulted from development in the watershed upstream from the park, and lowered water tables from incising of the stream channel or urban groundwater use, resulting in long-term moderate adverse effects on these sensitive areas.

Other actions within the park have contributed to lesser impacts on wetlands and floodplains, including off-trail uses and various visitor uses, such as horseback riding that can disturb floodplain and wetland soils and vegetation. Dogs that are allowed to run free disrupt wetland ground cover and soils and help spread noxious weeds in the floodplain. Dumping in these locations can affect water quality and the ecological integrity of wetland areas and introduce foreign materials into the system, which could be carried away during flooding. Impacts would depend on the type and amount of material dumped, but mostly short-term localized negligible impacts would be expected. Park operations and maintenance activities can result in small areas of disturbed soils or vegetation, causing localized negligible to minor adverse impacts on wetlands. Structures have been located in the 100-year floodplain, although with little impact on floodplain functioning. Future actions that could cause adverse impacts to floodplains include reconstruction of the parkway, which could have short- and long-term, negligible to minor adverse impacts due to the increase in impervious surface and amount of runoff.

All of these activities, when combined with the moderate impacts to wetlands and negligible to minor to floodplains from continued deer browsing and trampling expected under alternative A, would result in cumulative impacts to wetlands and floodplains that would be adverse, long term, and moderate.

## **Conclusion**

Adverse, long-term, moderate impacts on wetlands and floodplains could result from soil erosion and sedimentation due to loss of vegetation from increased deer browsing, disturbance to small wetland areas and vernal pools from deer trampling and vegetation loss, and changes in species composition, assuming continued high numbers of deer and possible growth in the population over the life of the plan. Past, present, and future activities both inside and outside the park, when combined with the continued pressure on forest resources expected under this alternative, would result in adverse, long-term, moderate impacts on wetlands and floodplains. Because the effects of this alternative would not physically affect the floodplain and the floodplain plant community would continue to exist, although with an altered species composition, there would be no impairment of park wetlands or floodplains under alternative A.

## **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

### **Analysis**

Several non-lethal actions under alternative B would be implemented in combination to protect forest resources and reduce the park's deer population. Actions include the use of large-scale exclosures and reproductive control of does.

Under alternative B, approximately 14 exclosures would be used to exclude deer from certain areas in order to allow reforestation to occur. Each exclosure would encompass 7 to 25 acres and would be located throughout the park for at least 10 years, after which time the exclosures would be relocated. Several of these are proposed to be located specifically to protect the forested wetland areas and the associated 100-year floodplains located in the northern portion of the park (see figure 6). The use of large exclosures could have both beneficial and adverse impacts on park wetlands and floodplains. If positioned to enclose wetlands, there would be no direct impacts to wetlands from the construction of the fencing, and revegetation within the exclosures would help minimize the potential for soil erosion and increase vegetation cover in approximately 5% of the park at any one time. However, exclosures alone would not decrease overall deer browsing pressure within the park and the benefits of the exclosures in one location might initially be offset by adverse impacts in other wetland areas. Also, when the exclosures are moved, all herbaceous wetland vegetation would be subject to deer browsing again. Adverse impacts from the use of the exclosures would be long term and negligible to minor, and the protection of these forested wetland areas would have long-term beneficial impacts as more and more of the woody vegetation is regenerated due to protection afforded by the exclosures.

As described under the “Vegetation” topic, the use of reproductive control could reduce the deer population to a limited extent if it was successfully implemented. However, even if all does targeted were treated, reproductive control would take several years to take effect, with a best case scenario of a 5% reduction in population over several years after 90% of the does were treated (Hobbs et al. 2000). Therefore, adverse impacts to wetland vegetation structure and species composition and to smaller wetlands that are not protected by exclosures would continue to occur over the long term, with intensity depending on site-specific conditions. However, any reduction in the deer population would help decrease the loss of vegetation due to deer browsing and would be beneficial in the long term.

No modification or development of floodplains is expected under alternative B, but the exclosures would be constructed within the 100-year floodplain at several locations where the areas to be protected are forested wetlands or lie in riparian areas. The permanent placement of posts and fencing would present a potential for affecting flood characteristics in local areas if flood debris would catch on these and obstruct the natural flow of water during flood events. This would likely have a negligible adverse impact on overall floodplain functioning, but could result in short-term, minor adverse impacts on flooding during storm events.

### **Cumulative Impacts**

Management actions identified in alternative B, where a few forested wetlands would be protected from browsing, combined with reproductive control, could reduce the deer density after more than 15 years of implementation, would provide some beneficial impacts over the long term, but not immediately. Large exclosures would give certain areas of forested wetlands the opportunity to regenerate, and the exclosures would also keep out trespassing dogs, a long-term benefit. However, adverse effects from increased development and other past cumulative adverse actions, in conjunction with continued deer browsing pressure and possible trampling effects on the other wetlands areas, would not be offset by the beneficial effects of proposed actions. Therefore, cumulative impacts to wetlands under this alternative would be adverse, long term, and moderate.

### **Conclusion**

Use of exclosures to protect many of the park’s forested wetlands would gradually result in beneficial long-term impacts to wetlands and many vernal pools located in fenced areas, as reforestation occurred in the large exclosures, although continued long-term minor to moderate adverse impacts would be expected in areas that are not fenced and in smaller wetland areas and seeps. Beneficial long-term impacts would also result from decreased vegetation loss as reproductive control of the deer population would gradually reduce deer numbers over time. Construction of exclosures within the 100-year floodplain would likely

have a negligible adverse impact on overall floodplain functioning, but could result in short-term, minor adverse impacts on the floodplain. Past, present, and future activities both inside and outside the park, when combined with the effects expected under this alternative, would result in adverse, long-term, moderate impacts on wetlands and floodplains. There would be no impairment of park wetlands or floodplains under alternative B.

#### **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

##### **Analysis**

Sharpshooting and capture and euthanasia, where appropriate, would be used to immediately reduce the number of deer within the park and to maintain sustainable deer population of 15 to 20 deer per square mile after the third year of implementation. A smaller deer herd would allow reforestation to occur throughout the park and for woody and herbaceous vegetative cover to recover, including within wetland areas, and would limit the damage from deer trampling in smaller wetland areas, resulting in beneficial, long-term impacts on wetlands.

No occupancy, modification, or development of floodplains is expected under alternative C, other than possibly some of the small caging around specific landscape or rare plants if these were located within wetlands or floodplains. The removal of ground vegetation through deer browsing would be greatly reduced, with long-term, beneficial effects on overall floodplain functioning.

##### **Cumulative Impacts**

The cumulative impacts from alternative C would be similar to those for alternatives A and B, but with a slightly greater beneficial effect from the immediate reduction of deer numbers and the maintenance of a smaller sustainable deer population (15 to 20 deer per square mile) after the third year of implementation. However, as with alternative B, the beneficial impacts of this alternative would only slightly offset some of the cumulative adverse impacts, since the majority of the impacts to wetlands and flooding have occurred from past actions and upstream development. Therefore, the combined actions of alternative C with other past, present, and future activities would result in long-term, minor to moderate adverse impacts.

##### **Conclusion**

Beneficial, long-term impacts on wetlands and floodplains would result from immediately reducing the number of deer in the park and maintaining a sustainable population of 15 to 20 deer per square mile after the third year of implementation. Vegetative ground cover would be able to reestablish itself, reducing flooding velocities and adding to the ecological value of wetland areas. Cumulative impacts would be adverse, long term, and minor to moderate due mainly to past actions, and the beneficial, long-term impacts of alternative C would offset cumulative impacts only slightly. There would be no impairment of park wetlands or floodplains under alternative C.

#### **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

##### **Analysis**

Under alternative D, direct reduction would be used to initially reduce the number of deer within the park, and reproductive control of does (and direct reduction, if needed) would then be used to maintain a sustainable population of approximately 15 to 20 deer per square mile after the third year of implementation. The reduction and long-term maintenance of a small herd (either through sharpshooting or reproductive control) would allow vegetative ground cover to reestablish itself in wetland areas, as well as in other areas of the park, and would limit the damage from deer trampling in smaller wetland areas, resulting in beneficial, long-term impacts on wetlands.

Similar to alternative C, no occupancy, modification, or development of floodplains is expected under alternative D, other than possibly some of the small caging around specific landscape or rare plants if these were located within wetlands or floodplains. The removal of ground vegetation through deer browsing would be greatly reduced, with long-term, beneficial effects on overall floodplain functioning.

### **Cumulative Impacts**

Cumulative impacts to wetlands and floodplains under alternative D would be very similar to those described for alternative C, with the beneficial, long-term effects on soils and water quality resulting from the relatively rapid reduction of deer numbers and the long-term maintenance of a smaller deer herd over the life of the plan. However, as with alternative C, these beneficial effects would only slightly offset the other adverse cumulative impacts from other past actions and overall cumulative impacts would be adverse, long term, and minor to moderate.

### **Conclusion**

Beneficial, long-term impacts on wetlands and floodplains would result from immediately reducing the number of deer in the park and maintaining a sustainable population of 15 to 20 deer per square mile after the third year of implementation. Vegetative ground cover would be able to reestablish itself, helping reduce flooding velocities and adding to the ecological value of wetland areas. Cumulative impacts would be adverse, long term, and minor to moderate due mainly to past actions, and the beneficial, long-term impacts of alternative D would offset cumulative impacts only slightly. There would be no impairment of park wetlands or floodplains under alternative D.

## WILDLIFE AND WILDLIFE HABITAT

### GUIDING REGULATIONS AND POLICIES

The NPS *Organic Act of 1916*, NPS *Management Policies 2006* (NPS 2006), and NPS *Reference Manual 77: Natural Resource Management* (NPS 1991) direct NPS managers to provide for the protection of park resources. The *Organic Act* requires that wildlife be conserved unimpaired for future generations, which has been interpreted to mean that native animal life are to be protected and perpetuated as part of a park unit's natural ecosystem. Parks rely on natural processes to control populations of native species to the greatest extent possible; otherwise, they are protected from harvest, harassment, or harm by human activities. The NPS *Management Policies 2006* make restoration of native species a high priority. Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and ecological integrity of plants and animals (NPS 2006, sec. 4.1). Policies in the NPS *Natural Resource Management Guideline* state, "the National Park Service will seek to perpetuate the native animal life as part of the natural ecosystem of parks" and that "native animal populations will be protected against . . . destruction . . . or harm through human actions."

Rock Creek Park's General Management Plan (2005a) includes the following desired conditions that pertain to wildlife:

- native plant and animal species function in as natural condition as possible, except where special management considerations are allowable under policy
- native species populations that have been severely reduced or extirpated are restored where feasible and sustainable
- invasive species are reduced in numbers and area or eliminated from natural areas of the park

### ASSUMPTIONS, METHODOLOGY, AND INTENSITY THRESHOLDS

The evaluation of wildlife (including deer) was based on a qualitative assessment of how expected changes to park vegetation (as a result of increased or decreased deer browsing pressure), or management actions themselves, would affect both the deer population and other park wildlife or wildlife habitat. The park's wildlife species are directly affected by the natural abundance, biodiversity, and the ecological integrity of the vegetation that comprises their habitat. For purposes of this plan/EIS, impacts to deer were assessed separately from impacts to other wildlife species, but using the same basic methodology and impact thresholds.

Available information on known wildlife, including unique or important wildlife or wildlife habitat, was compiled and analyzed in relation to the management actions. The thresholds for the intensity of an impact were defined as follows:

- Negligible:** There would be no observable or measurable impacts to native species, their habitats, or the natural processes sustaining them.
- Minor:** Impacts on native species, their habitats, or the natural processes sustaining them may not be detectable, and changes to population numbers, population structure, or other demographic factors would not occur. Occasional responses to disturbance by some individuals could be expected, but without interference to factors affecting population levels. Sufficient habitat would remain functional to maintain viability of all species. Impacts would be outside critical reproduction periods for sensitive native species.

**Moderate:** Impacts on native species, their habitats, or the natural processes sustaining them would be detectable, and changes to population numbers, population structure, or other demographic factors would occur, but species would remain stable and viable. Frequent responses to disturbance by some individuals could be expected, with some negative impacts to factors affecting population levels. Sufficient habitat would remain functional to maintain the viability of all native species. Some impacts might occur during critical periods of reproduction or in key habitat.

**Major:** Impacts on native species, their habitats, or the natural processes sustaining them would be detectable and extensive. Population numbers, population structure, or other demographic factors might experience large declines. Frequent responses to disturbance by some individuals would be expected, with negative impacts to factors resulting in a decrease in population levels. Loss of habitat might affect the viability of at least some species.

## AREA OF ANALYSIS

The area of analysis for assessment of impacts is Rock Creek Park. The area of analysis for cumulative impacts is the park and the areas that encompass typical deer and wildlife movement outside the park boundary.

## IMPACTS OF THE ALTERNATIVES ON THE WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) POPULATION

### ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)

#### Analysis

Under this alternative, park staff would continue monitoring the deer population and use some controls to protect important resources, none of which would reduce the size of the deer population in the park. The actions under this alternative would be very limited and would reflect what is occurring today. With no control on the deer population, the population would continue to vary depending on conditions; however, the general trend toward increased numbers would continue. In addition, the park would continue to conduct activities to protect sensitive plant species. As additional rare understory plant species are found within the park, they would be protected with additional caging, which would further limit potential food sources for park deer, but at a very small scale, a negligible adverse effect.

Under alternative A, the deer population in Rock Creek Park would continue to degrade the ground/shrub habitat that is important to deer. As detailed in the previous “Vegetation” section, the deer population would remain in excess of the recommended density for forest regeneration and may increase over time. This would adversely impact the abundance and diversity of native vegetation, including woody and herbaceous plants that provide forage and habitat for deer. High density deer populations that have reached or exceeded the ability of the natural environment to support them are at increased risk for disease and substantial losses due to malnutrition and parasitism, particularly during harsh winters. High deer density populations would also increase the potential for the spread of CWD, if the disease should occur near the park in the future.

Starvation and poor reproduction demonstrated by deer in overpopulated herds is not evidence that the herd is regulating itself. Starvation and disease are not acute mortality factors, such as predation, but

rather provide only chronic control over a population (Eve 1981, as cited in Warren 1991). Under these conditions, deer herds can remain at high levels for many years until starvation, disease, or severe winter weather cause a reduction in population size typically lasting two to five years. By this time, adverse ecological effects can already have occurred. Such reductions in the deer herd, as a result of natural die-offs, probably would not allow recovery of the natural community (Warren 1991).

It is expected that unchecked growth of the deer population under alternative A would continue to result in the degradation of habitat and loss of food sources. There would also be increased loss of deer through vehicle collisions, which would have adverse impacts on individual deer, but could keep deer numbers lower. The limitation on available forage and the high density would make individuals susceptible to starvation and to the spread of diseases such as EHD, which has been reported in locations near the park. Impacts could be severe, but the intensity of effects would depend on the level of stress incurred, and this would be related to how much forage the deer would find outside the park. Therefore, although impacts could be more severe, given the current condition of deer herd condition and the likelihood that deer would continue to seek food on neighboring properties, it is expected that alternative A would have long-term, moderate adverse impacts on the deer population.

### **Cumulative Impacts**

Impacts on deer from vehicle collisions and poaching, as well as disturbances from traffic, visitor use (including off-trail users and social trails), illegal camping, and the presence of unrestrained pets would all continue to have long-term, minor adverse impacts by displacing deer and potentially causing some mortality. Although wildlife diseases do not appear to be affecting deer at this time, the potential for these diseases, especially those like CWD and EHD that could affect deer populations, could also contribute to long-term adverse impacts on deer. The return of coyotes to the area could have limited beneficial effects on deer, as they are not expected to influence the population size to such an extent that it would reduce the effects of deer browse on habitat provided in the park. Deer management plans and programs of local, state, and other federal agencies also contribute to long-term, beneficial effects by helping maintain deer densities at lower levels; however, the effects of these programs are limited as evidenced by the continued growth of the deer population at Rock Creek Park. In fact, these programs may actually cause deer to move into the park where there is less pressure, thereby contributing to park deer population growth and associated effects of browsing on the degradation of deer habitat.

Actions resulting in cumulative impacts to deer habitat would be similar to those described for vegetation, since vegetation comprises the habitat that affects deer to a great extent. Urban development in the areas surrounding the park that result in encroachment into park lands and removal of vegetation that provides deer habitat in limited areas have caused, and will continue to cause, long-term minor localized adverse impacts. Acts of vandalism, dumping, illegal camping, and off-trail use have all had minor localized adverse impacts on deer habitat due to trampling and burying of vegetation, or spreading of noxious weed seeds, and will continue to do so in the future. Past fires have affected some areas, which have regrown but with more nonnative species. Past actions within the park, such as construction of facilities and roads, have resulted in removal of vegetation and adversely affected forest resources that support deer to a minor extent in limited areas. Gypsy moths have been a threat, but the park's efforts to control gypsy moths have minimized their impact to deer habitat. The park's exotic plant management efforts would also benefit deer habitat in the long term by removing plants that compete with native species. Continued park maintenance operations would have long-term minor adverse impacts on edge habitat for deer, limited to the areas affected. Any off-trail visitor uses affect deer habitat to some extent, but particular activities like horseback riding, dog walking, and hiking can lead to more social trails and spread of exotic weed seeds. Scientific research benefits park vegetation and deer habitats by supplying information needed for management decisions, but even the use of an area for research plots limits natural growth in those areas. All of these activities, when combined with the moderate adverse impacts to the deer population from the continued pressure on woody and herbaceous vegetation that makes up the deer habitat and the limited

natural regeneration expected under alternative A, because of continued deer browsing, would result in cumulative impacts that would be adverse, long term, and moderate.

### **Conclusion**

Under alternative A, there would be no control on the growth of the deer population, which would result in long-term, moderate adverse impacts on the deer population. These impacts would continue due to excessive deer browsing that would degrade habitat and limit food sources. Past, present, and future activities, when combined with the continued pressure on vegetative resources and deer habitat expected under this alternative, would result in adverse, long-term, moderate cumulative impacts. Although impacts to deer under alternative A could be severe, they would not approach the level of impairment over the long term.

### **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

#### **Analysis**

Under this alternative, several non-lethal actions would be implemented in combination to protect deer habitat and reduce deer numbers in the park. Actions include the use of large, fenced exclosures and reproductive control of does. Small caged areas and repellents would be implemented with negligible adverse impacts on deer food sources, as described under alternative A.

Use of large-scale exclosures and repellents would protect some deer habitat, but would exclude deer from potential food sources in approximately 5% to 10% of the park at any given time. Areas outside the exclosures would be affected by heavy deer browsing, which would have similar effects to those discussed under alternative A, including the degradation of habitat and loss of food sources. As a result, there would be long-term, moderate to major, adverse impacts on deer habitat and associated adverse impacts on the deer population.

If successfully implemented, surgical sterilization, supplemented by the use of reproductive controls when feasible (see chapter 2), would help reduce the impact on deer by gradually decreasing their numbers and allowing habitat to improve over time. Researchers disagree on the amount of time needed to reduce a population size using reproductive controls (Hobbs et al. 2000; Nielsen et al. 1997; Rudolph et al. 2000); however, the time required to see results could be several years. A number of factors may influence the efficacy and reduction period of this method, including the amount of immigration/emigration of deer to/from the park, availability of veterinarian and surgical facilities (at zoo or mobile field unit), mortality and recruitment rates, the size of the population at the time of initial treatment, and the percentage of the population treated. Other factors, such as untreated deer moving into the park and treated deer leaving the park, would also affect the time required to reduce herd numbers. The benefit of this action would be proportional to the amount of population reduction that it provided; therefore, a benefit could not actually be established until an improvement in vegetation and deer habitat was observed. Hobbs et al. (2000) described a model where if 90% of the breeding does in the park were effectively treated annually, mortality would need to exceed the number of surviving offspring from the 10% of untreated does in order to achieve a population reduction. An average mortality rate in urban/suburban deer populations is 10% (Hobbs et al. 2000). Based on these factors, it is expected that reproductive controls could stop population growth, but the park would not be able to reach its initial deer density goal within the life of this management plan using current technology. Therefore, impacts to deer habitat and deer would not be offset by this alternative and would continue to be adverse, long term, and moderate from degradation and the loss of food sources. Also, continued high deer densities could increase the potential for the spread of CWD, if it were detected near the park in the future.

Specific effects of surgical sterilization on breeding and social behavior (extended rut) that result from the associated loss of reproductive hormones are not well documented. But deer would be expected to react in a similar way to deer that have been treated with reproductive control agents (see the "Reproductive

Control” section of chapter 2 and appendix C). The intensity of long-term effects of implementing reproductive control on a free ranging deer herd is difficult to predict given the many variables. The effect on individual deer may be considered a major adverse impact, due to handling stress and the possible physiological or behavioral changes due to the use of sterilization and reproductive control agents. However, it is expected that the long-term adverse affect on the population would be minor to moderate, as the adverse impacts over time would be offset by the beneficial effect of population reduction.

### **Cumulative Impacts**

The same past, present, and future activity impacts described under alternative A would also occur under alternative B. Management actions identified in alternative B, where approximately 5% to 10% of the park’s vegetation would be protected from browsing, plus reproductive control would provide beneficial effects over the long term, but not immediately. Large exclosures would give small patches of deer habitat the opportunity to recover, and reproductive control could eventually help reduce the size of the deer herd, resulting in beneficial impacts that would combine with the beneficial effects of the return of coyotes, other deer management programs, control of gypsy moths and other plant diseases and pests, exotic plant management, and scientific research. However, adverse effects from continued development and other cumulative adverse actions described for alternative A, in conjunction with continued pressure on vegetation resources that make up deer habitat and potential effects of reproductive control, would not be offset by the beneficial effects of the proposed actions. Therefore, cumulative impacts to deer and deer habitat under this alternative would be adverse, long term, and moderate.

### **Conclusion**

Under alternative B, approximately 5% to 10% of the deer habitat in the park would benefit from construction exclosures over the life of this plan. Remaining habitat would continue to be adversely affected by deer browsing over the long term until reproductive controls became effective and the population decreased. However, because the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to deer habitat, and in turn deer, would be adverse, long term, and moderate as a result of habitat degradation and loss of food sources. There could also be long-term, major adverse impacts to individual deer from the physiological, biological, and behavioral effects associated with the use of reproductive control; however, long-term impacts to the population would be minor to moderate because the adverse effects would be offset over time by the benefits of population reduction. Past, present, and future activities, when combined with continued pressure on vegetative resources and deer habitat expected under this alternative, would result in long-term, moderate adverse cumulative impacts. Because alternative B would provide for reproductive control of the deer herd and a potential for gradual reduction in deer herd numbers over an extended period of time, it is not expected that impairment of the white-tailed deer herd in Rock Creek Park would occur under this alternative.

## **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

### **Analysis**

Sharpshooting would be used under this alternative, along with capture and euthanasia where appropriate, to reduce the deer herd size. The intent would be to rapidly reduce deer density within the park to allow for the herbaceous vegetation and tree seedlings to recover from browsing pressure. Small caged areas and repellents would be implemented with negligible adverse effects on the deer population, as described under alternative A.

Reducing deer density levels and maintaining these levels would allow vegetation to recover, providing better foraging habitat for deer in the park in the long term. Adverse impacts would still range from minor to moderate during the short term while habitat recovered. But, with increased vegetation and improved foraging habitat, this alternative would have beneficial, long-term effects, and the current adverse impacts

to deer and their habitat would be reduced to negligible or minor over the long term as the deer density goal is achieved.

This alternative would result in an impact to the deer population size, reducing the population from approximately 82 deer per square mile to approximately 15 to 20 deer per square mile. Research indicates that when habitat is stressed it cannot support healthy deer over the long term (Eve 1981, as cited in Warren 1991). When deer density is high, signs of nutritional stress, such as low body and internal organ mass, low fecal nitrogen levels, and high prevalence of parasitic infections, typically occur. When deer density is reduced to the nutritional carrying capacity, all of these indicators show improved condition (Sams et al. 1998). Also, a reduced deer density would help limit the spread of CWD, if this disease should be detected near the park in the future. As described in chapter 2, 15 to 20 deer per square mile is more closely aligned with levels that are in balance with other components of the ecosystem, namely a regenerating forest system. Therefore, reducing the population to this level would have a beneficial effect on the long-term viability of the deer population within the park by minimizing the potential for nutritional stress and disease, and improving habitat.

### **Cumulative Impacts**

The same past, present, and future activity impacts described under alternative A would also occur under alternative C. Relieving deer browsing pressure through rapid reduction in the deer population under alternative C would allow the majority of the park's habitat to regenerate, resulting in beneficial effects and reducing adverse impacts over the long term to negligible or minor levels. These effects, combined with other beneficial effects, would result in cumulative impacts that would be primarily beneficial. These beneficial effects would somewhat offset the adverse impacts from increased development and other cumulative adverse actions. Therefore, cumulative impacts to deer and deer habitat under this alternative would be mostly beneficial and long term.

### **Conclusion**

The relatively rapid reduction of the deer herd and the resultant regeneration of forage under alternative C would result in beneficial effects on deer herd health and would reduce adverse impacts to negligible or minor levels over the long term as the deer density goal was achieved. Adverse impacts would still range from minor to moderate while habitat recovered. Past, present, and future activities, when combined with the reduced browsing pressure expected under this alternative, would result in long-term, beneficial, cumulative impacts on deer herd health. There would be no impairment of the white-tailed deer population in the park under alternative C.

## **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

### **Analysis**

Under alternative D, the size of the deer herd would be directly reduced through sharpshooting and capture and euthanasia, and reproductive control or direct reduction (if needed) would be used to maintain the population at the desired level. Small caged areas and repellents would be implemented, as under alternative A.

As with alternative C, the intent of this alternative would be to rapidly reduce the deer density within the park to allow for the native vegetation to recover from deer browsing pressure. Adverse impacts would still range in the minor to moderate level during the short term while habitat recovered; however, as vegetation regenerated, better foraging habitat would be provided for the deer in the park.

Reproductive control (or direct reduction, if needed) would be used to maintain deer at a density that would further encourage forest regeneration and improvement of habitat for deer. As described for alternative B, a number of factors may influence the efficacy of this method, including the amount of

immigration/emigration of deer to/from the park, availability of veterinarian and surgical facilities (at zoo or mobile field unit), mortality and recruitment rates, the size of the population at the time of initial treatment, percentage of the population treated, as well as other factors, such as untreated deer moving into the park and treated deer leaving the park. Considering these factors, it is expected that reproductive controls could stop further population growth, allowing the park to maintain the deer density goal for the life of this management plan. With increased vegetation and improved foraging habitat, this alternative would have long-term beneficial effects on deer and deer habitat, and the current adverse impacts to deer and their habitat would be reduced to negligible or minor over the long term as the deer density goal was achieved.

As described for alternative B, surgical sterilization and the associated loss of reproductive hormones is expected to affect deer in a similar way to those that have been treated with reproductive control agents (see the “Reproductive Control” section of chapter 2 and appendix C). As a result, there could be long-term, major, adverse impacts to individual deer due to handling stress and the possible physiological or behavioral changes due to the use of sterilization and possibly reproductive controls. However, it is expected that the long-term, adverse affect on the population would be minor to moderate, as the impacts over time would be offset by the beneficial effect of population reduction.

This alternative would result in an impact to the deer population size, reducing the population from approximately 82 deer per square mile to approximately 15 to 20 deer per square mile. As described for alternative C, this would minimize the potential for the spread of CWD and for nutritional stress and result in a deer density more closely aligned with levels that are in balance with other components of the ecosystem, namely a regenerating forest system. Therefore, reducing the population to this level would have a beneficial effect on the long-term viability of the deer population within the park.

The impacts of each method (sharpshooting, euthanasia, or reproductive control) on deer and deer habitat would be essentially the same, as long as habitat was improved by reducing deer browsing pressure. Potential differences in impacts would relate to the time required for implementation and the resulting deer population size.

### **Cumulative Impacts**

The same past, present, and future activity impacts described under alternative A would also occur under alternative D. Rapidly reducing deer density levels and maintaining these levels under alternative D would relieve browsing pressure and provide better foraging habitat for deer in the park population. Achieving the deer density goal would result in long-term beneficial impacts and reduce adverse impact to negligible to minor levels.

Rapid deer density reduction would allow the forest to regenerate, resulting in beneficial impacts to deer habitat that would combine with other beneficial effects resulting in cumulative impacts that would be primarily beneficial. These beneficial impacts would offset the adverse effects from increased development and other cumulative adverse actions. Therefore, cumulative impacts to deer and their habitat under this alternative would be mostly beneficial and long term.

### **Conclusion**

Enhancing natural forest regeneration by quickly reducing deer browsing pressure under alternative D, and by maintaining a smaller deer population through the use of reproductive control (and direct reduction if needed), would result in beneficial, long-term impacts to deer and deer habitat by allowing vegetation to recover and improving foraging habitat. Over time as natural forest regeneration occurred, adverse, long-term, major impacts would be reduced to negligible to minor levels. Past, present, and future activities, when combined with the reduced pressure on woody and herbaceous vegetation (forest regeneration) expected under this alternative, would result in beneficial, long-term cumulative impacts. White-tailed deer would not be impaired under this alternative.

## IMPACTS OF THE ALTERNATIVES ON OTHER WILDLIFE

### ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)

#### Analysis

Under this alternative park staff would continue monitoring the deer population and conduct activities to protect native plants, such as creating small caged areas and applying limited amounts of repellents in landscaped areas. Maintaining small caged areas or applying repellents to protect individual or groups of plants from deer browsing could restrict other wildlife from using these plants. However, these actions would have little effect on other wildlife because of their small scale and their impact would not be measurable. Therefore, the impact of small caged areas and repellent use under this alternative would be adverse, short term, and negligible.

The vegetation/habitat conditions described in chapter 3, for both vegetation and other wildlife and wildlife habitat indicates that deer have already affected the vegetation, and thus habitat, for other wildlife species within the park. The herbaceous and woody seedling layers of the forest have been browsed by deer, and monitoring results indicate a substantial decline in seedlings in paired unfenced plots compared to fenced plots. McShea and Rappole (2000) found that avian species composition changes as the understory recovers from a period of extended deer browsing. Flowerdew and Ellwood (2001) suggested that deer have indirectly decreased bank vole (*Myodes glareolus*) populations by removing the bramble blackberry (*Rubus fruticosus*) that provides most of their hiding cover (S. Bates, pers. comm. 2008c).

Species that use deer as a food source, such as coyotes that now are known to occur in the park, could benefit from high deer density or open understory conditions. Other animals may also feed on deer carcasses, like crows (*Corvus* sp.), raccoons, and vultures. Small predators, such as foxes, hawks, skunks, and raccoons, would also benefit from a more open understory because prey would be easier to find. However, if the habitat of the prey species deteriorated to the point where prey (mice, rabbits, and ground-nesting birds) could no longer maintain viable populations within the park, then predator species would also decline).

Heavy deer browsing also degrades habitat and results in lack of cover for small mammals, as well as snakes, frogs, and small ground-nesting or feeding birds, making them increasingly vulnerable to predation from hawks, owls, foxes, skunks, raccoons, and coyotes. As previously described, breeding bird surveys are conducted in Rock Creek Park and have documented that many of the breeding birds found within Rock Creek Park nest on or near the ground. These include ground nesting birds, such as ovenbirds (*Seiurus aurocapilla*), black-and-white warblers (*Mniotilta varia*), worm-eating warblers (*Helmitheros vermivorus*); shrub nesting birds, such as northern cardinal (*Cardinalis cardinalis*), wood thrush (*Hylocichla mustelina*), American robin (*Turdus migratorius*), and American goldfinch (*Carduelis tristis*); as well as birds that nest both on the ground and in shrubs, such as song sparrows (*Melospiza melodia*), rufous-sided towhee (*Pipilo erythrophthalmus*), and common yellowthroat (*Geothlypis trichas*).

Species that depend primarily on other habitats are less affected by high deer numbers. Some frogs, snakes, salamanders, and turtles live close to water during much of their lives and are therefore less affected by deer. Similarly, heavy deer browsing would not directly change fish habitat. However, any amphibians that use vernal pools for breeding areas could be adversely impacted if deer overbrowsing impacted the pools through either siltation or reduction of vegetation that shades the pools. Other species (e.g., turtles and toads) are dependent on vegetation, fruits, and insects found within the understory of the forest, and their habitat is affected by high deer numbers. Therefore, animals such as turtles, rabbits, mice, and ground-nesting birds, which require ground vegetation to maintain viable populations within the park, would be adversely affected by high deer densities (greater than 20 deer per square mile) because

available food and cover would be greatly reduced by browsing. As browsing impacts increased, more and more wildlife species would be adversely affected by these changes.

Therefore, the impact of alternative A to other wildlife would be adverse, long term, and would range from negligible to major, depending on the species and its reliance on habitat that is adversely impacted by deer browse. Species that depend on ground cover, young tree seedlings, or understory shrubs for food, cover, or nesting habitat (such as ovenbirds, cardinals, goldfinches, and others described in the analysis above) could be severely reduced or possibly eliminated from the park over time, resulting in potentially major adverse effects. However, impacts on species that depend primarily on other habitats such as wetland-dwelling amphibians and reptiles, or middle or upper canopy dwellers such as owls and woodpeckers, would be negligible.

### **Cumulative Impacts**

Actions resulting in cumulative impacts to wildlife would be similar to those described for the deer population. These include vehicle collisions and poaching, disturbances from traffic, visitor use (including off-trail users and social trails), illegal camping, and the presence of unrestrained pets. These actions would all continue to have long-term, minor adverse impacts by displacing wildlife and potentially causing some mortality. Cell towers may result in bird collisions. The return of coyotes to the area has a beneficial effect on wildlife by helping to reestablish predator-prey relationships. Deer management plans and programs of local, state, and other federal agencies have limited contributions to long-term beneficial effects on wildlife and wildlife habitat by helping maintain a more balanced ecosystem. Past improvements to fish passages in the park also contribute beneficial effects on aquatic habitats and fish.

Actions resulting in cumulative impacts to wildlife habitat would also be similar to those described for deer. This includes urban development that has and would continue to cause long-term minor localized adverse impacts from the loss of habitat; acts of vandalism, and dumping, which have had and would continue to cause minor localized adverse impacts from trampling and burying of vegetation, or spreading of noxious weed seeds; past fires that have affected some areas, which have regrown but with more nonnative species; and past actions within the park, such as construction of facilities and roads that have resulted in removal of habitat. The park's exotic plant management efforts would also benefit wildlife habitat in the long term by removing plants that compete with native species. The future reconstruction of Rock Creek Parkway and continued park maintenance operations would have long-term minor adverse impacts on edge habitat for wildlife, limited to the areas affected. Any off-trail visitor uses affect wildlife habitat to some extent, but particular activities like horseback riding, dog walking, and hiking can lead to more social trails and spread of exotic weed seeds. Scientific research benefits park vegetation and wildlife habitats by supplying information needed for management decisions, but even the use of an area for research plots limits natural growth in those areas. All of these activities, when combined with the negligible to major impacts of continued pressure on woody and herbaceous vegetation that makes up the wildlife habitat and the limited natural regeneration expected under alternative A because of continued deer browsing, would result in cumulative impacts that would be adverse, long term, and minor to major depending on the species.

### **Conclusion**

Under alternative A, habitat for wildlife species other than white-tailed deer would continue to be adversely affected by a large deer population and related browsing, resulting in decreased plant diversity, increased invasive exotic plants, and reduced forest regeneration (as long as the deer population remained high or increased). A few predator species would benefit from a large deer population and an open understory, enabling them to better see and catch prey. However, the impacts of large numbers of deer browsing on vegetation would adversely affect a large percentage of habitats for other wildlife (e.g., ground-nesting birds, frogs, snakes, and turtles), resulting in adverse, long-term, and potentially

negligible to major impacts, depending on the species. Past, present, and future activities, when combined with the continued pressure on forest regeneration expected under this alternative, would result in both adverse and beneficial impacts, with adverse, long-term, major cumulative impacts.

As explained in the conclusion for “Vegetation” above, impairment is tied to the park’s purpose and significance, and the enabling legislation calls for the protection of animals within the park. Alternative A would not reverse the expected long-term continued growth in the deer population, and wildlife habitat would likely continue to be degraded. Although not all wildlife species would be affected to the same extent, impairment of those wildlife species that depend on the presence of ground cover and understory vegetation that are heavily browsed by deer could occur under this alternative over the long term.

## **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

### **Analysis**

Under this alternative, several non-lethal actions would be implemented in combination to protect wildlife habitat and reduce deer numbers in the park. Actions include the use of large, fenced enclosures and reproductive control of does. Small caged areas and repellents would be implemented, as under alternative A.

Large, fenced enclosures would be constructed to allow forest regeneration within localized areas of the park. Human presence associated with the installation of fenced enclosures could adversely affect wildlife while the actions were being carried out. However, such small areas of the park would be affected for a short period that the adverse impact would be short term and negligible.

As explained previously in this chapter under “Vegetation,” approximately 5% of the park would be protected from deer browsing in this manner at a given time, and about 5% to 10% of the woody vegetation would be protected over the life of the plan. The size of the openings in the fence (4 inches square) would allow small birds and mammals (e.g., songbirds, rabbits, and squirrels) to pass in and out of these enclosures. The added fence posts and fence would also provide perches for some birds, such as hawks. The fence could be an obstacle to other wildlife (e.g., birds or small mammals such as foxes running into the fence). This action would make more ground/shrub layer habitat available to other wildlife than alternative A over the long term. However, because only 5% of the park would be fenced off from browsing deer at any one time, and because deer density outside the protected areas would continue to remain high for many years (see following discussion), the beneficial impact to other wildlife would be limited.

Implementation of sterilization would have short-term, negligible adverse effects on other wildlife in the vicinity of the operations from the temporary noise and human presence, as well as the construction of bait stations and temporary holding pens, if needed. The use of reproductive controls could help reduce the impact on other wildlife by reducing effects of deer browsing on wildlife habitat. However, the time required to see these results could be several years; researchers disagree on the amount of time needed to reduce a population size using reproductive controls (Hobbs et al. 2000; Nielsen et al. 1997; Rudolph et al. 2000). The actual amount of time needed to observe a decrease would depend on a number of factors, such as the type of treatment used, its effectiveness in stopping reproduction, the size of the population at the time of initial treatment, the actual mortality rate, and the percentage of the population treated. Other factors, such as untreated deer moving into the park and treated deer leaving the park, would also affect the time required to reduce herd numbers. The benefit of this action would be proportional to the amount of population reduction that it achieved, and a corresponding improvement to understory habitat.

Hobbs et al. (2000) described a model where if 90% of the breeding does in the park were effectively treated annually, mortality would need to exceed the number of surviving offspring from the 10% of untreated does in order to achieve a population reduction. An average mortality rate in urban/suburban

deer populations is 10% (Hobbs et al. 2000). Based on these factors, it is expected that reproductive controls could stop population growth, but it would not be possible to achieve the density goals for the park during the life of this management plan.

Similar to alternative A, a continued high deer density and the associated browsing throughout the majority of the park would reduce the availability of food for species that depend on ground/shrub layer vegetation for survival. These species, including ground and/or shrub-nesting birds (e.g., ovenbirds, black-and-white warblers, northern cardinal, wood thrush, song sparrows, and rufous-sided towhee), turtles, toads, rabbits, and mice would decline over time, with potential adverse, long-term, major impacts. Other species that have a more diverse diet (e.g., raccoons) or that spend more time in other habitat (e.g., salamanders and snakes) or the upper canopy (e.g., barred owls [*Strix varia*] and woodpeckers) versus the ground/shrub layer, would be less affected by high or increased deer density. As with alternative A, species that use deer or their carcasses as a food source, such as coyotes, turtles, crows, and chickadees (*Parus* spp.), could benefit from the high deer densities. Small predators, such as foxes, hawks, skunks, and raccoons, would also benefit from a more open understory because prey would be easier to find. However, if the habitat of the prey species deteriorated to the point where prey (e.g., mice, rabbits, and ground-nesting birds) could no longer maintain viable populations within the park, then predator species would also decline. As a result, the overall impact to wildlife throughout the park would continue to be adverse, long term, and negligible to potentially major, depending on the species.

### **Cumulative Impacts**

The same cumulative actions described under alternative A would also occur under alternative B. Under alternative B, protecting approximately 5 to 10% of the park's vegetation from deer browsing through use of exclosures, and using reproductive control that could reduce deer density and related browsing impacts after more than 15 years of implementation, would gradually reduce impacts to wildlife habitat.

Combined with the effects of exotic plant control, research, and disease and pest control, this would provide some beneficial, long-term impacts. However, these beneficial effects would not be large enough to offset the adverse effects from increased development and other cumulative adverse actions, in conjunction with the continued deer browsing pressure on the majority of the woody and herbaceous vegetation that provides habitat for wildlife in the park. Therefore, overall cumulative impacts to wildlife habitat, and thus to other wildlife species, under this alternative would be adverse, long term, and moderate to major.

### **Conclusion**

Under alternative B, approximately 5% of the herbaceous vegetation and up to 10% of the woody vegetation in the park would benefit from the construction of large, fenced exclosures over the life of the plan. The remaining habitat, however, would continue to be subject to a high degree of deer browsing, adversely impacting both ground and shrub layer habitat for many other species of wildlife until reproductive controls took effect and reduced the deer population (more than 15 years). A few species would tend to benefit from a large deer population and an open understory, enabling them to better see and catch prey. Overall, impacts to other wildlife would be adverse, long term, and negligible to potentially major, depending on the species. Past, present, and future activities, when combined with the continued pressure on wildlife habitat expected under this alternative, would result in both adverse and beneficial impacts, with overall adverse, long term, moderate to major cumulative impacts on other wildlife. Since alternative B would provide continued protection of certain areas of the park over the long term and would introduce reproductive controls that could reduce deer numbers over an extended period of time, it is not expected that impairment of other wildlife species or habitat would occur under this alternative.

## **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

### **Analysis**

Under this alternative, sharpshooting would be used to reduce the deer herd size, along with capture and euthanasia where appropriate. The intent of this alternative would be to rapidly reduce deer density within the park to allow for the herbaceous vegetation and tree seedlings to recover from deer browsing pressure. Small caged areas and repellents would be implemented, as under alternative A.

Unlike alternative A, a reduced degree of deer browsing throughout the majority of the park would increase the availability of food and cover for species that depend on ground/shrub layer vegetation for survival. These species, including ground and/or shrub-nesting birds (e.g., ovenbirds, black-and-white warblers, northern cardinal, wood thrush, song sparrows, and rufous-sided towhee), turtles, toads, rabbits, and mice, would be able to maintain viable populations within the park. As the vegetation became more diverse and abundant with reduced browsing pressure, the number of wildlife species that would benefit from these changes would increase. This would be a beneficial, long-term impact on these species. Other species that have a more diverse diet (e.g., raccoons) or that spend more time in other habitat (e.g., frogs and salamanders) or the upper canopy (e.g., barred owls and woodpeckers) would be less affected by a reduced deer density, although a long-term benefit to upper canopy species would be gained in the future as forest regeneration maintained the upper canopy.

Predators that use deer as a food source, such as coyotes, could be somewhat adversely affected by a lower deer density or denser understory conditions. Other animals that feed on deer carcasses, such as crows and raccoons, could also be adversely affected. However, none of these species solely depend on deer as a food source, so the adverse impacts to these species would be long term and minor at most. Predators could find a denser understory more difficult for hunting small prey than the current open condition, but better habitat conditions and an increase in the abundance of prey species could also benefit these predators.

Wildlife, other than deer, would be temporarily disturbed by the presence of humans placing bait stations, shooting deer, setting traps, and observing deer behavior. Bait could provide a beneficial food source to other wildlife during the time reduction activities were conducted; however, the small quantity and short time periods that bait would be available would have a negligible impact on any species. There would be little surface disposal of deer waste and/or carcasses that would provide a beneficial food source to scavengers like the coyotes, crows, and raccoons since it is expected that the majority of carcasses would be disposed of through burial or offsite. The small number of carcasses left for natural decomposition would not be substantially different than what occurs through mortality from disease, old age, and car collisions. These human disturbances would be adverse, but temporary (less than 30 days per year), and negligible, as they would not cause any measurable change to the habitat or responses by other wildlife species.

Long-term reduction and controls on deer population growth would allow vegetation used as food and cover for other wildlife to become more abundant. Therefore, the impact of alternative C to other wildlife would be mostly beneficial and long term, depending on the species, and existing adverse impacts to other wildlife would be reduced to negligible or minor levels.

### **Cumulative Impacts**

The same past, present, and future actions described under alternative A would also occur under alternative C. Management actions identified in alternative C, where deer browsing pressure would be drastically reduced through a rapid reduction of the deer population would provide beneficial, long-term impacts to other wildlife. Some adverse impacts would result to habitat as a result of disturbances when qualified federal employees or authorized agents were setting traps, placing bait stations, occupying shooting locations, and removing deer carcasses. However, these impacts would be temporary and

isolated, causing little interference with other species activities, resulting in adverse, short-term, negligible impacts.

Rapid deer density reduction would allow the forest to regenerate, improving habitat for other wildlife and resulting in beneficial impacts that would combine with the beneficial effects of exotic plant control, research, and disease and pest control. These beneficial impacts would offset adverse effects from increased development and other cumulative adverse actions. Therefore, cumulative impacts to wildlife habitat, and thus other wildlife species, under this alternative would be mostly beneficial and long term.

## **Conclusion**

Under alternative C, impacts on other wildlife species and habitat would be beneficial and long term as a result of rapid reductions in deer numbers in the park, thereby reducing deer browsing pressure on woody and herbaceous vegetation and allowing increased abundance and diversity of other wildlife that depend on understory vegetation. Adverse, long-term impacts would be reduced to negligible or minor levels over time. A few predators and scavengers that use deer and their carcasses as a food source could be adversely affected by a lower deer density or denser understory conditions, but this alternative could also increase the availability of other prey. Adverse, long-term impacts would be reduced to negligible or minor levels over time. Human disturbances from trampling at bait stations, shooting sites, trapping locations, or deer carcass disposal sites would be temporary and isolated within the park. Therefore, adverse impacts of these actions on other wildlife species would be short term and negligible. Past, present, and future activities, when combined with the reduced browsing pressure on understory habitat expected under this alternative, would result in long-term, beneficial, cumulative impacts to other wildlife. There would be no impairment of other wildlife species or habitat under this alternative.

## **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

### **Analysis**

Under alternative D, the size of the deer herd would be directly reduced through sharpshooting and capture and euthanasia and reproductive control, or direct reduction (if needed) would be used to maintain the population at the desired level. Small caged areas and repellents would be implemented, as under alternative A.

Similar to alternative C, a reduced degree of deer browsing throughout the majority of the park would increase the availability of food for species that depend on ground/shrub layer vegetation for survival, such as ground and/or shrub-nesting birds (e.g., ovenbirds, black-and-white warblers, northern cardinal, wood thrush, song sparrows, and rufous-sided towhee), turtles, toads, rabbits, and mice. These species would be able to maintain viable populations within the park. As the vegetation became more diverse and abundant with reduced browsing pressure, the number of wildlife species that would benefit from these changes would increase. This would be a beneficial, long-term impact on these species. Other species that have a more diverse diet (e.g., raccoons) or that spend more time in other habitats (e.g., salamanders and frogs) or the upper canopy (e.g., barred owls and woodpeckers) would be less affected by a reduced deer density, although a long-term benefit to upper canopy species would be gained in the future as forest regeneration maintained the upper canopy.

Also similar to alternative C, a few species that use deer as a food source, such as coyotes, might be adversely affected by fewer deer or denser understory conditions. Other animals that feed on deer carcasses, such as box turtles, crows, and chickadees, would also be adversely affected. However, none of these species depends solely on deer as a food source, so the adverse impacts would be minor. Predators such as foxes, hawks, skunks, and raccoons would find a denser understory more difficult to hunt in than the current open condition. However, better habitat conditions and resulting increases in the abundance of prey species would also benefit these predators.

Wildlife other than deer would be temporarily disturbed by the presence of humans placing bait stations, shooting deer, setting traps, implementing reproductive control techniques, and observing deer behavior, similar to alternative C. Bait could provide a beneficial food source to other wildlife during the time that reduction activities were conducted; however, the small quantity and short time periods that bait would be available would have a negligible impact on any species. Limited surface disposal of deer waste and/or carcasses would provide a beneficial food source to scavengers like certain birds and turtles; however, under this alternative, it is expected that the majority of carcasses would be disposed of through burial or offsite. The small number of carcasses left for natural decomposition would not be substantially different than what occurs today through mortality from disease, old age, and car collisions. These human disturbances would be adverse, but temporary (less than 30 days per year), and negligible, as they would not cause any measurable change to the habitat or responses by other wildlife species.

Long-term reduction and controls on deer population growth would allow vegetation used as food and cover by other wildlife to become more abundant. Therefore, the impact of alternative D to other wildlife would be mostly beneficial and long term, depending on the species, and existing adverse impacts would be reduced to negligible or minor levels.

The impacts of each method (sharpshooting, euthanasia, or reproductive control) on other wildlife would be essentially the same, as long as habitat was improved by reducing deer browsing pressure. Potential differences in impacts would relate to the time required for implementation and the resulting deer population size.

### **Cumulative Impacts**

The same past, present, and future actions described under alternative A would also occur under alternative D. Rapidly reducing the deer population and alleviating browsing pressure on the majority of park habitat under alternative D would provide long-term beneficial impacts to other wildlife species.

Some adverse impacts would result to other wildlife as a result of disturbance by humans setting traps and bait stations, occupying shooting locations, and removing deer carcasses. However, these impacts would be temporary and isolated, causing little interference with other species' activities, resulting in adverse, short-term, negligible impacts.

Rapid deer density reduction would give the forest the opportunity to regenerate, improving habitat for other wildlife and resulting in beneficial impacts that would combine with the beneficial effects of exotic plant control, research, and disease and pest control, resulting in primarily beneficial cumulative impacts. These beneficial impacts would offset the adverse effects from increased development and other cumulative adverse actions. Therefore, cumulative impacts to wildlife under this alternative would be mostly beneficial and long term.

### **Conclusion**

Under alternative D, impacts on other wildlife would be long term and beneficial because of rapidly reduced deer numbers in the park, resulting in decreased browsing pressure and natural forest regeneration, allowing increased abundance and diversity of other wildlife that depend on understory vegetation. Adverse, long-term impacts would be reduced to negligible or minor levels over time. A few predators and scavengers that use deer and their carcasses as a food source could be adversely affected by a lower deer density or denser understory conditions, but this alternative could also increase the availability of other prey. Other wildlife would be temporarily affected by trampling at bait stations, shooting sites, trapping locations, reproductive control techniques, or deer carcass disposal sites. The adverse impacts of these isolated actions on other wildlife would be short term and negligible. Past, present, and future activities, when combined with the reduced pressure on understory habitat expected under this alternative, would result in beneficial, long-term cumulative impacts to other wildlife. There would be no impairment of other wildlife species or habitat under this alternative.

## **RARE, UNIQUE, THREATENED, OR ENDANGERED SPECIES**

### **GUIDING REGULATIONS AND POLICIES**

The *Endangered Species Act* (16 USC 1531 et seq.) and amendments (1973) mandate that all federal agencies consider the potential effects of their actions on species listed as threatened or endangered. If the NPS determines that an action may adversely affect a federally listed species, consultation with the U.S. Fish and Wildlife Service is required to ensure that the action will not jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat. In addition, the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act require protection and consideration of effects on migratory bird species and their nests and the named eagle species during any management action .

The NPS *Management Policies 2006* state that potential effects of agency actions will also be considered on state or locally listed species (NPS 2006). The NPS is required to control access to important habitat for such species and to perpetuate the natural distribution and abundance of these species and the ecosystems upon which they depend. NPS *Management Policies 2006* state that “[the NPS will] manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible” (NPS 2006, sec. 4.4.2.3).

Rock Creek Park's General Management Plan (2005a) includes the following desired conditions that pertain to rare, unique, or listed species:

- federal- and District of Columbia-listed threatened or endangered species and their habitats are protected and sustained
- native species populations that have been severely reduced or extirpated are restored where feasible and sustainable
- native plant and animal species function in as natural condition as possible, except where special management considerations are allowable under policy
- invasive species are reduced in numbers and area or eliminated from natural areas of the park

The endangered Hay's spring amphipod (*Stygobromus hayi*), discovered in five groundwater springs in Rock Creek Park in 1998, is the only known federally listed species that inhabits the park. The analysis also addresses 34 rare plants and 9 rare or uncommon animals (2 invertebrates and 7 birds) of Maryland that have been documented in Rock Creek Park, as well as 11 mammals, 23 reptiles, 16 amphibians, and 12 fish listed as species of greatest conservation need within the District of Columbia (see tables 14, 15, and 16).

### **ASSUMPTIONS, METHODOLOGY, AND INTENSITY THRESHOLDS**

To assess impacts on listed species, the following process was used:

- identification of which species are in areas likely to be affected by management actions described in the alternatives
- analysis of habitat loss or alteration caused by the alternatives
- analysis of disturbance potential of the actions and the species' potential to be affected by the actions

The information in this analysis was obtained through best professional judgment of park staff and experts in the field (as cited in the text) and by conducting a literature review. The following thresholds were used to determine impacts to sensitive and rare species.

## FEDERALLY LISTED SPECIES

The U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration Fisheries guidance for implementing section 7 consultation under the Endangered Species Act defines the terminology used to assess impacts to listed species as follows (USFWS and NMFS 1998):

- No effect:** the appropriate conclusion when the action agency determines its proposed action will not affect a listed species or designated critical habitat.
- May affect, is not likely to adversely affect:** the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect or evaluate insignificant effects; or (2) expect discountable effects to occur.
- May affect, likely to adversely affect:** the appropriate finding in a biological assessment (or conclusion during informal consultation) if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial (see definition of “is not likely to adversely affect”). In the event the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action “is likely to adversely affect” the listed species. If incidental take is anticipated to occur as a result of the proposed action, an “is likely to adversely affect” determination should be made. An “is likely to adversely affect” determination requires the initiation of formal section 7 consultation.

The following thresholds were used to determine the magnitude of effects on federally listed special status species and their associated habitat, including designated critical habitat that would result from implementation of any of the alternatives. The Endangered Species determinations pursuant to section 7 of the Act are included.

### ADVERSE

- Negligible:** There would be no observable or measurable impacts to federally listed species, their habitats, or the natural processes sustaining them in the proposed project area. This impact intensity would equate to a determination of “no effect” under section 7 of the *Endangered Species Act*.
- Minor:** Individuals may temporarily avoid areas. Impacts would not affect critical periods (e.g., breeding, nesting, denning, feeding, or resting) or habitat. This impact intensity would equate to a determination of “not likely to adversely affect” under section 7 of the *Endangered Species Act*.
- Moderate:** Individuals may be impacted by disturbances that interfere with critical periods (e.g., breeding, nesting, denning, feeding, or resting) or habitat; however, the level of impact would not result in a physical injury, mortality, or extirpation from the park. This impact intensity would equate to a determination of “likely to adversely affect” under section 7 of the *Endangered Species Act*.

**Major:** Individuals may suffer physical injury or mortality or populations may be extirpated from the park. This impact intensity would equate to a determination of “likely to adversely affect” under section 7 of the *Endangered Species Act*.

#### BENEFICIAL

**Negligible:** There would be no observable or measurable impacts to federally listed species, their habitats, including critical habitat designated under the *Endangered Species Act*, or the natural processes sustaining them in a park site. This impact intensity would equate to a determination of “no effect” under section 7 of the *Endangered Species Act*.

**Minor:** Impacts would result in slight increases to viability of the species in the park as species-limiting factors (e.g., habitat loss, competition, and mortality) are kept in check. Nonessential features of critical habitat in a park site would be slightly improved. This impact intensity would equate to a determination of “not likely to adversely affect” under section 7 of the *Endangered Species Act*.

**Moderate:** Impacts would result in improved viability of the species, population structure, and species population levels in the park, as species-limiting factors (e.g., habitat loss, competition, and mortality) are reduced. Some essential features of critical habitat would be improved. This impact intensity would equate to a determination of “not likely to adversely affect” under section 7 of the *Endangered Species Act*.

**Major:** Impacts would result in highly noticeable improvements to species viability, population structure, and species population levels in the park, as species-limiting factors (e.g., habitat loss, competition, and mortality) are nearly eliminated. All essential features of the critical habitat would be improved. This impact intensity would equate to a determination of “not likely to adversely affect” under section 7 of the *Endangered Species Act*.

#### STATE / DISTRICT OF COLUMBIA LISTED AND SPECIAL STATUS SPECIES

The assessment of impacts on both plant and animal species listed by either the state of Maryland or the District of Columbia (but not at the federal level under the *Endangered Species Act*) uses the same thresholds developed for the assessment of impacts on wildlife, as follows:

**Negligible:** There would be no observable or measurable impacts to native species, their habitats, or the natural processes sustaining them.

**Minor:** Impacts on native species, their habitats, or the natural processes sustaining them may not be detectable, and changes to population numbers, population structure, genetic variation, or other demographic factors would not occur. Occasional responses to disturbance by some individuals could be expected, but without interference to factors affecting population levels. Sufficient habitat would remain functional to maintain viability of all species. Impacts would be outside critical reproduction periods for sensitive native species.

**Moderate:** Impacts on native species, their habitats, or the natural processes sustaining them would be detectable, and changes to population numbers, population structure, genetic variation, or other demographic factors would occur, but species would remain stable and viable. Frequent responses to disturbance by some individuals could be expected, with some negative impacts to factors affecting population levels. Sufficient habitat would remain functional to maintain the viability of all native species. Some impacts might occur during critical periods of reproduction or in key habitat.

**Major:** Impacts on native species, their habitats, or the natural processes sustaining them would be detectable and extensive. Population numbers, population structure, genetic variation, or other demographic factors might experience large declines. Frequent responses to disturbance by some individuals would be expected, with negative impacts to factors resulting in a decrease in population levels. Loss of habitat might affect the viability of at least some species.

## AREA OF ANALYSIS

The area of analysis for assessing impacts on rare, unique, threatened, or endangered species is Rock Creek Park. The area of analysis for cumulative impacts includes the park.

## IMPACTS OF THE ALTERNATIVES

### ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)

#### Analysis

**Federally Listed Species.** The one federally listed species in the park, Hay's spring amphipod, is a groundwater species that spends the majority of its life below the surface feeding on detritus and other invertebrates, but that also occurs occasionally at the surface. Although the primary threats to this species are related to degradation of the subsurface groundwater (e.g., change in flows, pollution from fertilizers, pesticides, and petroleum leaks, and loss of detritus), disturbance of surface springs is also a concern. Monitoring of the deer population and use of some controls to protect important resources under alternative A would not affect groundwater or disturb springs and would not impact this species. However, the continued growth of the deer population and related effects of overabundance (i.e., trampling, browsing, nonnative species seed dispersal, etc.) could degrade surface springs by increasing erosion and sedimentation, compacting soils, and altering vegetation composition, in turn affecting the surface habitat in which the amphipod species is found infrequently. However, as described in the analysis for "Soils and Water Quality," the effects would be localized and are within historical or baseline water quality conditions. In addition, the relative abundance of rare amphipods in the park has been attributed to the long-term protection of groundwater quality afforded by the park. This protection is expected to continue despite the growth of the deer population, and therefore, the impacts are not expected to critically affect this species. As a result, there would be long-term, negligible to minor, adverse impacts on the Hay's spring amphipod.

#### State/District of Columbia Listed and Special Status Species

**Amphipods.** Four other species of amphipods, including the Kenk's amphipod (*Stygobromus kenki*), have been located in or near the park. As with the Hay's spring amphipod, the primary effects on these species under alternative A would be potential degradation of and water quality impacts to surface springs that

support these groundwater species from the effects of deer overabundance (e.g., trampling, browsing, nonnative species seed dispersal, etc.). If surface erosion can affect the groundwater beneath the spring, this could have long-term, negligible to minor, adverse impacts on these amphipods. Monitoring of the deer population and use of some controls to protect important resources under alternative A would not affect groundwater or disturb springs and would not impact this species.

**Invertebrates.** Two invertebrates, the Appalachian spring snail (*Fontigens bottimeri*) and gray petaltail dragonfly (*Tachopteryx thoreyi*), are considered rare or uncommon by the state of Maryland. These species are generally found in seeps, which, like the springs described above for amphipods, could be affected by potential degradation of and water quality impacts to surface springs as a result of deer overabundance (e.g., trampling, browsing, seed dispersal, etc.). This could have long-term, negligible to minor, adverse impacts on these invertebrates. Monitoring of the deer population and use of some controls to protect important resources under alternative A would not affect seeps and would not impact these species.

**Plants.** Based on reviews of available information on plant resistance or palatability to deer, 14 of the 34 listed plants have been identified as palatable or possibly palatable to deer (see table 14 in chapter 3): single-headed pussytoes (*Antennaria solitaria*), hairy rock cress (*Arabis hirsute*), Virginia snakeroot (*Aristolochia serpentaria*), cornel-leaf whitetop (*Doellingeria infirma* [*Aster infirmus*]), pubescent sedge (*Carex hirtifolia*), American chestnut (*Castanea dentata*), pointed-leaved tick-trefoil (*Desmodium glutinosum*), butternut (*Juglans cinerea*), two-leaved solomon's-seal (*Maianthemum canadense*), elliptic shinleaf (*Pyrola elliptica*), shingle oak (*Quercus imbricaria*), overcup oak (*Quercus lyrata*), table mountain pine (*Pinus pungens*), and little ladies tresses (*Spiranthes tuberosa*). Listed plants considered unpalatable or resistant to deer browsing include gold star (*Chrysogonum virginianum*), whorled coreopsis (*Coreopsis verticillata*), Kentucky coffee-tree (*Gymnocladus dioica*), common clubmoss (*Lycopodium clavatum*), basil balm (*Monarda clinopodia*), yellow passionflower (*Passiflora lutea*), Virginia ground cherry (*Physalis virginiana*), orange coneflower (*Rudbeckia fulgida*), decumbent pearlwort (*Sagina decumbens*), snowy skullcap (*Scutellaria serrata*), three-leaved cup plant (*Silphium trifoliatum*), hispid goldenrod (*Solidago hispida*), and golden alexanders (*Zizia aurea*). No information on deer palatability was found on the remaining seven plants (green dragon arum [*Arisaema dracontium*], Lancaster sedge [*Cyperus lancastriensis*], low kyllinga sedge [*Kyllinga pumila*], narrow melic grass [*Melica mutica*], Carolina leaf-flower [*Phyllanthus caroliniensis*], and long-beaked arrowhead [*Sagittaria longirostra*]) listed for the park, but it is likely that some of these are palatable to deer.

Under alternative A, the park would protect rare understory plant species that deer browse with caging if they are found in the park. Placing and maintaining caging around known locations of listed species protect these plants from deer browsing, resulting in localized beneficial, long-term impacts. However, impacts to state-listed species outside of these caged areas would be similar to what was described for vegetation. The primary impact to these species in the park would be the result of not taking action to control deer numbers and the potential for overbrowsing. Based on observations and research conducted within the park, deer browsing has already caused noticeable changes to the vegetation, including a substantial reduction in plant cover.

Browsing impacts to those sensitive species palatable or preferred by deer could result in a reduction of the species in the plant community, either because of mortality resulting directly from browsing or due to impacts to overall plant health, and its ability to produce seed stock or otherwise spread. Continuous browsing of preferred plants over time could result in the loss of individual species from the community. Similar impacts to sensitive species considered to be less palatable to deer would also be expected if food resources were limited due to deer population growth, seasonal or climate variations (e.g., drought), or reductions in plant abundance resulting from disease or insect impacts. As a result, providing no control on the growth of the deer population would have adverse, long-term, moderate to major impacts on the listed plant species not protected by caging.

**Wildlife.** The vegetation/habitat conditions described in chapter 3, for both vegetation and other wildlife and wildlife habitat indicates that deer have already affected the vegetation, and thus habitat, for other wildlife species within the park, including those listed or considered special status species by Maryland and the District of Columbia. The herbaceous and woody seedling layers of the forest have been browsed by deer, and monitoring results indicate a substantial decline in vegetation in paired unfenced plots compared to paired fenced plots, suggesting that the abundance and diversity of the animals using this understory habitat today is less than what it would be if deer browsing pressure was lower.

As described for “Other Wildlife and Wildlife Habitat,” the continued growth of the deer population and heavy deer browsing can degrade habitat and result in lack of food or cover for species that require ground vegetation to maintain viable populations within the park. This includes several species listed or considered special status species by Maryland and the District of Columbia (see tables 15 and 16 in chapter 3), including ground-nesting or feeding birds (e.g., mourning warbler [*Oporornis philadelphia*], Nashville warbler [*Vermivora ruficapilla*], bobolink [*Dolichonyx oryzivorus*], Acadian flycatcher [*Empidonax virescens*], American woodcock [*Scolopax minor*], brown thrasher [*Toxostoma rufum*] and eastern towhee [*Pipilo erythrophthalmus*]), as well as some small mammals (e.g., the southern bog lemming [*Synaptomys cooperi*], Alleghany woodrat [*Neotoma magister*], eastern chipmunk [*Tamias striatus*], and eastern cottontail [*Sylvilagus floridanus*]), and possibly some reptiles (e.g., corn snake [*Elaphe guttata guttata*], eastern garter snake [*Thamnophis sirtalis*], eastern hognose snake [*Heterodon platirhinos*], eastern worm snake [*Carphophis amoenus amoenus*], northern copperhead [*Agkistrodon contortrix*], northern ringneck snake [*Didophis punctatus edwardsii*], the eastern fence lizard, and the eastern box turtle [*Terrapene carolina*]), and amphibians (e.g., American toad [*Bufo americanus*], Fowler’s toad [*Bufo fowleri*]).

Predatory wildlife listed or considered special status species by Maryland and the District of Columbia (see table 16 in chapter 3), such as the broad-winged hawk (*Buteo playtpterus*), great-horned owl (*Bubo virginianus*), gray fox (*Urocyon cinereoargenteus*), and several snakes (e.g., corn snake, eastern hognose snake, northern copperhead, northern ringneck snake, northern scarlet snake [*Cemophora coccinea copei*], timber rattlesnake [*Crotalus horridus*]) could benefit from a more open understory because prey would be easier to find. However, if the habitat of the prey species deteriorated to the point where prey (mice, rabbits, and ground-nesting birds) could no longer maintain viable populations within the park, then predator species would also decline. Animals that may feed on deer carcasses, like Virginia opossum (*Didelphis virginiana*), could benefit slightly by higher deer densities.

Species that depend primarily on other habitats would be less affected by high or increased deer density. This would include species that occur primarily near wetlands and/or water (e.g., yellow-crowned night-heron [*Nyctanassa violacea*], American bittern [*Botaurus lentiginosus*], American black duck [*Ana rubripes*], black-crowned night-heron [*Nycticorax nycticorax*], and Wilson’s snipe [*Gallinago delicata*]; northern river otter [*Lutra canadensis*] and American mink [*Mustela vison*]; queen snake [*Regina septemvittata*], common musk turtle [*Sternotherus odoratus*], bog turtle [*Clemmys muhlenbergii*], eastern mud turtle [*Kinosternon subrubrum*], spotted turtle [*Chrysemys guttata*], and eastern redbelly turtle [*Pseudemys rubriventris*]; bullfrog [*Rana catesbeiana*], eastern mud salamander [*Pseudotriton m. montanus*], northern cricket frog [*Acris crepitans*], northern dusky salamander [*Desmognathus fuscus*], northern spring peeper [*Pseudacris crucifer*], northern two-lined salamander [*Eurycea bislineata*], pickerel frog [*Rana palustris*], northern red salamander [*Pseudotriton ruber ruber*], spotted salamander [*Ambystoma maculatum*], and upland chorus frog [*Pseudacris feriarum feriarum*]; and fish); in grasslands (e.g., eastern meadowlark [*Sturnella magna*], field sparrow [*Spizella pusilla*], grasshopper sparrow [*Ammodramus savannarum*]); those that use the canopy and sub-canopy layers (e.g., olive-sided flycatcher [*Contopus cooperi*], blackburnian warbler, cerulean warbler [*Dendroica cerulean*], Bicknell’s thrush [*Catharus bicknelli*], bald eagle [*Haliaeetus leucocephalus*], chimney swift [*Chaetura pelagica*], and great horned owl); or those that generally den or roost in tree cavities or behind bark (e.g., southern flying squirrel [*Glaucomys volans*], eastern small-footed myotis [*Myotis lebilii*], or eastern red bat

[*Lasiurus borealis*]). However, some of these species (e.g., birds, snakes, turtles, toads, salamanders, and some frogs) are dependent on vegetation, fruits, and/or insects found within the understory of the forest that would be affected by high deer numbers.

Those species noted above that require ground vegetation to maintain viable populations within the park, would be adversely affected by high deer densities (greater than 20 deer per square mile) because available food and cover would be greatly reduced by browsing. In addition, as browsing impacts increased, more and more species listed or considered special status species by Maryland and the District of Columbia would be adversely affected by these changes.

Therefore, the impact of alternative A to species listed or considered special status species by Maryland and the District of Columbia would be adverse, long-term, and negligible to major, depending on the species. Those that depend on ground cover, young tree seedlings, and the habitat they provide for food or cover for these species could be severely reduced or possibly eliminated from the park, while impacts on species that depend primarily on other habitats (not woodlands) or on the canopy for food and cover would be negligible.

### **Cumulative Impacts**

Actions resulting in cumulative impacts to rare, unique, threatened, or endangered wildlife species would be similar to those described for deer, wildlife, and vegetation. These include vehicle collisions and disturbances from traffic, visitor use (including off-trail users and social trails), illegal camping, and the presence of unrestrained pets. These actions would all continue to have long-term, minor adverse impacts by displacing rare, unique, threatened, or endangered species and potentially causing some mortality. Disease (e.g., rabies and West Nile virus) may also affect some species, and cell towers may result in bird collisions, which is being studied. The return of coyotes to the area has a beneficial effect on rare, unique, threatened, or endangered wildlife by helping to reestablish predator-prey relationships. Deer management plans and programs of local, state, and other federal agencies have limited contributions to long-term beneficial effects on rare, unique, threatened, or endangered species and their habitat by helping maintain a more balanced ecosystem. Past improvements to fish passages in the park also contribute beneficial effects on aquatic habitats and fish considered species of greatest conservation need within the District of Columbia.

Actions resulting in cumulative impacts to the state-listed plants, as well as habitat for rare, unique, threatened, or endangered wildlife, would be similar to those described for vegetation. Urban development has and would continue to cause long-term minor localized adverse impacts from the loss of state-listed plants and habitat for rare, unique, threatened, or endangered species. Other effects would include those from acts of vandalism, dumping, illegal camping, and off-trail use that have had and would continue to cause minor localized adverse impacts from trampling and burying of vegetation, or spreading of noxious weed seeds; past fires that have affected some areas, which have regrown but with more nonnative species; and past actions within the park, such as construction of facilities and roads, that have resulted in removal of habitat. Plant diseases and pests (e.g., gypsy moths) have had a large, relatively widespread adverse impact in the past, but have been somewhat reversed by the park's efforts to control such diseases and pests that continue to benefit forest resources. The park's exotic plant management efforts would also benefit state-listed plants, as well as habitat for rare, unique, threatened, or endangered wildlife, in the long term by removing plants that compete with native species. Continued park maintenance operations would have long-term minor adverse impacts on edge habitat for these species, limited to the areas affected. Nearly all visitor uses affect habitat for rare, unique, threatened, or endangered wildlife, and possibly some state-listed plants, to some extent, but particular activities like horseback riding, dog walking, and hiking lead to more social trails and spread of exotic weed seeds. Scientific research benefits park vegetation and habitat for rare, unique, threatened, or endangered species by supplying information needed for management decisions, but even the use of an area for research plots limits natural growth in those areas. All of these activities, when combined with the negligible to major

impacts of continued pressure on woody and herbaceous vegetation that makes up habitat for rare, unique, threatened, or endangered species, and the limited natural regeneration expected under alternative A because of continued deer browsing, would result in cumulative impacts that would be adverse, long term, and minor to major depending on the species.

### **Conclusion**

Impacts to rare, unique, threatened, or endangered species under alternative A would be both beneficial and adverse. Adverse impacts to the federally listed Hay's spring amphipod could be long term and negligible to minor. Beneficial impacts to state-listed plants would result from establishing caging around known individual plants and from establishing caging around newly discovered plants in the park.

Overall, there would be adverse, long-term, negligible to major impacts to rare, unique, threatened, or endangered species, from excessive deer browsing and the associated habitat degradation that could result in lack of food or cover for such species. Past, present, and future activities, when combined with the continued pressure on rare, unique, threatened, or endangered species expected under this alternative, would result in both adverse and beneficial impacts, with overall long-term, minor to major, adverse cumulative impacts.

Impairment under alternative A would be possible for some of the state-listed plants, because alternative A would not reverse the expected long-term continued growth in the deer population and damage to vegetation would likely continue, as described under "Vegetation" above. The park's enabling legislation calls for protection of park "timber, animals, and curiosities" in their natural conditions, and the GMP also calls for preservation of ecological resources, which would include special status species. Therefore, it is expected that impairment of certain state-listed plants that are palatable to deer, as well as habitat for rare, unique, threatened, or endangered species, could occur over the long term.

### **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

#### **Analysis**

Under this alternative, several non-lethal actions would be implemented in combination to protect wildlife habitat and reduce deer numbers in the park. Actions include the use of large, fenced exclosures and reproductive control of does. Small caged areas and repellents would be implemented, as under alternative A.

**Federally Listed Species.** The Hay's spring amphipod, a groundwater spring species that spends the majority of its life below the surface feeding on detritus, but also occurs occasionally at the surface, is the only federally-listed species found in the park. The construction of large-scale exclosures and administration of reproductive control agents, including the associated human presence, would not contribute to the primary threats to this species, which are related to degradation of the subsurface groundwater (e.g., change in flows, pollution from fertilizers, pesticides, and petroleum leaks, and loss of detritus). However, disturbance of surface springs is also a concern. Any springs known or with the potential to support the Hay's spring amphipod would be avoided during construction of the exclosures and administration of reproductive control agents, and as a result, the potential for trampling of the surface springs would be limited.

As explained previously in this chapter under "Vegetation," approximately 5% of the park would be protected from deer browsing in this manner at a given time, and about 5% to 10% of the woody vegetation would be protected over the life of the plan. If any of the springs that support Hay's spring amphipod are within an exclosure, there could be long-term beneficial effects by reducing the impacts of deer overbrowsing (i.e., trampling, browsing, seed dispersal, etc.) on the surface springs that connect to the groundwater habitat. However, because only 5% of the park would be fenced off from browsing deer at any one time, and because deer density outside the protected areas would continue to remain high for many years (see following discussion), the beneficial impact would be limited.

Under this alternative, the use of reproductive controls would eventually help reduce the deer population in the park, but the time required to see these results could be substantial (Hobbs et al. 2000; Nielsen et al. 1997; Rudolph et al. 2000) (see discussion in analysis for “Wildlife”). The benefit of this action would be proportional to the amount of population reduction that it achieved, and the corresponding reduction in impacts from overbrowsing.

Hobbs et al. (2000) described a model where if 90% of the breeding does in the park were effectively treated annually, mortality would need to exceed the number of surviving offspring from the 10% of untreated does in order to achieve a population reduction. An average mortality rate in urban/suburban deer populations is 10% (Hobbs et al. 2000). Based on these factors, it is expected that reproductive controls could stop population growth, but it would not be possible to achieve the density goals for the park during the life of this management plan.

Similar to alternative A, the continued growth of the deer population and related effects of overabundance outside the large-scale exclosures could degrade the surface spring by increasing erosion and sedimentation, compacting soils, and altering vegetation composition, in turn affecting the habitat for the amphipod species. However, as described in the analysis for “Soils and Water Quality,” the effects would be localized and are expected to be within historical or baseline water quality conditions. In addition, the relative abundance of rare amphipods in the park has been attributed to the long-term protection of groundwater quality afforded by the park. This protection is expected to continue despite the growth of the deer population, and therefore, the impacts are not expected to critically affect this species. As a result, there would be long-term, negligible to minor, adverse impacts on the Hay’s spring amphipod under alternative B.

#### **State/District of Columbia Listed and Special Status Species**

**Amphipods.** Four other species of amphipods, including the Kenk’s amphipod, have been located in or near the park. As described for Hay’s spring amphipod, the construction of large-scale exclosures and administration of reproductive control agents would not contribute to the primary threats to these species, degradation of the subsurface groundwater. Any springs known or with the potential to support these amphipods would be avoided during construction of the exclosures and administration of reproductive control agents, and as a result, the potential for trampling of the surface springs would be minimal. As explained for the Hay’s spring amphipod, if any of the springs that support these species are within an exclosure, there could be long-term beneficial effects by reducing the impacts of deer overbrowsing (i.e., trampling, browsing, seed dispersal, etc.) on the surface springs that connect to the groundwater habitat.

However, because only 5% of the park would be fenced off from browsing deer at any one time, and because deer density outside protected areas would continue to remain high for many years (see discussion for Hay’s spring amphipod), the beneficial impact would be limited. The potential for effects from deer overabundance, including increased erosion and sedimentation, soil compaction, and changes in vegetation composition would continue, and could in turn affect the habitat for the amphipod species outside of the exclosures. As described for alternative A, if surface erosion can affect the groundwater beneath the spring, this could have long-term, negligible to minor, adverse impacts on these species.

**Invertebrates.** Two invertebrates, the Appalachian spring snail and gray petaltail dragonfly, are considered rare or uncommon by the state of Maryland. These species are generally found in seeps and could be disturbed by human presence during construction of the large exclosures or administration of reproductive control agents under alternative B. However, small areas of the park would be affected for a short period and the adverse impact would be short term and negligible.

As explained for the amphipods, if any of the seeps that support these invertebrates are within an exclosure, there could be long-term beneficial effects by reducing the impacts of deer overbrowsing (i.e., trampling, browsing, seed dispersal, etc.) on the surface springs that connect to the groundwater habitat. However, because only 5% of the park would be fenced off from browsing deer at any one time, and

because deer density outside protected areas would continue to remain high for many years (see discussion for Hay's spring amphipod), the beneficial impact would be limited.

The potential for effects from deer overabundance, including increased erosion and sedimentation, soil compaction, and changes in vegetation composition, would continue and could in turn affect the habitat for the Appalachian spring snail and gray petaltail dragonfly outside of the exclosures. As described for alternative A, this could have long-term, negligible to minor, adverse impacts on these species.

**Plants.** Construction of the large scale exclosures and administration of reproductive control agents would result in ground disturbances, including trampling by workers, which could affect state-listed plant species and their habitat. Exclosure areas would be surveyed for state-listed plants prior to construction and any plants identified would be avoided. Personnel involved in these activities would also be educated about these plants and the potential impacts. In addition, small areas of the park would be affected for only a short period, and as a result, the adverse impact would be short term and negligible.

If any of the state-listed plants are within an exclosure, there could be long-term beneficial effects by removing the impacts of deer overbrowsing (i.e., trampling, browsing, seed dispersal, etc.) in these areas. However, because only 5% of the park would be fenced off from browsing deer at any one time, and because deer density outside protected areas would continue to remain high for many years (see discussion for Hay's spring amphipod), the beneficial impact would be limited.

As described for alternative A, 14 of the 34 state-listed plants have been identified as palatable or possibly palatable to deer, 13 are considered unpalatable or resistant to deer browsing, and no information on deer palatability was found on the remaining seven plants listed for the park, but it is likely that some of these are palatable to deer (see table 14 in chapter 3). Based on observations and research conducted within the park, deer browsing has already caused noticeable changes to the vegetation, including a substantial reduction in density. Browsing impacts to those sensitive species palatable to or preferred by deer could result in a reduction of the species in the plant community, either because of mortality resulting directly from browsing or due to impacts to overall plant health, and its ability to produce seed stock or otherwise spread. Continuous browsing of preferred plants over time could result in the loss of individual species from the community. Similar impacts to sensitive species considered to be less palatable to deer would also be expected if food resources were limited due to deer population growth, seasonal or climate variations (e.g., drought), or reductions in plant abundance resulting from disease or insect impacts. As a result, alternative B would continue to have adverse, long-term, moderate to major impacts on the listed plant species not protected by fencing.

**Wildlife.** Large, fenced exclosures would be constructed to allow forest regeneration within localized areas of the park. Human presence associated with the installation of fenced exclosures could adversely affect wildlife listed or considered special status species by Maryland and the District of Columbia by causing displacement while the actions were being carried out. However, small areas of the park would be affected for such a short period that the adverse impact would be short term, negligible, and localized. In addition, surveys for wildlife listed or considered special status species by Maryland and the District of Columbia would be conducted prior to constructing the exclosures and locations and timing would be shifted as practicable to minimize impacts on wildlife listed or considered special status species by Maryland and the District of Columbia.

As explained previously, approximately 5% of the park would be protected from deer browsing in this manner at a given time, and about 5% to 10% of the woody vegetation would be protected over the life of the plan. The size of the openings in the exclosure fence (4 inches square) would allow small birds and mammals listed or considered special status species by Maryland and the District of Columbia to pass in and out of these exclosures. The added fence posts and fence would also provide perches for some birds, such as hawks, but the fence could be an obstacle to others. This action would make more ground/shrub layer habitat available to wildlife listed or considered special status species by Maryland and the District of Columbia than alternative A. However, because only 5% of the park would be fenced off from

browsing deer at any one time, and because deer density outside the protected areas would continue to remain high for many years (see discussion for Hay's spring amphipod), the beneficial impact would be limited.

Implementation of sterilization would have short-term, negligible adverse effects on wildlife listed or considered special status species by Maryland and the District of Columbia in the vicinity of the operations from temporary noise and human presence, as well as the construction of bait stations and temporary holding pens. Bait could provide a beneficial food source to some species during the time reduction activities were conducted; however, the small quantity and short time periods that bait would be available would have a negligible impact on any species. The use of reproductive controls could help reduce impacts to these species; however, the benefit of this action would be proportional to the amount of population reduction that it achieved and a corresponding improvement to understory habitat. As described previously, it is expected that reproductive controls could slow population growth, but it would not be possible to achieve the density goals for the park during the life of this management plan.

Similar to alternative A, a continued high deer density and the associated browsing throughout the majority of the park would reduce the availability of food for wildlife listed or considered special status species by Maryland and the District of Columbia that depend on ground/shrub layer vegetation for survival. This includes (see table 15 in chapter 3) ground and/or shrub-nesting birds (e.g., mourning warbler, Nashville warbler, bobolink, Acadian flycatcher, American woodcock, brown thrasher, and eastern towhee), as well as some small mammals (e.g., southern bog lemming, Alleghany woodrat, eastern chipmunk, and eastern cottontail), reptiles (e.g., corn snake, eastern garter snake, eastern hognose snake, eastern worm snake, northern copperhead, northern ringneck snake, northern fence lizard, and eastern box turtle), and amphibians (e.g., American toad, Fowler's toad, marbled salamander [*Ambystoma opacum*], redback salamander [*Plethodon cinereus*], and redspotted newt [*Notophthalmus viridescens*]).

Predatory wildlife listed or considered special status species by Maryland and the District of Columbia (see table 16 in chapter 3), such as the broad-winged hawk, great-horned owl, gray fox, and several snakes (e.g., corn snake, eastern hognose snake, northern copperhead, northern ringneck snake, northern scarlet snake, timber rattlesnake) could benefit from a more open understory because prey would be easier to find. However, if the habitat of the prey species deteriorated to the point where prey (mice, rabbits, and ground-nesting birds) could no longer maintain viable populations within the park, then predator species would also decline. Animals that may feed on deer carcasses, like Virginia opossum, could benefit slightly by higher deer densities.

Species that depend primarily on other habitats would be less affected by high or increased deer density. This would include species that occur primarily near wetlands and/or water (e.g., yellow-crowned night-heron, American bittern, American black duck, black-crowned night-heron, and Wilson's snipe; northern river otters and American minks; queen snake, common musk turtle, bog turtle, eastern mud turtle, spotted turtle, and eastern redbelly turtle; bullfrog, eastern mud salamander, northern cricket frog, northern dusky salamander, northern spring peeper, northern two-lined salamander, pickerel frog, northern red salamander, spotted salamander, and upland chorus frog, and fish); in grasslands (e.g., eastern meadowlark, field sparrow, and grasshopper sparrow); those that use the canopy and sub-canopy layers (e.g., olive-sided flycatcher, blackburnian flycatchers, cerulean warbler, Bicknell's thrush, bald eagle, chimney swift, and great-horned owl); or those that generally den or roost in tree cavities or behind bark (e.g., southern flying squirrel, eastern small-footed myotis, or eastern red bat). However, some of these species (e.g., birds, snakes, turtles, toads, salamanders, and some frogs) are dependent on vegetation, fruits, and/or insects found within the understory of the forest that would be affected by high deer numbers.

Those species noted above that require ground vegetation to maintain viable populations within the park would be adversely affected by high deer densities (greater than 20 deer per square mile) because available food and cover would be greatly reduced by browsing. In addition, as browsing impacts

increased, more and more species listed or considered special status species by Maryland and the District of Columbia would be adversely affected by these changes.

Therefore, the impact of alternative B to wildlife species listed or considered special status species by Maryland and the District of Columbia would continue to be adverse, long term, and negligible to major, depending on the species. Those that depend on ground cover, young tree seedlings, and the habitat they provide for food or cover for these species could be severely reduced, while impacts on species that depend primarily on other habitats (not woodlands) or on the canopy for food and cover would be negligible.

### **Cumulative Impacts**

The same past, present, and reasonably foreseeable actions described under alternative A would also occur under alternative B. All of these actions, when combined with an extended use of large-scale exclosures and a long-term reduction in deer browsing pressure resulting from the use of reproductive controls, would result in both beneficial and adverse cumulative impacts to species listed or considered special status species by Maryland and the District of Columbia. Adverse cumulative impacts would be long term and minor to moderate.

### **Conclusion**

Adverse impacts to the federally listed Hay's spring amphipod could be long term and negligible to minor. Impacts to species listed or considered special status species by Maryland and the District of Columbia under alternative B would be adverse, long term, and moderate to major, until reproductive controls on the park deer herd were effective. The placement and maintenance of large exclosures would protect herbaceous vegetation in about 5% of the park at any one time, and woody vegetation in up to 10% of the park over the life of the plan. The areas selected for exclosures would include many species listed or considered special status species by Maryland and the District of Columbia, resulting in beneficial, long-term impacts. However, adverse, long-term, negligible to moderate impacts due to deer browsing would continue outside the exclosures. Past, present, and future activities, when combined with the continued pressure on species listed or considered special status species by Maryland and the District of Columbia expected under this alternative, would result in both beneficial and adverse impacts. Although alternative B would not be expected to reverse the expected long-term continued growth in the deer population, reproductive controls (if successful) would stop the growth in population. Damage to rare plants would be reduced over the long term and would be mitigated to some extent by the use of exclosures and caging. Therefore, it is not expected that impairment of state-listed plants, or habitat for rare, unique, threatened, or endangered species, would occur over the long term.

## **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

### **Analysis**

Under this alternative, sharpshooting would be used to reduce the deer herd size, along with capture and euthanasia where appropriate. The intent of this alternative would be to rapidly reduce deer density within the park to allow for the herbaceous vegetation and tree seedlings to recover from deer browsing pressure. Small caged areas and repellents would be implemented, as under alternative A.

**Federally Listed Species.** The implementation of sharpshooting and capture and euthanasia (where appropriate) would not contribute to primary threats to the Hay's spring amphipod, which are related to degradation of the subsurface groundwater (e.g., change in flows, pollution from fertilizers, pesticides, and petroleum leaks, and loss of detritus). Bait stations could be used and would be located such that the ground would serve as a backstop for bullets that do not remain in the target animal, and shooting locations would be cleaned up to remove shells or bullets that miss their target. Although disturbance of surface springs is also a concern, any springs known or with the potential to support the Hay's spring

amphipod would be avoided during implementation of sharpshooting or capture and euthanasia, and the potential for trampling of the surface springs would be limited. Any human disturbances related to implementation of alternative C would be adverse, but temporary (less than 30 days per year), and negligible, as they would not cause any measurable change to the habitat or responses by the Hay's spring amphipod.

Under alternative C, a reduced deer density throughout the majority of the park would minimize the potential for surface springs to be degraded by decreasing erosion, sedimentation, and soil compaction, as well as helping to restore native plant communities. This would, in turn, minimize potential impacts on the habitat for the Hay's spring amphipod which would result in long-term, beneficial effects that would reduce adverse impacts to negligible.

### **State/District of Columbia Listed and Special Status Species**

**Amphipods.** As described for the Hay's spring amphipod, the implementation of sharpshooting and capture and euthanasia (where appropriate) would not contribute to primary threats to state-listed amphipods. Although bullets containing lead may be used, bait stations and trained sharpshooters could be used and would minimize the potential for groundwater impacts from lead contamination. Although disturbance of the surface spring is also a concern, any springs known or with the potential to support state-listed amphipods would be avoided during implementation of sharpshooting or capture and euthanasia as practicable. As a result, the potential for trampling of the surface springs would be limited. These human disturbances would be adverse, but temporary (less than 30 days per year), and negligible, as they would not cause any measurable change to the habitat for or responses by these amphipods.

Under alternative C, a reduced deer density throughout the majority of the park would minimize the potential for surface springs to be degraded by decreasing erosion, sedimentation, and soil compaction, as well as helping to restore native plant communities. This would, in turn, minimize potential impacts on the habitat for the state-listed amphipods which would result in long-term, beneficial effects that reduce existing impacts to negligible.

**Invertebrates.** The two invertebrates considered rare or uncommon by the state of Maryland, the Appalachian spring snail and gray petaltail dragonfly, could be disturbed by trampling during implementation of sharpshooting and capture and euthanasia (where appropriate) under alternative C. However, small areas of the park would be affected for a short period and the adverse impact would be short term and negligible.

As explained for the amphipods, a reduced deer density throughout the majority of the park would minimize the potential for seeps that support the Appalachian spring snail and gray petaltail dragonfly to be degraded by decreasing erosion, sedimentation, and soil compaction, as well as helping to restore native plant communities. This would, in turn, minimize potential impacts on the habitat for the state-listed invertebrates, which would result in long-term, beneficial effects over time.

**Plants.** The implementation of sharpshooting and capture and euthanasia (where appropriate) would result in ground disturbances, including trampling by workers, that could affect state-listed plant species and their habitat. However, small areas of the park would be affected for only a short period and by relatively few individuals. As a result, the adverse impact would be short term and negligible.

A reduced deer density throughout the majority of the park would promote the growth of sensitive species if suitable habitat characteristics and seed stock were present. A smaller deer herd density would reduce browsing pressure on native plant communities over time, resulting in a reestablishment and an increase in the extent of natural communities in the park. Increased areas of native vegetation would be expected to promote the reestablishment of special concern species. Reducing deer herd density would decrease the potential for deer browsing impacts to sensitive species, resulting in beneficial, long-term impacts. Some browsing of preferred sensitive plant species (see alternatives A and B) occurring outside small, caged

exclosures would be expected to occur, even with herd density maintained at target levels (15 to 20 deer per square mile). As a result, potential impacts to palatable sensitive plant species occurring outside exclosures would be reduced to adverse, long term, and minor.

**Wildlife.** As described for alternative C in the “Wildlife” section of this chapter, wildlife listed or considered special status species by Maryland and the District of Columbia would be temporarily disturbed by the presence of humans placing bait stations, shooting deer, setting traps, and observing deer behavior. Bait could provide a beneficial food source to some species during the time reduction activities were conducted; however, the small quantity and short time periods that bait would be available would have a negligible impact on any species. There would be little surface disposal of deer waste and/or carcasses that would provide a beneficial food source to scavengers like Virginia opossum, because it is expected that the majority of carcasses would be disposed of through burial or off-site. The small number of carcasses left for natural decomposition would not be substantially different than what occurs through mortality from disease, old age, and car collisions. These human disturbances would be adverse, but temporary (less than 30 days per year), and negligible, as they would not cause any measurable change to the habitat or responses by wildlife listed or considered special status species by Maryland and the District of Columbia.

A reduced degree of deer browsing throughout the majority of the park would increase the availability of food and cover for wildlife listed or considered special status species by Maryland and the District of Columbia and that depend on ground/shrub layer vegetation for survival (see table 15 in chapter 3). This includes ground and/or shrub-nesting birds (e.g., mourning warbler, Nashville warbler, bobolink, Acadian flycatcher, American woodcock, brown thrasher, and eastern towhee), as well as some small mammals (e.g., southern bog lemming, Alleghany woodrat, eastern chipmunk, and eastern cottontail), reptiles (e.g., corn snake, eastern garter snake, eastern hognose snake, eastern worm snake, northern copperhead, northern ringneck snake, northern fence lizard, and eastern box turtle), and amphibians (e.g., American toad, Fowler’s toad, marbled salamander, redback salamander, and redspotted newt). These species would be able to maintain viable populations within the park, and as the vegetation became more diverse and abundant with reduced browsing pressure, the number of species that would benefit from these changes would increase. This would be a beneficial, long-term impact on these species.

Wildlife listed or considered special status species by Maryland and the District of Columbia that depend primarily on other habitats would be less affected by a reduced deer density, although a long-term benefit to upper canopy species would be gained in the future as forest regeneration maintained the upper canopy. This would include species that occur primarily near wetlands and/or water (e.g., yellow-crowned night-heron, American bittern, American black duck, black-crowned night-heron, and Wilson’s snipe; northern river otter and American mink; queen snake, common musk turtle, bog turtle, eastern mud turtle, spotted turtle, and eastern redbelly turtle; bullfrog, eastern mud salamander, northern cricket frog, northern dusky salamander, northern spring peeper, northern two-lined salamander, pickerel frog, northern red salamander, spotted salamander, and upland chorus frog, and fish); in grasslands (e.g., eastern meadowlark, field sparrow, and grasshopper sparrow); those that use the canopy and sub-canopy layers (e.g., olive-sided flycatcher, Blackburnian flycatcher, cerulean warbler, Bicknell’s thrush, bald eagle, chimney swift, and great-horned owl); or those that generally den or roost in tree cavities or behind bark (e.g., southern flying squirrel, eastern small-footed myotis, or eastern red bat).

Predatory wildlife listed or considered special status species by Maryland and the District of Columbia (see table 16 in chapter 3), such as the broad-winged hawk, great-horned owl, gray fox, and several snakes (e.g., corn snake, eastern hognose snake, northern copperhead, northern ringneck snake, northern scarlet snake, timber rattlesnake) would find a denser understory more difficult for hunting small prey than the current open condition. However, better habitat conditions and an increase in the abundance of prey species would also benefit these predators. Other wildlife listed or considered special status species by Maryland and the District of Columbia that potentially feed on deer carcasses, such as Virginia opossum, would also be slightly adversely affected.

Overall, long-term reduction and controls on deer population growth would allow vegetation used as food and cover for other wildlife to become more abundant. Therefore, the impact of alternative C to wildlife listed or considered special status species by Maryland and the District of Columbia would be mostly beneficial and long term, depending on the species and existing adverse impacts would be reduced to negligible or minor levels.

### **Cumulative Impacts**

The same past, present, and future actions described under alternative A would also occur under alternative C. Management actions identified in alternative C, where deer browsing pressure would be drastically reduced through a rapid reduction of the deer population, would provide beneficial, long-term impacts to species listed or considered special status species by Maryland and the District of Columbia. Some adverse impacts would result to habitat as a result of disturbances when qualified federal employees or authorized agents were setting traps, placing bait stations, occupying shooting locations, and removing deer carcasses. However, these impacts would be temporary and isolated, causing little disturbance and resulting in adverse, short-term, negligible impacts.

Rapid deer density reduction would allow the forest to regenerate, improving habitat and reducing impacts of overbrowsing for species listed or considered special status species by Maryland and the District of Columbia. This would result in beneficial impacts that would combine with the beneficial effects of exotic plant control, research, and disease and pest control. These beneficial impacts would offset adverse effects from increased development and other cumulative adverse actions. Therefore, cumulative impacts to species listed or considered special status species by Maryland and the District of Columbia under this alternative would be mostly beneficial and long term.

### **Conclusion**

Under alternative C, the reduced deer density would minimize potential impacts on the habitat for the Hay's spring amphipod, resulting in long-term, beneficial effects that would reduce adverse impacts to negligible. Impacts on species listed or considered special status species by Maryland and the District of Columbia, as well as their habitat, would be beneficial and long term as a result of rapid reductions in deer numbers in the park that would reduce deer browsing pressure on woody and herbaceous vegetation and allow increased abundance and diversity of other species that depend on understory vegetation. A few predators that use deer as a food source could be adversely affected by a lower deer density, as could scavengers that feed on deer carcasses, but this alternative could also increase the availability of other prey. Adverse, long-term impacts would be reduced to negligible or minor levels over time. Human disturbances from trampling at bait stations, shooting sites, trapping locations, or deer carcass disposal sites would be temporary and isolated within the park. Therefore, adverse impacts of these actions on species listed or considered special status species by Maryland and the District of Columbia would be short term and negligible. Past, present, and future activities, when combined with the reduced browsing pressure on understory habitat expected under this alternative, would result in long-term, beneficial, cumulative impacts to species listed or considered special status species by Maryland and the District of Columbia. There would be no impairment of rare, unique, threatened or endangered species or their habitat under this alternative.

## **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

### **Analysis**

Under alternative D, the size of the deer herd would be directly reduced through sharpshooting and capture and euthanasia, and reproductive control or direct reduction (if needed) would be used to maintain the population at the desired level. Small caged areas and repellents would be implemented, as under alternative A.

**Federally Listed Species.** As described for alternative C, the implementation of sharpshooting, capture, and euthanasia (where appropriate), and/or reproductive control would not contribute to primary threats to the Hay's spring amphipod. Although disturbance of the surface spring is also a concern, any springs known or with the potential to support the Hay's spring amphipod would be avoided during implementation of sharpshooting or capture and euthanasia as practicable. As a result, the potential for trampling of the surface springs would be limited. These human disturbances would be adverse, but temporary (less than 30 days per year), and negligible, as they would not cause any measurable change to the habitat or responses by the Hay's spring amphipod.

Under alternative D, a reduced deer density throughout the majority of the park would minimize the potential for surface springs to be degraded by decreasing erosion, sedimentation, and soil compaction, as well as helping to restore native plant communities. This would, in turn, minimize potential impacts on the habitat for the Hay's spring amphipod which would result in long-term, beneficial effects that reduce existing adverse impacts to negligible.

### **State/District of Columbia Listed and Special Status Species**

**Amphipods.** As described for the Hay's spring amphipod, the implementation of this alternative would not contribute to primary threats to state-listed amphipods, and any springs known or with the potential to support state-listed amphipods would be avoided during deer management activities. As a result, the potential for trampling of the surface springs would be limited, and these temporary (less than 30 days per year), adverse impacts from human disturbance would be negligible, as they would not cause any measurable change to the habitat for or responses by these amphipods.

Alternative D would reduce deer density throughout the majority of the park and minimize the potential impacts on surface spring habitat for the state-listed amphipods, by reducing erosion, sedimentation, and soil compaction, as well as helping to restore native plant communities. This would, in turn, result in long-term, beneficial effects that reduce existing impacts to negligible.

**Invertebrates.** The two invertebrates considered rare or uncommon by the state of Maryland, the Appalachian spring snail and gray petaltail dragonfly, could be disturbed by trampling during implementation of alternative C. However, small areas of the park would be affected for a short period and the adverse impact would be short term and negligible.

As explained for the amphipods, a reduced deer density throughout the majority of the park would minimize the potential for seeps that support the Appalachian spring snail and gray petaltail dragonfly to be degraded by decreasing erosion, sedimentation, and soil compaction, as well as helping to restore native plant communities. This would, in turn, minimize potential impacts on the habitat for the state-listed invertebrates which would result in long-term, beneficial effects that reduce existing adverse impacts to negligible.

**Plants.** The implementation of alternative D would result in ground disturbances, including trampling by those implementing the alternative, which could affect state-listed plant species and their habitat. However, small areas of the park would be affected for only a short period, and personnel involved in these activities would also be educated about these plants and the potential impacts. As a result, the adverse impact would be short term and negligible.

Alternative D would result in a reduced deer density throughout the majority of the park. As described for alternative C, this would promote the growth of sensitive species, reduce browsing pressure on native plant communities over time, and result in the reestablishment of special concern species. Reducing deer herd density would decrease the potential for deer browsing impacts to sensitive species, resulting in beneficial, long-term impacts. Some browsing of preferred sensitive plant species (see alternatives A and B) occurring outside small, caged enclosures would be expected to occur, even with herd density

maintained at target levels (15 to 20 deer per square mile). As a result, potential impacts to palatable sensitive plant species occurring outside exclosures would be reduced to adverse, long term, and minor.

**Wildlife.** As described for alternative C, wildlife listed or considered special status species by Maryland and the District of Columbia would be temporarily disturbed during implementation of alternative D during sharpshooting activities. The small quantity and short time periods that bait would be available would have a slightly beneficial impact on any species by providing additional food sources. The majority of carcasses would be disposed of through burial or off-site disposal, and the small number of carcasses left for natural decomposition would not be substantially different than what occurs through mortality, resulting in a limited beneficial effect for scavengers like Virginia opossum. These human disturbances would be adverse, but temporary (less than 30 days per year), and negligible, as they would not cause any measurable change to the habitat or responses by wildlife listed or considered special status species by Maryland and the District of Columbia.

A reduced degree of deer browsing throughout the majority of the park would increase the availability of food and cover for wildlife listed or considered special status species by Maryland and the District of Columbia and that depend on ground/shrub layer vegetation for survival (see table 15 in chapter 3). This includes ground and/or shrub-nesting birds (e.g., mourning warbler, Nashville warbler, bobolink, Acadian flycatcher, American woodcock, brown thrasher, and eastern towhee), as well as some small mammals (e.g., the southern bog lemming, Alleghany woodrat, eastern chipmunk, and eastern cottontail), reptiles (e.g., corn snake, eastern garter snake, eastern hognose snake, eastern worm snake, northern copperhead, northern ringneck snake, the northern fence lizard, and eastern box turtle), and amphibians (e.g., American toad, Fowler's toad, marbled salamander, redback salamander, and redspotted newt). These species would be able to maintain viable populations within the park and as the vegetation became more diverse and abundant with reduced browsing pressure, the number of species that would benefit from these changes would increase. This would be a beneficial, long-term impact on these species.

Wildlife listed or considered special status species by Maryland and the District of Columbia that depend primarily on other habitats would be less affected by a reduced deer density, although a long-term benefit to upper canopy species would be gained in the future as forest regeneration maintained the upper canopy. This would include species that occur primarily near wetlands and/or water (e.g., yellow-crowned night-heron, American bittern, American black duck, black-crowned night-heron, and Wilson's snipe; northern river otter and American mink; queen snake, common musk turtle, bog turtle, eastern mud turtle, spotted turtle, and eastern redbelly turtle; bullfrog, eastern mud salamander, northern cricket frog, northern dusky salamander, northern spring peeper, northern two-lined salamander, pickerel frog, northern red salamander, spotted salamander, and upland chorus frog, and fish); in grasslands (e.g., eastern meadowlark, field sparrow, and grasshopper sparrow); those that use the canopy and sub-canopy layers (e.g., olive-sided flycatcher, Blackburnian flycatcher, cerulean warbler, Bicknell's thrush, bald eagle, chimney swift, and great-horned owl); or those that generally den or roost in tree cavities or behind bark (e.g., southern flying squirrel, eastern small-footed myotis, or eastern red bat).

Predatory wildlife listed or considered special status species by Maryland and the District of Columbia (see table 16 in chapter 3), such as the broad-winged hawk, great-horned owl, gray fox, and several snakes (e.g., corn snake, eastern hognose snake, northern copperhead, northern ringneck snake, northern scarlet snake, timber rattlesnake) would find a denser understory more difficult for hunting small prey than the current open condition. However, better habitat conditions and an increase in the abundance of prey species would also benefit these predators. Other wildlife listed or considered special status species by Maryland and the District of Columbia that potentially feed on deer carcasses, such as the Virginia opossum and the eastern box turtle, would also be adversely affected.

Overall, long-term reduction and controls on deer population growth would allow vegetation used as food and cover for other wildlife to become more abundant. Therefore, the impact of alternative D to wildlife listed or considered special status species by Maryland and the District of Columbia, would be mostly

beneficial and long term, depending on the species, and existing adverse impacts would be reduced to negligible or minor levels.

### **Cumulative Impacts**

The same past, present, and future actions described under alternative A would also occur under alternative D. Management actions identified in alternative D, where deer browsing pressure would be drastically reduced through a rapid reduction of the deer population would provide beneficial, long-term impacts to species listed or considered special status species by Maryland and the District of Columbia. Some adverse impacts would result to habitat as a result of disturbances when qualified federal employees or authorized agents were implementing sharpshooting, capture and euthanasia, and/or reproductive control. However, these impacts would be temporary and isolated, causing little disturbance and resulting in adverse, short-term, negligible impacts.

Rapid deer density reduction would allow the forest to regenerate, improving habitat and reducing impacts of overbrowsing for species listed or considered special status species by Maryland and the District of Columbia. This would result in beneficial impacts that would combine with the beneficial effects of exotic plant control, research, and disease and pest control. These beneficial impacts would offset adverse effects from increased development and other cumulative adverse actions. Therefore, cumulative impacts to species listed or considered special status species by Maryland and the District of Columbia under this alternative would be mostly beneficial and long term.

### **Conclusion**

Under alternative D, the reduced deer density would minimize potential impacts on the habitat for the Hay's spring amphipod, resulting in long-term, beneficial effects that would reduce adverse impacts to negligible. Impacts on species listed or considered special status species by Maryland and the District of Columbia, as well as their habitat, would be beneficial and long term as a result of rapid reductions in deer numbers in the park that would reduce deer browsing pressure on woody and herbaceous vegetation and allow increased abundance and diversity of other species that depend on understory vegetation. Adverse, long-term impacts would be reduced to negligible or minor levels over time. A few predators and scavengers that use deer and their carcasses as a food source could be adversely affected by a lower deer density or denser understory conditions, but this alternative could also increase the availability of other prey. Adverse, long-term impacts would be reduced to negligible or minor levels over time. Human disturbances from trampling during implementation of sharpshooting, capture and euthanasia, and/or reproductive control would be temporary and isolated within the park. Therefore, adverse impacts of these actions on species listed or considered special status species by Maryland and the District of Columbia, would be short term and negligible. Past, present, and future activities, when combined with the reduced browsing pressure on understory habitat expected under this alternative, would result in long-term, beneficial, cumulative impacts to species listed or considered special status species by Maryland and the District of Columbia. There would be no impairment of these species or their habitat under this alternative.

## CULTURAL LANDSCAPES

### GUIDING REGULATIONS AND POLICIES

Federal actions that have the potential to affect cultural resources are subject to a variety of laws. The *National Historic Preservation Act* (1966, as amended) is the principal legislative authority for managing cultural resources associated with NPS projects. Generally, Section 106 of the act requires all federal agencies to consider the effects of their actions on cultural resources listed on or determined eligible for listing in the National Register of Historic Places. Such resources are termed historic properties.

Agreement on how to mitigate effects to historic properties is reached through consultation with the State Historic Preservation Officer; the Tribal Historic Preservation Officer, if applicable; and the Advisory Council on Historic Preservation, as necessary. In addition, federal agencies must minimize harm to historic properties that would be adversely affected by a federal undertaking. Section 110 of the act requires federal agencies to establish preservation programs for the identification, evaluation, and nomination of historic properties to the National Register of Historic Places. Other important laws or EOs designed to protect cultural landscapes include *EO 11593*, “Protection and Enhancement of the Cultural Environment.”

Through legislation the NPS is charged with the protection and management of cultural resources in its custody. This is furthered implemented through Director’s Order 28: *Cultural Resource Management*, *NPS Management Policies 2006* (NPS 2006), and the 1995 “Servicewide Programmatic Agreement among the National Park Service, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers.” These documents charge NPS managers with avoiding or minimizing to the greatest degree practicable, adverse impacts on park resources and values. Although the NPS has the discretion to allow certain impacts in parks, that discretion is limited by the statutory requirement that park resources and values remain unimpaired, unless a specific law directly provides otherwise.

### ASSUMPTIONS AND METHODOLOGY

The NPS categorizes cultural resources as archeological resources, cultural landscapes, historic structures, museum objects, and ethnographic resources. As noted under “Issues and Impact Topics” in chapter 1, only impacts to cultural landscapes have been retained for detailed analysis in this plan/EIS.

The descriptions of effects on cultural resources that are presented in this section are intended to comply with the requirements of both NEPA and Section 106 of the *National Historic Preservation Act*. In accordance with the regulations of the Advisory Council on Historic Preservation on implementing Section 106 (36 CFR Part 800, Protection of Historic Properties), impacts on cultural resources are to be identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that are either listed on or eligible to be listed in the National Register of Historic Places; (3) applying the criteria of an adverse effect to affected cultural resources either listed on or eligible to be listed in the national register; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

Under the Advisory Council’s regulations, a determination of either *adverse effect* or *no adverse effect* must also be made for affected cultural resources eligible for listing in the National Register of Historic Places. An *adverse effect* occurs whenever an impact alters, directly or indirectly, any of the characteristic that qualifies the resource for inclusion in the national register (for example, diminishing the integrity of the resource’s location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the proposal that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5, Assessment of Adverse Effects). A determination of *no adverse effect* means there would either be no effect or that the effect would not

diminish in any way the characteristics that qualify the cultural resource for inclusion in the National Register of Historic Places.

Council on Environmental Quality regulations and the NPS Director's Order 12 also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact (e.g., reducing the intensity of an impact from major to moderate or minor). Any resultant reduction in the intensity of an impact due to mitigation, however, is an estimate of the effectiveness of mitigation under NEPA only. Cultural resources are nonrenewable resources, and adverse effects generally consume, diminish, or destroy the original historic materials or form, resulting in a loss in the integrity of the resource that can never be recovered. Therefore, although actions determined to have an adverse effect under Section 106 of the *National Historic Preservation Act* may be mitigated, the effect remains adverse.

A Section 106 summary is included in the impact analysis sections for cultural landscapes. The Section 106 summary is an assessment of the effect of the undertaking (implementation of the alternative) only on cultural resources listed on or eligible for the National Register of Historic Places, based on the criteria of effect and criteria of adverse effect found in the regulations of the Advisory Council on Historic Preservation.

#### **METHODOLOGY AND INTENSITY THRESHOLDS**

Cultural landscapes are landscapes that have been adapted for or influenced by human use. Cultural landscapes that are designated within national parks have been determined to have historic significance and integrity.

In analyzing how alternative approaches for deer management would affect the cultural landscape of Rock Creek Park, attention was paid to the program's effect on vegetation as a character-defining feature of the cultural landscape and on views and vistas.

For the assessment of potential impacts to cultural landscapes, the principal sources reviewed were Dumbarton Oaks Park Cultural Landscape Report (NPS 2000a), Montrose Park Cultural Landscape Report (NPS 2004d), Linnaean Hill Cultural Landscape Inventory (NPS 2003a), and Peirce Mill Cultural Landscape Inventory (NPS 2003b).

For purposes of analyzing potential impacts to cultural landscapes, the thresholds of change for the intensity of an impact are defined as follows:

**Negligible:** The impact would be at the lowest level of detection, with neither adverse nor beneficial consequences. For purposes of Section 106 of the *National Historic Preservation Act*, the determination of effect would be *no adverse effect*.

**Minor: Adverse impact:** Alteration of a pattern(s) or feature(s) of the cultural landscape listed on or eligible for listing in the National Register of Historic Places would not diminish the overall integrity of the landscape. For purposes of Section 106 of the *National Historic Preservation Act*, the determination of effect would be *no adverse effect*.

**Beneficial impact:** Preservation of landscape patterns and features would be 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 1996b), therefore maintaining the integrity of the cultural landscape. For purposes of Section 106 of the *National Historic Preservation Act*, the determination of effect would be *no adverse effect*.

**Moderate:** **Adverse impact:** The impact would alter a pattern(s) or feature(s) of the cultural landscape, diminishing the overall integrity of the landscape. For purposes of Section 106 of the *National Historic Preservation Act*, the determination of effect would be *adverse effect*. A memorandum of agreement would be executed among the NPS and the State Historic Preservation Officer and, if necessary, the Advisory Council on Historic Preservation in accordance with 36 CFR 800.6(b). Measures identified in the memorandum of agreement to minimize or mitigate adverse impacts would reduce the intensity of impact under NEPA from major to moderate.

**Beneficial impact:** The landscape or its features would be rehabilitated 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 1996b), to make possible a compatible use of the landscape while preserving its character-defining features. For purposes of Section 106 of the *National Historic Preservation Act*, the determination of effect would be *no adverse effect*.

**Major:** **Adverse impact:** The impact would alter a pattern(s) or feature(s) of the cultural landscape, diminishing the overall integrity of the resource. For purposes of Section 106 of the *National Historic Preservation Act*, the determination of effect would be *adverse effect*. Measures to minimize or mitigate adverse impacts could not be agreed upon, and the NPS and the State Historic Preservation Officer and/or Advisory Council on Historic Preservation would be unable to negotiate and execute a memorandum of agreement in accordance with 36 CFR 800.6(b).

**Beneficial impact:** The cultural landscape would be restored 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 1996b) to accurately depict the features and character of a landscape as it appeared during its period of significance. For purposes of Section 106 of the *National Historic Preservation Act*, the determination of effect would be *no adverse effect*.

## AREA OF ANALYSIS

There are 25 units (listed in chapter 1) in Rock Creek Park covered by the plan/EIS that contain cultural landscapes, as determined by the NPS. For the purpose of this analysis, including cumulative impacts, the area of potential effect includes these 25 units.

## IMPACTS OF THE ALTERNATIVES

### ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)

#### Analysis

One of the greatest impacts on park vegetation has been the growth in the deer population and subsequent deer browsing, which has caused a depletion in the forest's herbaceous and shrub vegetation and has adversely affected numerous cultural landscape plantings. This has a potential impact on cultural landscape elements, both natural and designed, because much of the natural or planted vegetation is a key component of the park's cultural landscapes. For example, the park's *Dumbarton Oaks Cultural*

*Landscape Report* states that forest vegetation contributes to the significance of the cultural landscape (NPS 2000a).

Under alternative A, park staff would continue monitoring the deer population and would conduct activities to protect native plants, such as creating small caged areas and applying repellents to a small number of landscaped areas. However, deer populations would be expected to remain at high levels or slightly increase over the long term, and browsing would continue throughout the park, causing a decline in the long-term abundance and diversity of native plant species, contributing to further establishment of invasive exotic species within the park, and reducing or eliminating palatable landscape plantings. As a result, the plant species and cultural plantings that have existed historically in the park would continue to be reduced and in some cases could be lost. This continued decline in these plant communities would result in an adverse, long-term, minor to moderate impact to the park's cultural landscape (depending on the landscape and the plant's importance to the landscape), because native and introduced plant communities comprise a component of most cultural landscape character-defining features. The degree of impact would depend on the size of the future deer population and the associated degree of impact on the park plant communities and the susceptibility of the particular planting to deer browse.

Small caged areas and repellents would continue to be used to protect landscape plantings, new restoration plantings, or rare plant species from deer browsing in specified areas. In addition, protection of these landscape features would result in beneficial, long-term, minor impacts in localized areas, but this would not compensate for the severe impacts caused by overbrowsing throughout the park's cultural landscapes.

### **Cumulative Impacts**

Various past and present actions and events have affected the vegetation at Rock Creek Park that is an important component of the cultural landscape. Gypsy moths, which cause large-scale tree defoliation and can lead to mortality, are a serious concern throughout northern Maryland and Washington D.C. They have become sufficiently abundant so as to require aerial spraying to prevent deforestation and related impacts. Fires have affected various areas of the park and suppression has also reduced the number of fire-dependent native species. In the decades before the park was established, a blight destroyed the American chestnut, at one time a major element of the Rock Creek Park forest, as well as most of the eastern deciduous forest. All diseases and activities that affect the native woodlands would also affect the historic character of the site, resulting in adverse, long-term, minor to moderate impacts.

Invasive exotic vegetation is a problem inside and outside the park. Disturbance from natural events or from human activities can make conditions favorable for invasive exotic plant species. The spread of exotic species could have adverse impacts on cultural landscapes if the species overtake the established native and planted species that constitute the cultural landscape. An intensive program to prevent the spread of invasive exotic vegetation in the park over the long term would result in beneficial, minor impacts to the park's cultural landscapes.

Land use changes in areas adjacent to Rock Creek Park affect views and vistas, gradually eroding the sense of place that used to surround the park. Character-defining features of a historic landscape include changes, either individually or collectively, that have occurred over time. Particularly affected is land along the various parkways leading into the main body of Rock Creek Park and other vulnerable sites on the immediate boundary of the park. Development or new construction has the potential to degrade the views of the natural and designed cultural landscapes that comprise the park. Park development and maintenance would have short- and long-term negligible impacts because recognized cultural landscapes would be protected by park policy. Similarly, telecommunications facilities development would have to comply with park policy to preserve cultural landscapes when facilities are sited.

The practice of riding mountain/motor bikes on embankments and Civil War era earthworks contributes to long-term, moderate, adverse impacts on those particular features of the various landscapes within the park units.

Overall, impacts from the actions described above, coupled with the continued decline of native plant communities and cultural plantings under alternative A, would result in adverse, long-term, minor to moderate cumulative impacts to the cultural landscape.

### **Conclusion**

The use of small cages and repellents to protect landscape plantings, new restoration plantings, or rare plant species at specified areas could result in beneficial, long-term, minor impacts to these parts of the park's vegetation. However, continued growth of the deer population and the associated ongoing decline in the abundance and diversity of the native plant communities and cultural plantings would result in an adverse, long-term, minor to moderate impact to the park's cultural landscapes. Adverse, long-term, minor to moderate cumulative impacts would result from the ongoing decline of native plant communities as a result of disease processes, development, vandalism, and deer browsing, despite benefits from the use of small cages and repellents and exotic species control. No impairment of cultural landscapes would occur under alternative A.

### **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

#### **Analysis**

Several non-lethal actions would be implemented under this alternative, in addition to actions described under alternative A, to protect forest resources, including the use of large-scale exclosures (figure 4) and reproductive control for does. The large-scale exclosures would vary in size, depending on the landscape, and each would enclose from 7 to 25 acres. Assuming 14 exclosures were erected, 167 acres or about 5% to 10% of the forested area would be protected from deer browsing over the life of the plan, allowing for the regeneration of forest vegetation within the exclosures. This represents approximately 5% of the entire park and approximately 10% of the main park reservation. Although habitat is becoming limited within the park, deer browsing would be more concentrated outside the exclosures and could cause some continued decline in native and landscaped plants in these areas. In addition, the woven-wire, 8-foot fenced exclosures would introduce new structural elements into the park's overall landscape. The exclosures are planned for the Rock Creek unit only; no cultural landscapes in other Rock Creek Park units would be affected. The exclosures would be inconsistent with the park's designed and historic landscapes that reflect the significance of early 1900s buildings, gardens, and natural features. To mitigate potential impacts to the historic landscapes, the exclosures would be located some distance from common visitor use areas so that they would not intrude on these landscapes. The exclosures might be visible during the winter and spring from locations within the park, such as Parkside Drive trail where the views are contributing features to the cultural landscape. However, due to their materials and construction, they would be difficult to see. Regardless, the presence of these exclosures would result in long-term minor to moderate adverse impacts to the cultural landscapes in which they are located.

The regeneration of native vegetation within the exclosures would begin to rehabilitate portions of the cultural landscape. As described in alternative A, small cages and repellents would also be used to protect other character-defining vegetation features. These small-scale cages, combined with the protection afforded by the large exclosures, would result in localized beneficial, long-term, minor impacts to the cultural landscape because of expected vegetation regeneration in these areas.

Reproductive controls under alternative B would involve the use of bait piles and possibly temporary holding pens. Bait piles would be placed in unobtrusive locations so as not to impact the visitor's appreciation of the cultural landscape. The same is true of temporary holding areas or pens; these would be placed in locations away from gardens, structures, and other cultural landscape features, limiting

adverse impacts to negligible or minor levels. Reproductive control techniques for does would gradually limit deer population growth over the long term and allow for regeneration of native plant communities outside the exclosures, with long-term beneficial minor impacts to the park's cultural landscapes, but this benefit would not be experienced during the life of this plan. Since reproductive controls would take a long time to reduce the size of the deer population, deer numbers would be expected to remain at high levels over the life of the plan. Browsing would continue throughout the park and cause a decline in the long-term abundance and diversity of native plant species, particularly to susceptible cultural and landscape plantings that are integral to many of the park's cultural landscapes. As a result, there would be adverse, long-term, minor to moderate impact to the park's cultural landscapes (depending on the landscape and the plants importance to the landscape) over the life of the plan. The degree of impact would depend on the size of the future deer population and the associated degree of impact on the park plant communities and the susceptibility of the particular planting to deer browse.

### **Cumulative Impacts**

The same past, present, and future actions described under alternative A would also occur under alternative B. Management actions identified in alternative B, where approximately 5% to 10% of the park's vegetation would be protected from browsing, combined with reproductive control, could reduce the deer density after more than 15 years of implementation, would provide some beneficial impacts over the long term, but not immediately. Adverse effects from increased development and other cumulative adverse actions, in conjunction with continued deer browsing pressure on the majority of the herbaceous and woody vegetation and delayed reduction in the deer population, would not be offset by the beneficial effects of proposed actions. Therefore, cumulative impacts to cultural landscapes under this alternative would be adverse, long term, and moderate.

### **Conclusion**

Under alternative B, overall approximately 5% of the entire park and up to 10% of the main park reservation would benefit from constructing exclosures over the life of this plan. However, remaining vegetation within the park would continue to be adversely affected by deer browsing over the long term until reproductive controls became effective and the population decreased. Also, presence of the exclosures would result in long-term minor to moderate adverse impacts to the cultural landscapes in which they are located. Since the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to vegetation would be adverse, long term, and minor to moderate as the young vegetation and ground cover decreased in quantity and diversity in the majority of the park and cultural plantings would continue to be affected where not fenced. Past, present, and future activities, when combined with the continued pressure on vegetation expected under this alternative, would result in long-term, moderate adverse cumulative impacts. Because alternative B would provide continued protection of certain areas of the park over the long term, it would meet the minimum of protecting 5 to 10% of the forested area at any one time (Bowersox, pers. comm. 2005), and would introduce reproductive controls that could reduce deer numbers gradually over an extended period of time, it is not expected that impairment of cultural landscapes would occur under this alternative.

## **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

### **Analysis**

Under this alternative sharpshooting activities would reduce the herd size, along with capture and euthanasia where appropriate. Similar to alternative A, placing small cages around individual or small groups of plants or landscaping would also be part of this alternative.

Reducing the deer population from 82 deer per square mile (as of 2007) to 15 to 20 deer per square mile within approximately three years would result in diminished browsing pressure. This reduced pressure

would allow park plant populations to regenerate and would improve the abundance and diversity of native species within the park over the long term. Decreased browsing, as well as small caged areas and repellent use, would also help protect landscape plantings, new restoration plantings, and/or rare plant species at specified areas. Because native plant populations and cultural plantings are character-defining vegetation features of the park's cultural landscape, the re-establishment or rehabilitation of this feature would result in beneficial, long-term, moderate impacts to the park and component landscapes.

Sharpshooting activities related to deer reduction, including setting up bait stations, occupying shooting areas, and dragging deer to locations for processing, transport, or burial would have some temporary effects on vegetation and, as a result, the cultural landscape. Sharpshooting could require portable tree stands to be temporarily hung in trees. Removing deer carcasses from the kill site could require dragging over vegetation, which would temporarily trample some herbaceous and woody vegetation. However, the area of impact from these actions would be small (less than 1% of park vegetation), resulting in an adverse, short-term, negligible impact to the park and component landscapes.

The park intends to donate all deer meat to local charitable organizations to the maximum extent possible. If this is done, field dressing would occur in the park and the entrails would be buried or placed in barrels for disposal at a processing facility. Surface disposal methods would occur in areas that would not be visible from or within easy access of trails, roads, facilities, or neighboring properties, resulting in adverse, short-term, negligible impacts. Burial pits would be in previously disturbed sites in or near developed areas of the park that are not components of cultural landscapes. These sites would be generally devoid of vegetation except for weeds and would not be located in designed landscapes or next to historic features. In addition, burial pits would not be located within an area identified as an archeological site or as having archeological resources. These areas would be fully covered, fenced to prevent entry, and reseeded when the weather and season are appropriate. The impact to the component cultural landscapes would be temporary, adverse, short term, and negligible.

### **Cumulative Impacts**

The same past, present, and future impacts described under alternative A would also occur under alternative C. Quickly reducing the park's deer population would provide beneficial, long-term effects, with adverse impacts being reduced to negligible or minor levels over time. These effects, combined with other beneficial effects, would result in cumulative impacts that would be primarily beneficial. These beneficial impacts would somewhat offset the adverse effects from increased development and other cumulative adverse actions. Therefore, cumulative impacts to cultural landscapes under this alternative would be mostly beneficial, minor, and long term.

### **Conclusion**

Enhancing natural forest regeneration by quickly reducing deer browsing pressure under alternative C, and by maintaining a smaller deer population through direct reduction, would result in beneficial, long-term impacts because vegetation in cultural landscapes throughout the park could thrive and recover where effects have been noted. Over time as natural forest regeneration occurred, beneficial, long-term, moderate impacts on cultural landscapes could be expected. Past, present, and future activities, when combined with the reduced pressure on vegetation and subsequent forest regeneration, would result in beneficial, long-term cumulative impacts. Cultural landscapes would not be impaired under this alternative.

## **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

### **Analysis**

Direct reduction would be implemented under alternative D to quickly reduce the size of the deer herd and reproductive control and direct reduction (if needed) would be used as a maintenance tool to keep the

deer herd at reduced numbers. Small caged areas and repellents would be used as described under alternative A and deer waste and carcasses would be disposed of as described under alternative C. Impacts under this alternative would be the same as alternative C. Native plant populations would be rehabilitated by the direct reduction in deer populations, and other character-defining vegetation features would be potentially protected through some small-scale caging and repellent use, resulting in beneficial, long-term, moderate impacts to the park and component landscapes. Some adverse, short-term, negligible impacts could also result from sharpshooting and deer waste disposal activities.

### **Cumulative Impacts**

The same past, present, and reasonably foreseeable actions described under alternative A would also occur under alternative D. Rapidly reducing the deer population would relieve browsing pressure on a majority of the park's vegetation, providing moderate, long-term, beneficial impacts to cultural landscapes. Some adverse impacts would affect woody and herbaceous vegetation as a result of trampling due to setting bait stations, occupying shooting locations, removing deer carcasses, and using traps. However, these impacts would be isolated, affecting less than 1% of the park, resulting in adverse, short-term, negligible impacts.

Rapid deer density reduction would give the forest the opportunity to thrive and regenerate, resulting in beneficial impacts that would combine with other beneficial effects, resulting in cumulative impacts that would be primarily beneficial. These beneficial impacts would somewhat offset the adverse effects from increased development and other cumulative adverse actions. Therefore, cumulative impacts to vegetation under this alternative would be mostly beneficial, minor, and long term.

### **Conclusion**

Enhancing natural forest regeneration by quickly reducing deer browsing pressure under alternative D, and by maintaining a smaller deer population through the use of reproductive control (and direct reduction if needed), would result in beneficial, moderate, long-term impacts because vegetation that is an important component of cultural landscapes could thrive and recover throughout the park. Under alternative D less than 1% of the park's vegetation would be affected by trampling at bait stations, shooting sites, trapping locations or disposal sites. Therefore, adverse impacts of these actions on cultural landscapes would be short term and negligible. Past, present, and future activities, when combined with the reduced pressure on vegetation (forest regeneration) expected under this alternative, would result in beneficial, long-term cumulative impacts. Cultural landscapes would not be impaired under this alternative.

### **NATIONAL HISTORIC PRESERVATION ACT SECTION 106 SUMMARY**

This plan/EIS analyzes the impacts of four alternatives on cultural landscapes in Rock Creek Park. The alternatives include a no-action alternative and three action alternatives. All of Rock Creek Park and associated administrative units are potentially eligible for listing in the National Register of Historic Places as a historic cultural landscape. Dumbarton Oaks Park was individually listed in the National Register in 2004, and Montrose Park was individually listed in 2006. Historic districts, or features of cultural landscapes within the park, such as the Rock Creek and Potomac Parkway Historic District, the Civil War Fort Sites, the Peirce-Klinge Mansion, and the Peirce Mill have already been listed in the National Register of Historic Places.

Under alternative A, continued growth in the existing deer population and excessive deer browsing would continue to limit successful regeneration of native plant communities within the park, resulting in an adverse, long-term, moderate impact to the park's cultural landscape. Potential beneficial impacts to the park's cultural landscapes could result from the use of small caged areas to protect small groups of native plants and, if threatened by deer browsing, to protect landscape plantings, reducing the need for replanting trees to maintain the desired landscape. Because there would be a continued decline of native plant

communities and little natural tree regeneration due to continued deer browsing, implementation of alternative A would result in an *adverse effect* on the park's cultural landscape.

Under alternative B, large fenced enclosures would be constructed to allow up to 10% of the park's forest, a character-defining vegetation feature in the park's cultural landscape, to regenerate over the life of the plan, resulting in long-term beneficial impacts. The fences would be a new structural element within the landscape, but they would be temporary and would be placed in areas not easily visible to visitors. Reproductive control measures would take several years to be effective under alternative B, so there would be long-term moderate adverse impacts for the life of this plan, since the deer population would not be reduced enough to reduce impacts on cultural plantings and native vegetation that contributes to cultural landscapes. Therefore, alternative B would result in an *adverse effect* on the park's cultural landscape.

Under alternative C, the quick reduction of the deer population would cause a substantial decline in browsing of native plant populations. Native plants would begin to regenerate, resulting in long-term benefits to native plants, a character-defining vegetation feature in the park's cultural landscape. Therefore, *no adverse effect* would result from actions taken under alternative C.

Alternative D would be a combination of reproductive controls described in alternative B and lethal controls described in alternative C. These combined actions would result in a direct reduction in the deer population and the protection of vegetation that is an identifying characteristic of the cultural landscape, resulting in a *no adverse effect* under alternative D.

In accordance with Section 106 of the *National Historic Preservation Act*, potential adverse impacts (as defined in 36 CFR 800) on cultural landscapes listed on or eligible for listing in the National Register of Historic Places would be coordinated between the NPS and the State Historic Preservation Officer to determine the level of effect on the property and to determine any necessary mitigation measures. Continuing implementation of the *Cultural Resource Management Guideline* (NPS 2002b) and adherence to *NPS Management Policies 2006* (NPS 2006) and the 1995 Servicewide programmatic agreement with the Advisory Council on Historic Preservation and National Conference of State Historic Preservation Officers would all aid in reducing the potential to adversely impact historic properties.

Copies of this plan/EIS will be distributed to the District of Columbia State Historic Preservation Officer *and the Advisory Council on Historic Preservation* for review and comment related to compliance with Section 106 of the *National Historic Preservation Act*.



## SOUNDSCAPES

### GUIDING REGULATIONS AND POLICIES

The National Park System includes some of the quietest places on earth, as well as a rich variety of sounds intrinsic to park environments. These intrinsic sounds are recognized and valued as a park resource in keeping with the NPS mission (NPS *Management Policies 2006* [NPS 2006, sec. 1.4.6]), and are referred to as the park's natural soundscape. The natural soundscape, sometimes called natural quiet, is the aggregate of all the natural sounds that occur in parks, absent human-caused sound, together with the physical capacity for transmitting the natural sounds (NPS *Management Policies 2006* [NPS 2006, sec. 4.9]). It includes all of the sounds of nature, including such “nonquiet” sounds as birds calling, waterfalls, thunder, and waves breaking against the shore. Some natural sounds are also part of the biological or other physical resource components of parks (e.g., animal communication, sounds produced by physical processes, such as wind in trees, thunder, and running water).

National Park Service policy requires the protection of natural soundscapes from degradation due to noise (undesirable human-caused sound) (NPS *Management Policies 2006* [NPS 2006, sec. 4.9]). The NPS is specifically directed to “take action to prevent or minimize all noise that, through frequency, magnitude, or duration, adversely affects the natural soundscape or other park resources or values, or that exceeds levels that have been identified as being acceptable to, or appropriate for, visitor uses at the sites being monitored” (NPS *Management Policies 2006* [NPS 2006, sec. 4.9]). Overriding all of this is the fundamental purpose of the National Park System, established in law (e.g., 16 USC 1 et seq.), which is to conserve park resources and values (NPS *Management Policies 2006* [NPS 2006, sec. 1.4.3]). National Park Service managers must always seek ways to avoid or to minimize, to the greatest degree practicable, adverse impacts on park resources and values (NPS *Management Policies 2006* [NPS 2006, sec 1.4.3]).

Director’s Order 47: Soundscape Preservation and Noise Management, and the methodology being developed for the reference manual for Director’s Order 47 states:

An important part of the NPS mission is to preserve and/or restore the natural resources of the parks, including the natural soundscapes associated with units of the national park system. Natural sounds are intrinsic elements of the environment that are often associated with parks and park purposes. They are inherent components of "the scenery and the natural and historic objects and the wild life" protected by the NPS Organic Act. They are vital to the natural functioning of many parks and may provide valuable indicators of the health of various ecosystems. Intrusive sounds are of concern to the NPS because they sometimes impede the Service's ability to accomplish its mission (NPS 2000b).

### ASSUMPTIONS, METHODOLOGY, AND INTENSITY THRESHOLDS

Impacts to soundscapes were assessed by considering context, time, and intensity. For example, noise for a certain period and intensity would be a greater impact in a highly sensitive context, and a given intensity would be a greater impact if it occurred more often or for a longer duration. It is usually necessary to evaluate all three factors together to determine the level of noise impact. In some cases, an analysis of one or more factors may indicate one impact level, while an analysis of another factor may indicate a different impact level, according to the criteria below. In such cases, best professional judgment based on a documented rationale is used to determine which impact level best applies to the situation being evaluated.

National literature was used to estimate the average decibel levels of proposed actions and areas of use by visitors were identified in relation to where the actions were proposed. Other considerations, such as topography, were then used to identify areas where noise levels could be exacerbated or minimized.

The following thresholds were used to determine the magnitude of effects on soundscapes.

**Negligible:** Natural sounds would prevail; (activity) noise would be very infrequent or absent, mostly immeasurable.

**Minor:** Natural sounds would predominate in areas where management objectives call for natural processes to predominate, with (activity) noise infrequent at low levels. In areas where (activity) noise is consistent with the park's purpose and objectives, natural sounds could be heard occasionally.

**Moderate:** In areas where management objectives call for natural processes to predominate, natural sounds would predominate, but (activity) noise could occasionally be present at low to moderate levels. In areas where (activity) noise is consistent with the park's purpose and objectives, (activity) noise would predominate during daylight hours and would not be overly disruptive to noise-sensitive visitor activities in the area; in such areas, natural sounds could still be heard occasionally.

**Major:** In areas where management objectives call for natural processes to predominate, natural sounds would be impacted by (activity) noise sources frequently or for extended periods of time. In areas where (activity) noise is consistent with the park's purpose and zoning, the natural soundscape would be impacted most of the day; noise would disrupt conversation for long periods of time and/or make enjoyment of other activities in the area difficult; natural sounds would rarely be heard during the day.

## **AREA OF ANALYSIS**

The area of analysis, including assessment of cumulative impacts, is the entire park and immediately adjacent landowners.

## **IMPACTS OF THE ALTERNATIVES**

### **ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)**

#### **Analysis**

Under the "no-action" alternative, Rock Creek Park would continue to implement current management actions and policies related to deer and the deer's effects on the park. Current management would include deer population monitoring, as well as caging of small areas and using small amounts of repellents to protect native plants and ornamental landscaping. Noise from constructing caging around landscape plants and applying repellents by hand would be minimal. Under alternative A, park staff may use trucks to reach areas to be caged or monitored. Traffic, construction, and application sound impacts would likely be adverse, localized, short term, and negligible.

## Cumulative Impacts

Adverse impacts to soundscapes within and surrounding the park have occurred and will continue to occur from several actions related to park maintenance and operations, traffic and transportation, and special community events. Past maintenance and operations actions within the park, such as construction of facilities, roads, and landscaping work have all resulted in increased noise levels within the park, thus adversely affecting soundscapes to a minor extent in limited areas. Noise generated from highways, planes, helicopters, and emergency vehicles has, and would continue to further impact the park's natural soundscape in both the short and long term. Although there are places in the park where visitors can experience a natural setting and listen to the sounds of bird calls, water, and animals, complete solitude in the park is unlikely given its urban setting and discontinuous nature. Special and community events, especially at the Carter Barron Amphitheater, have occurred and will continue to occur within the park, thus adversely affecting soundscapes to a minor extent within the park. The future reconstruction of Rock Creek and Potomac Parkway and continued park maintenance operations would have long-term minor adverse impacts on soundscapes in limited areas within the foreseeable future. All of these activities, when combined with the negligible impacts on soundscapes expected under alternative A, would result in cumulative impacts that would be adverse, short and long term, and minor to moderate.

## Conclusion

Under alternative A, the actions taken to protect plants and monitor the deer population and park vegetation would result in a short-term, negligible adverse impact on soundscapes. Cumulative impacts would range from minor to moderate and adverse depending on the source, due to the variety and abundance of noise sources that already exist around and within the park. No impairment of the park's soundscapes would occur under this alternative.

## ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS

### Analysis

A combination of non-lethal actions would be implemented under alternative B, in addition to the actions described under alternative A, to protect forest seedlings, promote forest regeneration, and gradually reduce deer numbers in the park. The additional actions would include constructing large-scale fenced enclosures and controlling doe reproduction through surgical sterilization and reproductive control. As deer were excluded from feeding within the large enclosures, open (nontreated) areas would be monitored for changes in vegetation because of probable increased browsing pressure. Forest regeneration would be monitored both inside and outside the enclosures as described under alternative A.

Park staff would construct up to 14 large enclosures of various configurations to fit the landscape, each covering from about 7 to 25 acres or up to a total of approximately 167 acres. Construction of the enclosures would require approximately 150 days. This represents approximately 5% of the entire park and approximately 10% of the main park reservation. The enclosures would be initially located throughout the main park unit (Reservation 339), where they would be relatively easy to access, yet away from high use visitor areas or scenic views. Residents and visitors would experience minor, short-term, adverse noise impacts due to construction of fencing and enclosures in specific, localized areas, which would last only during the 150-day construction period. Such construction would not affect all residents and visitors, only those in areas where fencing and enclosures have been identified. The need for additional fencing would result in adverse noise impacts over the long term, as such actions would occur for several years into the future, but the duration of the specific activities and their associated noise would be intermittent and short term.

Minimal noise impacts are expected from administering reproductive control of does. There would be some noise resulting from vehicles entering and exiting the park to set up bait stations, construction activities to set up holding pens, firing of dart guns, and vehicles entering and exiting the park to deliver

the reproductive control agents. Visitors to the park's popular attractions, such as trails and forested areas would most likely be the most affected. However, reproductive control activities would be restricted to remote areas of the park as much as possible so that adverse impacts would be primarily short term and negligible. Therefore, under alternative B, noise impacts to residents and visitors would be primarily short term, negligible to minor (depending on the location), and adverse.

### **Cumulative Impacts**

The same past, present, and future actions described under alternative A would also occur under alternative B. Management actions described in alternative B, where up to 10% of the park's forested area would be protected by large exclosures over the life of the plan, combined with reproductive control of does, would provide short term, negligible to minor adverse impacts on soundscapes within and immediately surrounding the park. Noise generated by highways, planes, helicopters and emergency vehicles, as well as special and community events would continue, as described under alternative A, and would combine with the minimal amount of noise that would be generated under this alternative. Therefore, when combined with the short-term, negligible to minor adverse impacts to soundscapes expected under alternative B, cumulative impacts would be minor to moderate and adverse in the short and long term.

### **Conclusion**

Impacts to soundscapes would be short term, negligible to minor, and adverse under alternative B due to intermittent construction of exclosures and reproductive control activities. The degree of the impact would vary by location. However, even though individual construction and reproductive control activities would be short term, they would continue indefinitely into the future, resulting in both short- and long-term, negligible to minor, adverse impacts. Cumulative impacts due primarily to the variety and abundance of existing noise sources would be minor to moderate and adverse in the short and long term. No impairment of the park's soundscapes would occur under this alternative.

## **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

### **Analysis**

Alternative C would continue the actions described under alternative A, with two types of lethal action used to reduce and control deer herd numbers. National Park Service staff or their authorized agents would conduct sharpshooting and capture and euthanasia to reduce the deer population. Bait stations may be used to attract deer. In most locations, high-power, small caliber rifles would be used from close range. Efforts would be made to make the shootings as humane as possible; it is anticipated that only one shot or possibly two would be required per deer as highly trained staff would be used. Noise suppression devices and night vision equipment would be employed to reduce disturbance to the public.

Sharpshooting with firearms would primarily occur at night (between dusk and dawn), primarily during late fall and winter months when deer are more visible and fewer visitors are in the park. In some restricted areas, sharpshooting may be done during the day if needed, which could maximize effectiveness and minimize overall time of restrictions. If this is done, the areas would be closed to park visitors. In addition, exhibits would be displayed at visitor centers, and information would be posted on the park's website to educate the public regarding deer management actions. Visitor access would be restricted as necessary during the time the reduction is taking place, and the park would be patrolled by NPS personnel and U.S. Park Police to ensure safety of the public. Also, shooting would occur during the winter months, when visitation levels would be low.

Bait stations could be used to attract deer to safe removal locations, concentrate deer, improve removal success, and to allow the use of ground as a backstop. Bait stations would consist of small grains, apples,

hay, or other food placed on the ground. The stations would be placed in park-approved locations away from public use areas to maximize the efficiency and safety of the reduction program.

Noise impacts to park visitors would be minimal, as implementation of this alternative is planned for fall or winter and would primarily occur after sunset, when fewer visitors would be in the park. Local residents would likely experience the most impacts. As described in chapter 3, noise from a small caliber rifle would be approximately 160 dBA (decibels, A-weighted decibel scale) at the source (table 17). Assuming that the sound level decreases 6 decibels (dB) with a doubling of the distance (MN Pollution Control Agency 1999; Komanoff and Shaw 2000; OPTI 2002), an individual approximately 500 feet from the source of a firearm discharged without a suppressor would experience a noise level of about 106 dBA, which is considered very loud and comparable to highway construction noise. Use of a suppressor (see chapter 2) would bring that down to approximately 76 dBA at 500 feet from the source, which is comparable to busy traffic. However, this does not consider attenuation from soft surfaces and topography, factors that would decrease the decibel levels even more, assuming a decrease of 7.5 dB with doubling of distance from a point source (Caltrans 1998), particularly if residents were indoors at night. For example, sound impacts would likely be somewhat less in densely vegetated or hilly areas of the main park unit. Sound would also be attenuated if shooting blinds were carefully positioned in areas that are heavily wooded; beside a hill, or unoccupied structure; and located as far from residences as possible. These conditions would result in a level of about 62.5 dBA at 500 feet from the source in a wooded area, which is considered lower than a conversational speech level (table 17). Because the park intends to perform sharpshooting primarily at night when there is less overall traffic and other day-time noise, the perceived annoyance level to neighboring residents would likely be higher than if conducted during the day. The sounds of such noise during meal times or leisure times could increase levels of annoyance. In addition, efforts would be made to schedule sharpshooting activities during the fall or winter when visitation is lower and to expedite the process as quickly and humanely as possible. Therefore, impacts to soundscapes under this alternative would be adverse, minor to moderate, and short term, given the duration of the action. Long-term impacts would occur as the activity is repeated over time (possibly several years) to maintain herd numbers at a specified level.

The intensity of the adverse impacts would vary depending on several factors, particularly perceived levels of annoyance. Individuals who are farther from the source of the firearm, support the removal efforts, and have experienced hunting efforts in the past would likely experience minor adverse impacts. Individuals who are closer to the source of the firearm would likely experience moderate adverse impacts if such sounds made enjoyment of other activities in the area difficult. However, because most of the park closes at night and visitation is lowest during fall and winter when sharpshooting activities would occur, impacts to visitors would likely be minimized.

Overall, impacts under alternative C would be adverse, both short and long term, and range from minor to moderate, depending on the proximity and attenuation factors between the source and the general public or visitor.

### **Cumulative Impacts**

The same past, present, and future activity impacts described under alternative A would also occur under alternative C. Noise generated by highways, planes, helicopters and emergency vehicles, as well as special and community events would continue, as described under alternative A, and would combine with the firearm noise that would be generated under this alternative. Therefore, when combined with the short-term, minor to moderate adverse impacts to soundscapes expected under alternative C, cumulative impacts would be minor to moderate and adverse in the short and long term. These impacts would be expected to decrease as the need for removal efforts decreases as well.

## **Conclusion**

Impacts to soundscapes from sharpshooting would be adverse, short and long term, and minor to moderate, primarily affecting nearby residents because sharpshooting would occur mostly at night and during off-peak visitation seasons. Perception of the intensity of the impacts would vary depending on several factors, including timing, attenuation levels, and distance from the source, resulting in minor to moderate impacts to individuals experiencing the sound. Cumulative impacts would be adverse, short and long term, and minor to moderate. However, these impacts would be expected to decrease in the long term, as deer populations in all affected areas decrease and the need for direct reduction decreases as well. No impairment of the park's soundscapes would occur under this alternative.

## **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

### **Analysis**

Alternative D would include all actions described under alternative A, plus a combination of certain additional lethal and non-lethal actions from alternatives B and C to reduce deer herd numbers. The lethal actions would include both sharpshooting and capture/euthanasia, and these actions would be taken initially to quickly reduce the deer herd numbers. Reproductive control of does would be implemented to maintain the reduced herd numbers through sterilization or reproductive control, if feasible. If reproductive controls meeting required criteria become available sooner than expected, the park could select to use these first (before the initial sharpshooting), so that deer are not as hard to capture and more can be treated. However, for this analysis, it is assumed that sharpshooting would be conducted first, and that population maintenance would be conducted via the most practicable method and could include a combination of lethal and non-lethal methods (i.e., sharpshooting could be used for maintaining the deer herd if necessary).

Noise related to construction of fencing, reproductive control activities, and ensuing monitoring would continue, as described under alternative B. Noise impacts related to this component of this alternative would be short term, adverse, and negligible. Long-term impacts would continue as more fencing, exclosures, reproductive control, and spraying is required; however, the need for such actions is expected to decrease because implementation of this alternative also contains elements to control the size of the overall deer herd.

The greatest impact from noise would be from the use of firearms. As described under alternative C, intensity of the noise impacts would vary based on several factors, including proximity to the firearm, use of noise suppression devices, and perceived annoyance level. The need for further sharpshooting efforts would likely decrease over the long term as the effects of this action and the use of reproductive controls would result in a decrease in the size of the deer herd. Therefore, the overall effect of implementation of all components of this alternative would be short and long term, adverse, and minor to moderate, with expected decreases in intensity over the long term.

### **Cumulative Impacts**

The same past, present, and future activity impacts described under alternative A would also occur under alternative D. Noise generated by highways, planes, helicopters and emergency vehicles, as well as special and community events would continue, as described under alternative A, and would combine with the firearm noise that would be generated under this alternative. Therefore, when combined with the short-term, minor to moderate adverse impacts to soundscapes expected under alternative D, cumulative impacts would be minor to moderate and adverse in the short and long term. As explained under alternative C, these impacts would be expected to decrease as the need for removal efforts decreases as well.

## **Conclusion**

Overall impacts to soundscapes under this alternative would be short and long term, adverse, and minor to moderate, particularly due to the use of firearms. Perception of impact intensity would vary based on several factors, particularly timing, distance, and attenuation from the source. However, long-term impacts would be expected to decrease as the overall herd population decreases, reducing the need for direct reduction. Cumulative impacts would be adverse, short and long term, and minor to moderate. However, these impacts would be expected to decrease in the long term, as deer populations in all affected areas decrease and the need for direct reduction decreases as well. No impairment of the park's soundscapes would occur under this alternative.



## VISITOR USE AND EXPERIENCE

### GUIDING REGULATIONS AND POLICIES

The NPS *Management Policies 2006* (NPS 2006) state that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Management goals include making available to the public traditional outdoor recreational opportunities that are not detrimental to the natural or cultural resources of the park.

While preservation and conservation are key components of the NPS *Management Policies 2006*, they also instruct park units to provide for recreational opportunities. The NPS achieves its preservation and conservation purposes by working to maintain all native plants and animals as parts of the natural ecosystem, emphasizing preservation and conservation over recreation. The NPS will achieve this by preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur (NPS 2006, sec. 4.4.1).

Rock Creek Park's General Management Plan (2005a) includes the following desired conditions that pertain to visitor use and experience:

- visitors have opportunities to enjoy the park in ways that leave park resources unimpaired for future generations
- visitors understand and appreciate park values and resources and have the information necessary to adapt to the park's environments

### ASSUMPTIONS, METHODOLOGY, AND INTENSITY THRESHOLDS

Past visitor use data, comments from the public, and personal observations of visitation patterns were used to estimate the effects of the alternative actions on visitors. It is assumed that annual visitation over the life of the plan will remain relatively steady at about 2 million visitors per year, with slight variations from year to year. The thresholds for the intensity of an impact are defined as follows:

- Negligible:** The impact would be barely detectable and/or would affect few visitors. Visitors would not likely be aware of the effects associated with management actions.
- Minor:** The impact would be detectable and/or would only affect some visitors. Visitors would likely be aware of the effects associated with management actions. The changes in visitor use and experience would be slight but detectable; however, visitor satisfaction would not be measurably affected.
- Moderate:** The impact would be readily apparent and/or would affect many visitors. Visitors would be aware of the effects associated with management actions. Visitor satisfaction might be measurably affected (visitors could be either satisfied or dissatisfied). Some visitors would choose to pursue activities in other available local or regional areas.
- Major:** The impact would affect the majority of visitors. Visitors would be highly aware of the effects associated with management actions. Changes in visitor use and experience would be readily apparent. Some visitors would choose to pursue activities in other available local or regional areas.

## **AREA OF ANALYSIS**

The area of analysis is the entire park and adjacent landowners, who constitute a large number of visitors, for all alternatives, including cumulative assessments.

## **IMPACTS OF THE ALTERNATIVES**

### **ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)**

#### **Analysis**

Park staff would continue monitoring the deer population under alternative A and would conduct activities to protect native plants, such as creating small caged areas and applying a minimal amount of repellents to landscaped areas.

The most common reasons for visiting Rock Creek Park are exercise (61%), followed by escaping the city environment (47%), and spending time with family/friends (37%). The reason least often listed was commuting to work (6%). "Other" reasons included attending a concert, walking the dog, golfing, gardening, enjoying nature, eating lunch, commuting home, visiting the planetarium, and studying (29%) (Littlejohn 1999). Small caged areas would not adversely impact those who visit the park to exercise, as these caged areas would not be located on paths nor recreational areas. Depending on the methods visitors use to escape the city environment, they could be adversely impacted by the sight of small caged areas throughout the park. Conversely, the caged areas protect rare plants and vegetation that visitors would not otherwise see due to excessive deer browsing. Visitors who primarily escape the city environment by driving through the park would be the least affected, as caged areas would be difficult to detect while driving. Visitors who primarily escape the city environment by hiking would be affected to a greater degree, depending on the location of the trail and the number of cages encountered.

Visitors who come to the park primarily to enjoy natural history (14%) or learn about history/nature (10%) would be most affected under this alternative, as impacts to natural and historical vegetation from excessive deer browsing would continue under this alternative, diminishing the likelihood of appreciating such vegetation. Adverse impacts to visitor experience from the heavily browsed vegetation would be long term, localized, and range from minor to moderate.

When asked to rate the importance of selected features or qualities of the park (extremely important, very important, moderately important, somewhat important, or not important), "scenic beauty" received the highest importance ratings when "extremely important" and "very important" ratings were combined (73% ranked it extremely important, and 21% ranked it very important, a total of 94%) (Littlejohn 1999). Under this alternative, visitors who value the scenic beauty could be adversely affected by manmade fences that would disrupt views and by the lack of shrubbery and flowering plants in the forest understory. These impacts would adversely affect a large percentage of the park's visitors, resulting in adverse, long-term, minor to moderate impacts.

Visitors also placed a high importance on native plants and wildlife in the park, with 44% ranking this as extremely important and 23% as very important. Under this alternative, the deer population would continue to grow and/or remain at high levels, adversely impacting native plants and, as a result, wildlife and wildlife habitat. Therefore, the majority of park visitors who value native plants and wildlife, including the many birdwatchers that use the park, could experience long-term, adverse, minor to moderate impacts as the diversity and abundance of native vegetation in the park decreases as a result of deer browsing. In addition, overbrowsing by deer gives invasive exotic plant species an opportunity to become established, which could potentially out compete native plants and contribute to adverse impacts to visitors who value native vegetation. Although it is not known what percent of visitors place a high importance specifically on seeing deer, any visitors who do would have a higher chance of viewing deer

under this alternative. However, the condition of the deer may decline as the population grows and food becomes less available. Therefore, if visitors viewed ill or emaciated deer, visitor experience could be adversely affected.

Picnickers, photographers, and visitors who visit historic or cultural sites could be adversely affected by the sight of small cages and the effects of deer browsing on native vegetation and wildlife. However, these visitors are primarily focused on specific activities or areas, and they would be less likely to see cages or notice browsing impacts.

Impacts of alternative A would not likely adversely affect cross-country skiers, or horseback riders to a measurable extent. These visitors comprise a small percentage of overall visitation and engage in specific activities in areas that may not be as affected by deer management activities or the impacts of overbrowsing.

Minimal application of repellents at the park would also result in short-term, negligible adverse impacts to visitors who might view this activity or smell the applied herbicides, as use would be limited primarily to landscaped areas.

Educational efforts included under this alternative, such as communication with the public about deer management activities as described in chapter 2, would help offset adverse impacts to all park visitors, who would be informed of the reasons for implementing the management activities. Monitoring efforts described under this alternative, such as deer population surveys and vegetation monitoring, would have little to no impact on visitors since surveys would be conducted at night when the park is closed, and most visitors would likely interpret vegetation monitoring as consistent with scientific efforts expected at a unit of the National Park System.

### **Cumulative Impacts**

Adverse impacts to visitor use and experience within the park have occurred and would continue to occur under alternative A. The growing deer population has adversely affected the scenic quality of the park as extensive deer browsing has reduced the abundance of native vegetation and wildlife that visitors value. The presence of rabies, Lyme disease, and West Nile virus would continue under alternative A, which would affect the wildlife that many visitors come to see. Acts of illegal camping, off-trail users, unrestrained pets, poaching, and dumping have all had and continue to have minor localized adverse impacts to visitor use and experience. Exotic plant control has had a primarily beneficial impact on visitor use and experience, as exotic and invasive species have been reduced to allow for the regeneration of native species that comprise the natural beauty of the park. Park management and operations have had, for the most part, beneficial impacts to visitor use and experience, as interpretive programs have been developed, and trails have been established and maintained. Slight short-term negligible to minor adverse impacts from park management and operations have resulted from noise caused from construction of facilities, roads, and landscaping work, which as a result has impacted visitor experience.

Traffic and vehicle collisions have occurred and would continue to occur under alternative A, adversely impacting visitor use and experience. Urban development has impacted visitor use and experience both adversely and beneficially, and would continue to do so under each alternative. While noticeable urban development immediately outside park boundaries may diminish the feeling of “wildness” within the park, this same urban development has increased accessibility for neighboring residents. Current shrinking of green space surrounding the park under alternative A would continue to have negligible to minor adverse impacts on visitor use and experience. The future reconstruction of Rock Creek and Potomac Parkway, as well as park trails would have short-term minor adverse impacts on visitor use as it may inconvenience access and local commutes through the park; however, long-term beneficial impacts to visitor use and experience would result from the improvement of the parkway and trails.

All of these activities, when combined with the continued pressure on forest resources expected under alternative A from continued deer browsing, would result in both adverse and beneficial cumulative impacts to visitor use and experience. Adverse cumulative impacts would be long term and minor to moderate.

### **Conclusion**

Impacts to visitor use and experience under alternative A would be both beneficial and adverse to those visitors who maybe primarily interested in viewing deer (beneficial in that there would be more deer to see, adverse in that the appearance of the herd could be poor). However, overall impacts related to a decreased ability to view scenery (including native vegetation) and other wildlife, which a large majority of visitors rated as important, would be long term, minor to moderate and adverse. Past, present, and future activities, when combined with the continued pressure on forest resources expected under this alternative, would result in both adverse and beneficial (depending on an individual visitor's goals) impacts. Overall cumulative impacts would be long term, minor to moderate and adverse.

### **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

#### **Analysis**

A combination of non-lethal actions would be implemented under alternative B, in addition to the actions described under alternative A, to protect forest seedlings, promote forest regeneration, and gradually reduce deer numbers in the park. The additional actions would include constructing large-scale fenced exclosures, and controlling doe reproduction through surgical sterilization and reproductive control. As deer were excluded from feeding within the large exclosures, open (nontreated) areas would be monitored for changes in vegetation because of probable increased browsing pressure. Forest regeneration would be monitored as described under alternative A.

Repellents and small caged areas described under alternative A would continue to be used under alternative B, but large fenced exclosures would be constructed to allow reforestation. Park staff would construct up to 14 large exclosures of various configurations to fit the landscape, each covering from about 7 to 25 acres or up to a total of approximately 167 acres. This represents approximately 5% of the entire park and approximately 10% of the main park reservation. The exclosures would be initially located throughout the main park unit (Reservation 339) where they would be relatively easy to access, yet away from high use visitor areas or scenic views. Visitors hiking in the park to view wildlife and scenery would be most affected under this alternative. Birdwatchers, cross-country skiers, and nature photographers who may desire a more natural, primitive park experience would also be adversely affected. Visitors to the park's historic or cultural sites might also be adversely affected by intrusions on the cultural landscape. Those who primarily experience the park by car might not be as affected by the sight of the exclosures, which would probably not be detectable from vehicles. To protect park resources and minimize visual impacts of the exclosures, park staff would consider locating them in areas not visible from visitor use areas.

Visitors would also be affected by fence construction activities, which would result in visual intrusions, such as the presence of work crews and employees in certain areas of the forest. Not all visitors would be impacted, only those in areas where the activities occurred. These adverse impacts would be negligible to minor and short term during construction, but would occur repeatedly over the life of the plan, resulting in long-term impacts.

The use of reproductive controls on does would be based on available technology. Initially, sterilization would be used to reduce the herd's ability to reproduce, followed by use of a reproductive control agent. If more does were captured at once than could be treated, temporary holding areas may be necessary to house deer prior to treatment. Holding areas would be in compliance with American Veterinarian Medical Association standards, and the holding period would not be more than a day. To ensure that visitors

would understand the nature of the treatment efforts, the park would conduct educational programs to inform visitors about the procedures and explain why the treatments are necessary. However, visitors may see various aspects of the reproductive control operations, which could result in minor adverse impacts to their visitor experience.

The park plans to implement deer management educational and interpretive efforts under all alternatives, and visitors would be made aware of the reasons for the exclosures and their benefit to forest regeneration, which would beneficially impact visitors with the knowledge that the natural environment would eventually improve. Such information could offset adverse impacts related to visual aesthetics caused by the exclosures. Adverse impacts would be negligible to minor and short term, gradually changing to negligible beneficial in the long term as the forest regenerates due to protection afforded by the exclosures.

With reproductive control, deer would be marked with ear tags. Visitors could be troubled by the sight of deer with artificial markings, particularly those who primarily come to the park to see deer. Again, educational material would alert visitors to deer management activities and explain their purpose and expected outcomes.

As reproductive controls eventually take effect and the deer population begins to decrease over time, some park visitors might notice reductions in the excessive browsing pressure that has been damaging forest resources. There would be an increased ability to view native plants and animals, including birds, wildflowers, and other wildlife. However, many years would be required to achieve these beneficial impacts. Overall, short-term impacts would be adverse and minor, gradually becoming beneficial in the long term.

Those visitors who are interested primarily in seeing deer would be adversely affected. However, the herd size would not be reduced to the extent that deer would become rare in the park, rather they would still be visible, but they would be more in balance with other elements of the ecosystem. The herd might be healthier under this alternative as compared to alternative A. Therefore, visitors who value seeing deer might also prefer seeing fewer deer if it means maintaining a healthy, viable herd, which could lessen the intensity of the adverse impact to these visitors to negligible or minor.

### **Cumulative Impacts**

The same past, present, and future actions described under alternative A would also occur under alternative B. Management actions described in alternative B, where approximately 5% to 10% of the park's forested area would be protected by large exclosures, combined with reproductive control of does, would provide short-term, negligible to minor adverse impacts on visitor use and experience in the short term, gradually becoming beneficial in the long term. Therefore, cumulative impacts to visitor use and experience would be mostly beneficial, negligible to minor and long term due to combined forest regeneration activities, which would enhance the overall visitor experience.

### **Conclusion**

Under alternative B, approximately 10% of the main park reservation would benefit from constructing exclosures over the life of this plan. Visitors under alternative B would experience adverse, short-term impacts primarily due to aesthetics and closures of certain areas of the park, as well as a slight increase in noise levels during construction of exclosures and reproductive control efforts that would take place primarily between October and April. These impacts would be offset by the educational and interpretive information that would explain the purpose of deer management activities, which would reduce adverse impacts to minor. Short-term impacts would eventually give way to beneficial, long-term impacts as the need for exclosures diminished and the deer population declined, resulting in a restored forest ecosystem throughout the park. However, many years would be required to achieve these beneficial results. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such

an impact would be negligible to minor, as opportunities to view deer would still exist. Cumulative impacts to visitors would be mostly beneficial and long term due to the effects of combined forest regeneration activities.

### **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

#### **Analysis**

Alternative C would continue the actions described under alternative A, with two types of lethal action used to reduce and control deer herd numbers. The NPS or their authorized agents would conduct sharpshooting and capture and euthanasia to reduce the deer population. Visitors would be affected primarily by closures required to conduct the direct reduction activities. Sharpshooting with firearms would primarily occur at night (between dusk and dawn), primarily during late fall and winter months when deer are more visible and fewer visitors are in the park. In some restricted areas, sharpshooting may be done during the day if needed, which could maximize effectiveness and minimize overall time of restrictions. If this is done, the areas would be closed to park visitors. The public would be notified of any park closures in advance, exhibits regarding deer management would be displayed at visitor centers, and information would be posted on the park's website to inform the public of deer management actions. Visitor access could be limited as necessary while reductions were taking place, and NPS park personnel and U.S. Park Police would patrol public areas to ensure compliance with park closures and public safety measures. Noise suppression equipment would be used to decrease impacts to the soundscape, and visitors would only be affected by noise if sharpshooting occurred during the day and in areas that were not restricted or closed to visitor use.

Because sharpshooting activities would occur when visitation is lower (during fall and winter months), and primarily at night (when the park is closed), adverse impacts to visitors related to closures or noise from high-power, small caliber rifles would be negligible. Impacts would be both short and long term, as limited sharpshooting activities would continue beyond the initial 3-year reduction period to maintain the target population in the future.

Visitors could be adversely affected by deer being removed by archery or by being captured and euthanized in certain circumstances. If archery is used, there is a possibility of a deer not succumbing immediately and fleeing the area, and it could then be seen by the public. However, all sharpshooters would be trained in removal of deer using archery, would shoot only at close range, and would take deer only in limited circumstances. Therefore, the likelihood of this happening is slight. For capture and euthanasia, deer would be captured as humanely as possible using methods such as nets or box traps, which visitors could see if hiking, jogging, walking dogs, etc. However, capture and euthanasia would primarily be used in special circumstances, and activities would occur at dawn or dusk when visitation is low. In most cases, euthanasia would apply to individual deer. If this method was required to remove several deer at one time, the area would be temporarily closed to visitors. Under either circumstance, capture and euthanasia would occur when needed, rather than as a scheduled activity. Because this method would be used only in limited circumstances, the likelihood of visitors being exposed to deer being captured and euthanized would be low. Impacts to visitor use would be sporadic over the life of this plan, adverse, and negligible.

The waste and/or carcasses would be disposed of primarily in pits created at developed areas or offsite. Because the priority would be to donate meat, disposal would only include the few carcasses that might be unsuitable for donation. The majority of carcasses buried would be done so offsite. If onsite surface disposal were used, it would occur only in remote areas, which would be unlikely to be noticed by visitors. Burial would occur soon after shooting, when the park is closed to visitors. In addition, sharpshooting would occur during fall and winter months when fewer people visit Rock Creek Park. Therefore, few, if any, visitors would be exposed to deer remains or burial activities under this alternative.

The park plans to implement deer management educational and interpretive efforts under all alternatives, and visitors would be made aware of the reasons for the activities and their benefit to forest regeneration.

As under alternative B, long-term beneficial impacts would occur to most visitors because the forest would regenerate, creating increased ability to view foliage and wildflowers, and providing improved habitat for a variety of species. Beneficial impacts and forest regeneration would be realized fairly quickly, as direct reduction would have an immediate impact on the size of the deer herd. Maintaining a viable herd size would help ensure a more balanced ecosystem into the future.

Also mentioned under alternative B, the ability to see deer would decrease, and those visitors who are interested primarily in seeing deer would be adversely affected. However, the herd size would not be reduced to the extent that deer would become rare in the park, rather they would still be visible, but they would be more in balance with other elements of the ecosystem. The herd might be healthier under this alternative as compared to alternative A. Therefore, visitors who value seeing deer might also prefer seeing fewer deer if it means maintaining a healthy, viable herd, which could lessen the intensity of the adverse impact to these visitors to negligible or minor.

### **Cumulative Impacts**

The same past, present, and future activities expected under alternative A would also occur under alternative C. Quickly reducing the park's deer population would provide beneficial, long-term effects, with adverse impacts being reduced to negligible or minor levels over time. These effects, combined with other beneficial effects, would result in cumulative impacts that would be primarily beneficial, negligible to minor, and long term. These beneficial impacts would somewhat offset the adverse effects from increased development and other cumulative adverse actions described under alternative A. Therefore, cumulative impacts to visitor use and experience under this alternative would be mostly beneficial and long term.

### **Conclusion**

Few visitors under alternative C would see lethal deer management actions occur, since they would primarily occur during fall and winter and at night, when few, if any, visitors are in the park. These impacts would be offset by the educational and interpretive information that would explain the purpose of the deer management activities. Therefore, adverse impacts would be long term and negligible. Long-term beneficial impacts would occur as a result of forest regeneration, which would have a moderate effect on visitors, due to the restoration of natural resources. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in herd size, but such impacts would be negligible to minor as opportunities to view deer would still exist. As under alternative B, cumulative impacts to visitors would be mostly beneficial and long term due to combined forest regeneration activities.

## **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

### **Analysis**

Alternative D would include all actions described under alternative A, plus a combination of certain additional lethal and non-lethal actions from alternatives B and C to reduce deer herd numbers. The lethal actions would include both sharpshooting and capture/euthanasia, and these actions would be taken initially to quickly reduce the deer herd numbers. Reproductive control of does would be implemented to maintain the reduced herd numbers through sterilization or reproductive control, if feasible. If reproductive controls meeting required criteria become available sooner than expected, the park could select to use these first (before the initial sharpshooting), so that deer are not as hard to capture and more can be treated. However, for this analysis, it is assumed that sharpshooting would be conducted first, and that population maintenance would be conducted via the most practicable method and could include a

combination of lethal and non-lethal methods (i.e., sharpshooting could be used for maintaining the deer herd if necessary).

Adverse impacts related to sharpshooting activities would be long term and negligible, since they would primarily occur during fall and winter and at night, but beneficial impacts would result from a relatively rapid reduction in deer herd size, which would result in enhanced forest regeneration. Disposal of deer carcasses and waste would occur as described under alternative C. Visitors would only be slightly affected by the continued use of small caged areas and repellents, a negligible impact. Reproductive control would be applied after sharpshooting efforts had reduced the deer population. Therefore, reproductive control activities would augment direct reduction to reduce deer browsing pressure and allow forest regeneration, increasing the quality of Rock Creek Park's scenery and the diversity of its plants and animals. Resulting impacts to visitors would be beneficial and long term. Adverse impacts could occur from visitors being exposed to reproductive control activities and associated area closures. Educational and interpretive activities would help explain why deer management is needed.

As under the other action alternatives, visitors interested primarily in seeing deer could be adversely affected by the long-term reduction in the deer population. However, adverse impacts to these visitors would be negligible for the reasons mentioned under alternatives B and C.

### **Cumulative Impacts**

The same past, present, and future activity impacts described under alternative A would also occur under alternative D. Quickly reducing the park's deer population would provide beneficial, long-term effects, with adverse impacts being reduced to negligible or minor levels over time. These effects, combined with other beneficial effects, would result in cumulative impacts that would be primarily beneficial. These beneficial impacts would somewhat offset the adverse effects from increased development and other cumulative adverse actions described under alternative A. Therefore, cumulative impacts to vegetation under this alternative would be mostly beneficial and long term.

### **Conclusion**

Adverse, short-term impacts could occur if visitors were exposed to direct reduction or reproductive control actions described under alternative D. These impacts would be offset by educational and interpretive information that would explain the purpose of the deer management actions, resulting in negligible adverse impacts. Beneficial impacts would occur in the long term, as the forest regenerated and visitors could see increased plant and animal diversity, and enjoy enhanced scenery. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such impact would be negligible to minor, as opportunities to view deer would still exist. Cumulative impacts to visitors' ability to enjoy Rock Creek Park's scenery and species diversity, regardless of the type of activity involved, would be primarily beneficial and long term.

## VISITOR AND EMPLOYEE SAFETY

The safety of both visitors and NPS employees at Rock Creek Park could be affected by implementation of the proposed deer management actions. Impacts to visitor safety would be related to the presence of fences, the use of dart guns and firearms, as well as any additional associated deer management activities. Impacts to employee safety would be related to the use of firearms and dart guns, and the potential for any accidents that could result from implementation of the other proposed actions.

### GUIDING REGULATIONS AND POLICIES

The NPS *Management Policies 2006* state that, “while recognizing that there are limitations on its capability to totally eliminate all hazards, the Service . . . will seek to provide a safe and healthful environment for visitors and employees.” The policies also state that “the Service will reduce or remove known hazards and apply other appropriate measures, including closures, guarding, signing, or other forms of education” (NPS 2006, sec. 8.2.5.1).

Rock Creek Park’s General Management Plan (2005a) includes the following desired condition that pertains to visitor and employee safety: visitor and employee safety and health are protected.

### ASSUMPTIONS, METHODOLOGY, AND INTENSITY THRESHOLDS

The purpose of this impact analysis is to identify the level of impact that implementing each of the proposed alternatives would have on the safety of visitors and employees at Rock Creek Park. Past accident data, park goals, and personal observations of safety issues were used to assess the effects of the alternative actions on the safety of visitors and employees.

### VISITOR SAFETY

The impact thresholds for visitor safety are defined below.

- Negligible:** There would be no discernible effects to visitor safety; slight injuries could occur, but none would be reportable.
- Minor:** Any reported visitor injury would require first aid that could be provided by park staff.
- Moderate:** Any reported visitor injury would require further medical attention beyond what was available at the park.
- Major:** A visitor injury would result in permanent disability or death.

### AREA OF ANALYSIS

The study area for this analysis, including analysis of cumulative impacts, is Rock Creek Park and any surrounding properties.

### IMPACTS OF THE ALTERNATIVES

#### ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)

##### Analysis

Park staff would continue to erect small cages around sensitive plants and apply repellents to landscaped areas under alternative A. They would also continue monitoring activities and deer population surveys.

No accidents or injuries have occurred to visitors as a result of such activities, and no accidents are anticipated from their continuation, resulting in negligible impacts. However, the high deer population would continue to contribute to vehicle accidents experienced by visitors using park roads, resulting in minor to possibly moderate adverse effects on these visitors. Therefore, adverse, long-term impacts are expected, which could range from negligible (from regular monitoring and maintenance) to moderate (from potential vehicle accidents), with most visitors experiencing no or only slight injuries.

### **Cumulative Impacts**

Visitation at Rock Creek Park is expected to remain relatively steady in future years, with continued pressure for various recreational uses and the potential for accidents and vehicle collisions. In addition, some visitors engage in certain activities at Rock Creek Park that are inherently more dangerous than others, such as horseback riding, and accidents involving trips and falls would always be expected, with negligible adverse impacts to visitor safety. Urbanization and associated crime unfortunately would be expected to continue at some level in the future, despite the continued presence of the U. S. Park Police, who patrol 1,800 acres of Rock Creek Park and adjacent parks. Overall, the impacts to park visitors that have and would be expected to occur, combined with the impacts expected under this alternative, would result in long-term, minor adverse cumulative impacts.

### **Conclusion**

Adverse, long-term, negligible to moderate adverse impacts could occur under this alternative, as it is expected that no discernible effects to visitor safety would result from deer management actions, but vehicle collisions would continue. Cumulative impacts would primarily be related to other injuries that visitors could sustain in the park; these impacts would also be adverse, long term, and minor.

## **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

### **Analysis**

Several non-lethal actions would be implemented under alternative B, including the use of large exclosures and reproductive control of does, which would include sterilization using the services of a veterinarian, use of a dart gun, and possible construction of temporary holding pens. Actions described under alternative A (e.g., use of small cages and limited application of repellents) would continue.

Large exclosures would be constructed throughout the park and would be relocated as vegetation regrowth exceeded deer browsing height (60 inches or 150 centimeters). Visitors would not be able to use the fenced areas during or after construction, which would ensure no one would get hurt trying to get into or out of the exclosures. Park staff would place exclosures in locations so as to minimize impacts to visitor use wherever possible, offsetting any related safety issues. Some visitors could walk off-trail and into an exclosure. However, the likelihood of this happening would be very slight.

Under this alternative, initial sterilization would involve gathering of does for treatment in a confined area around bait piles, possible use of holding pens, and transport of the does to the field station where the procedure would be performed. This would occur in closed areas not near park borders, so injuries to visitors would be negligible. Later, does would be treated with a reproductive control agent that would most likely be administered remotely with a dart gun. The application of annual treatments would also be required. As with sterilization, bait piles would be placed to lure does to certain locations chosen to minimize visitor inconvenience. These areas would be closed to public use for the duration of the activity. Treatment would occur during September and October, but during off-peak visitor hours (early morning and evening). To reduce impacts to visitor safety, preference would be given to conducting the treatment on weekdays. If dart guns were not used, does would be lured into a trap site so that they could be treated with the drugs and tagged. Again, these areas would be closed to visitor use, and precautions would be taken to minimize safety impacts.

No impacts to visitor safety from increased monitoring are expected, as such activities would apply primarily to monitoring exclosures, which would be closed to visitors, and open forested areas, where park staff would exercise safety precautions. However, the continued presence of a large number of deer over the life of the plan would continue to contribute to vehicle deer collisions on park roads and result in minor to moderate adverse impacts.

### **Cumulative Impacts**

The actions described under the cumulative scenario for alternative A would also apply to alternative B. Any increase in overall visitation could lead to an increase in visitor accidents or injuries. However, the combined effects of these actions combined with the accidents expected under alternative B are expected to remain minor, as few visitors engage in higher risk activities. Therefore, cumulative impacts would be adverse, long term, and minor.

### **Conclusion**

This alternative includes measures to protect visitors from accident or injury, such as closing deer-treatment areas to visitor use. In addition, reproductive control activities would be conducted by qualified federal employees or authorized agents, whose training and experience with such activities would help ensure safety. Therefore, any adverse impacts to visitors would be short and long term and negligible from deer management, although the continued presence of a large number of deer over the life of the plan would continue to contribute to vehicle deer collisions on park roads and result in minor to moderate adverse impacts. Cumulative impacts would be adverse, long term, and minor.

## **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

### **Analysis**

Qualified federal employees or authorized agents would conduct direct reduction of the deer herd through sharpshooting, and capture and euthanasia of individual deer would be used where sharpshooting is not appropriate due to safety concerns (e.g., near adjacent residences).

Deer would be shot with high-power, small caliber rifles at close range. Measures taken to ensure the safety of Rock Creek Park's visitors would include shooting at night during late fall or winter months when visitation is low, closing areas to visitors if shooting is required, notifying the public in advance of any park closures, providing exhibits regarding deer management actions in the visitor center, and posting information on the park's website. Law enforcement personnel would also patrol the perimeter areas where sharpshooting would occur, and a safe distance would be maintained from any occupied building. Bait stations would be used to attract deer to safe removal locations. Park staff would approve the location of bait stations before sharpshooting took place. The park would comply with all federal firearm laws administered by the Bureau of Alcohol, Tobacco, and Firearms. The majority of deer reduction activities would occur during the first three years of this plan, decreasing in scope (and the potential for accidents) during ensuing years as the deer population declined.

The safety of visitors and adjacent property owners could also be affected by capturing and euthanizing deer. It is unlikely that visitors would be exposed to such action, which would occur primarily at dawn or dusk. If this method was required to remove multiple deer, the area would be temporarily closed to visitors.

The safety measures used under this alternative would ensure the safety of all visitors, and the sizeable reduction of the deer herd would reduce the number of vehicle-deer collisions on park roads. Therefore, adverse impacts would be primarily negligible to minor. Impacts related to deer management would be mostly short term, as the activities would occur for a short period of time each year over primarily a three-year period. However, long-term impacts would also occur as annual deer removal would be required

following the initial herd reduction in order to maintain the herd at the desired level and the continued presence of deer near park roadways.

### **Cumulative Impacts**

The cumulative scenario described under alternative A would also apply to alternative C. Any increase in park visitation would lead to an increase in the number of visitors potentially exposed to lethal removal activities. Accidents that might occur as a result of high-risk or other visitor activities would combine with the negligible to minor impacts expected under this alternative. However, few visitors engage in higher-risk activities at Rock Creek Park, and park staff would implement precautions to ensure the safety of park visitors. Therefore, cumulative impacts would be adverse, long term, and negligible to minor.

### **Conclusion**

Although this alternative includes actions that could be dangerous to visitors, the extent of safety measures would result in adverse, short- and long-term, negligible to minor impacts, as it is expected that no discernible effects to visitor safety would occur from deer management actions and the possibility of deer-vehicle collisions would be diminished. Cumulative impacts would be adverse, long term, and negligible to minor.

## **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

### **Analysis**

Under alternative D, direct reduction would be implemented to reduce the size of the deer herd, and reproductive control would be used to maintain reduced herd numbers. Small caged areas and repellents would be used as under alternative A.

As described under alternative A, visitors could experience negligible, short- and long-term, adverse impacts as a result of park staff erecting small caged areas and applying repellents. Sharpshooting and capture and euthanasia would be implemented over the first three years of the plan to reduce the size of the deer herd. Reproductive controls would then be administered if available and feasible, most likely through remote injection with a dart gun. However, in both cases, qualified federal employees or authorized agents trained in safety measures would perform these activities, and areas of the park would be closed to visitation, reducing the potential for injury to visitors under this alternative. Sharpshooting would occur primarily at night during off-peak seasons (fall and winter), and darting would occur primarily on weekdays during off-peak hours (early morning and evening). Sharpshooting would not occur within 100 feet of a building or within 400 feet of the park boundary. Treatment areas would be closed to the public, and educational material would inform visitors of deer management actions and the reasons for them. Bait stations would be used to attract deer to safe treatment locations. Park staff would approve the location of bait stations before sharpshooting took place. The park would comply with all federal firearm laws administered by the Bureau of Alcohol, Tobacco, and Firearms.

If dart guns were not used to administer reproductive controls, deer would be lured into a trap site so they could be treated and tagged. These areas would be closed to visitor use, and precautions would be taken to minimize safety impacts. However, this type of treatment would be more time-consuming than the remote dart gun, likely extending the period of time for performing activities to weekends and times of high visitation. In addition, deer would be more sensitive to either type of reproductive control treatment, as they would have become sensitized to human presence and noise after three years of sharpshooting. This would increase the amount of time required to treat the animals, which could increase the amount of visitor exposure to safety risks.

The safety of visitors could also be affected by capturing and euthanizing deer, similar to alternative C. It is unlikely that visitors would be exposed to such action, which would occur primarily at dawn or dusk. If this method was required to remove multiple deer, the area would be temporarily closed to visitors.

No impacts related to additional monitoring called for under this alternative are expected to affect visitor safety, and the sizeable reduction of the deer herd would reduce the number of vehicle-deer collisions on park roads. Therefore, adverse impacts would be primarily negligible to minor.

### **Cumulative Impacts**

The cumulative scenario described under alternative A would also apply to alternative D. An increase in park visitation would increase the number of visitors potentially exposed to firearm and dart gun activities. Accidents that might occur as a result of high-risk or other visitor activities would combine with the negligible impacts expected under this alternative. However, few visitors engage in higher-risk activities at Rock Creek Park, and the park would implement safety measures to ensure visitor welfare. Therefore, cumulative impacts would be adverse, long term, and negligible to minor.

### **Conclusion**

While deer management actions under this alternative could be dangerous to park visitors, including park neighbors who visit the park, the extent of safety measures that would be used, such as area closures and periods of action, and locating activities away from park boundaries, would result in adverse, short- and long-term, negligible impacts. The possibility of deer-vehicle collisions would be greatly diminished. Cumulative impacts would be adverse, long term, and negligible to minor.

## **EMPLOYEE SAFETY**

The impact thresholds for employee safety are defined below.

- Negligible:** There would be no discernible effects to employee safety; slight injuries could occur and would be reportable.
- Minor:** Any reported employee injury would require first aid provided by the park or require a doctor's attention.
- Moderate:** Any reported employee injury would require medical attention beyond what is available at the park and would result in time off.
- Major:** An employee injury would result in permanent disability or death.

## **AREA OF ANALYSIS**

The study area for this analysis, including the cumulative impact analysis, is Rock Creek Park.

## **IMPACTS OF THE ALTERNATIVES**

### **ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)**

#### **Analysis**

Park staff would continue to erect small cages around sensitive plants and apply repellents to landscaped areas under alternative A. They would also continue monitoring activities and surveys. No accidents or injuries have occurred to employees as a result of such activities, and no accidents are anticipated from their continuation, as the park is currently meeting its employee safety goals. No discernible effects to employee safety are expected, and impacts would be adverse, long term, and negligible.

### **Cumulative Impacts**

Accidents also affect park employees. Most injuries or accidents have been usually sustained by maintenance staff and park rangers, who often perform manual work outdoors, including research monitoring. This has resulted in a few injuries every year, but below park safety goals, a negligible adverse impact. Other actions anticipated for the future, such as implementation of research monitoring and exotic plant control could increase risks to employees. Any type of law enforcement needs are handled by the U.S. Park Police, which reduces the risk for other park employees. Since the park is currently meeting its employee safety goal and staff engage in a variety of safety-related training activities, impacts from all activities, including any deer management actions, are expected to remain adverse, long term, and negligible.

### **Conclusion**

Impacts would be adverse, long term, and negligible under this alternative, as it is expected that no discernible effects to employee safety would occur as a result of deer management actions. Cumulative impacts would be mainly related to other injuries that employees could sustain while working in the park; these impacts would also be adverse, long term, and negligible.

### **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

#### **Analysis**

Several non-lethal actions would be implemented under alternative B, including the use of large exclosures and reproductive control for does. Actions described under alternative A (e.g., use of small cages) would continue.

Large exclosures would be constructed throughout the park and would be relocated as vegetation regrowth exceeded 60 inches or 150 centimeters (deer-browsing height). Employees could be injured while constructing the exclosures; however, park staff typically exercise caution and apply safety techniques in all construction projects, as defined by the park's training and awareness activities.

Under this alternative, initial sterilization would involve gathering of does for treatment in a confined area around bait piles, possible use of holding pens, and transport of the does to the field station where the procedure would be performed. This could involve injuries to employees from deer handling and rounding up (such as being kicked or stabbed by antlers), but use of qualified federal employees or authorized agents, whose training and experience with such activities would help ensure safety, would minimize hazards. Additional reproductive control would involve treating does with a reproductive agent, which would most likely be remotely administered with a dart-type gun. Bait piles would be placed to lure does to treatment locations, concentrating efforts in safe areas. This activity would increase the potential of employee accident or injury. However, safety precautions would be followed, and training in the use of treatment methods would help ensure employee safety. If more than one shooting location was used to administer reproductive controls with dart guns, these areas would be adequately separated. If dart guns were not used, does would be captured and reproductive controls applied manually. Few if any injuries to employees are expected from this method since the capture and treatment of deer would be conducted by qualified federal employees or authorized agents who are professionally trained to perform these tasks. In addition, federal employees or authorized agents would also be qualified to handle live deer in order to prevent disease transmission and prevent harm to employees.

Although the level of employee involvement in deer management activities under this alternative would increase compared to alternative A, impacts would remain negligible to minor due to the safety precautions that would be taken and the use of properly trained personnel. Any adverse impacts to employees would also be short and long term for the reasons described above.

No impacts to park staff are expected from increased monitoring defined under this alternative.

### **Cumulative Impacts**

The cumulative scenario described under alternative A would also apply to alternative B. Accidents that might occur to employees conducting other park tasks, combined with the negligible impacts expected under this alternative, are expected to be adverse, long term, and negligible.

### **Conclusion**

Employees could be injured while constructing enclosures; however, park staff are trained to exercise caution and apply safety techniques in all construction projects. Reproductive control activities described under this alternative would be conducted by qualified federal employees or authorized agents, whose training and experience would help ensure their safety. Therefore, any adverse impacts to government employees would be short and long term and negligible to minor. Cumulative impacts would also be adverse, long term, and negligible.

## **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

### **Analysis**

Qualified federal employees or authorized agents would conduct direct reduction of deer through sharpshooting, and capture and euthanasia of individual deer would be used where sharpshooting would not be appropriate. Small caged areas and repellents would be used as under alternative A.

As described under alternative A, adverse, short- and long-term, negligible impacts related to erecting small caged areas and applying repellents would apply to this alternative as well.

The safety of park employees could be affected by sharpshooting and capture and euthanasia activities proposed under this alternative. Qualified federal employees or authorized agents would conduct the sharpshooting activities, and their experience in such efforts would help ensure the safety of park employees. If more than one shooting location was used to administer reproductive controls with dart guns, these areas would be adequately separated. Qualified federal employees or authorized agents would also capture and euthanize deer, as such actions would occur sporadically on an as-needed basis. Therefore, impacts to the safety of employees could increase from potential injuries (kicks, bites, stabbing with antlers) that could occur during deer handling. Every precaution would be taken to ensure the safety of employees, and employees would apply safety training and awareness activities designed to reduce safety risks. Activities would be in compliance with all federal firearm laws administered by the Bureau of Alcohol, Tobacco, and Firearms. Although more risks would be involved due to the use of firearms, adverse impacts to the safety of employees would be expected to be negligible to minor due to the safety precautions park staff would follow.

### **Cumulative Impacts**

The cumulative scenario described under alternative A would also apply to alternative C. Accidents that could occur to employees conducting other park tasks would combine with the negligible to minor impacts expected under this alternative from increased employee involvement in potentially dangerous deer management activities. Therefore, cumulative impacts would be adverse, long term, and negligible to minor.

### **Conclusion**

Although this alternative includes actions that could be dangerous to employees, adverse, short- and long-term, negligible to minor impacts would occur, due to safety precautions and property trained staff. Cumulative impacts would also be adverse, long term, and negligible.

## **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

### **Analysis**

Under alternative D, direct reduction would be implemented to reduce the size of the deer herd, and reproductive control would be used to maintain reduced deer herd numbers if feasible. Small caged areas and repellents would be used as under alternative A.

As described under alternative A, adverse, short- and long-term, negligible impacts related to erecting small caged areas and applying repellents would apply to this alternative as well. In addition, as described under alternative C, sharpshooting and capture and euthanasia would be used to reduce the deer herd during the first three years of this plan, which would increase the potential risk of injury due to the use of firearms and the need to capture and euthanize some deer. However, safety precautions taken by park staff would offset these risks, as described under alternative C. Reproductive controls would be implemented as described under alternative B to maintain the lowered deer population level after direct reduction efforts had reduced the population size. This would most likely involve remotely injecting deer with a reproductive control agent using a dart gun. This type of treatment could take more time than under alternative B because deer would probably become sensitive to the presence of humans and guns during the initial sharpshooting activities. Again, safety precautions would be followed to limit the potential for injury. Therefore, overall impacts to employees would be adverse, long term, and negligible to minor as park staff would engage in more potentially dangerous deer management tasks under this alternative. It is expected that any injuries sustained would be treatable by park staff and would result in less than eight hours of lost work time.

### **Cumulative Impacts**

The cumulative scenario described under alternative A would also apply to alternative D. Accidents that might occur to employees conducting other park tasks, combined with the negligible to minor impacts expected under this alternative, would result in long term, negligible to minor adverse cumulative impacts.

### **Conclusion**

Like alternative C, this alternative includes activities that would be potentially dangerous to employees. However, the extent of safety measures that would be employed would result in adverse, short- and long-term, negligible to minor impacts, as it is expected that any injuries sustained would be treatable by park staff and would result in less than eight hours of lost work time. Cumulative impacts would also be adverse, long term, and negligible to minor.

## SOCIOECONOMIC RESOURCES

### GUIDING REGULATIONS AND POLICIES

The *National Environmental Policy Act* requires that economic and social impacts be analyzed in an EIS when they are interrelated with natural or physical impacts. Economic impacts would potentially result from deer browsing damage to landscaping on private lands adjacent to the park as a result of changes in deer populations at Rock Creek Park; therefore, they are addressed in this document.

### ASSUMPTIONS, METHODOLOGY, AND INTENSITY THRESHOLDS

Because of the limited supply of deer forage within the park, deer that frequent the park may also browse on landscaping plants outside the park on adjacent public and private lands. It is assumed that deer that are habituated to the park may seek food sources outside the park as the quality and quantity of browse within the park decreases. The Maryland Department of Natural Resources indicates that the sex and age of the deer and habitat types will result in home foraging ranges of varying sizes. Yearling males will move many miles, whereas adult females usually have smaller, more consistent annual home ranges. Deer in quality habitat will travel less than deer in poorer quality habitat (MD DNR 2005).

Impact threshold definitions for socioeconomic conditions focus on landscaping depredation to neighboring lands and the number of complaints related to deer damage received by the park, and were defined as follows:

- Negligible:** No effects would occur, or the effects on neighboring landowners or other socioeconomic conditions would be below or at the level of detection.
- Minor:** The effects on neighboring landowners or other socioeconomic conditions would be small but detectable. The impact would be slight, but would not be detectable outside the neighboring lands and would affect only a few adjacent landowners.
- Moderate:** The effects on neighboring landowners or other socioeconomic conditions would be readily apparent. Changes in economic or social conditions would be limited and confined locally, and they would affect more than a few landowners.
- Major:** The effects on neighboring landowners or other socioeconomic conditions would be readily apparent. Changes in social or economic conditions would be substantial, extend beyond the local area, and affect the majority of landowners.

### AREA OF ANALYSIS

The area of analysis includes Rock Creek Park and the adjacent landowners.

## **IMPACTS OF THE ALTERNATIVES**

### **ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)**

#### **Analysis**

Under this alternative, park staff would continue to implement current management actions and policies related to deer and their effects. This would include deer population monitoring, as well as caging of small areas and using small amounts of repellents to protect native plants and ornamental landscaping. Current monitoring efforts would continue to record deer browsing impacts and deer population numbers within the park, although specific monitoring actions may be modified or discontinued over time, depending on the results and need for monitoring. Educational and interpretive activities would continue to be used to inform the public about deer ecology and park resource issues, and cooperation with regional entities and inter-jurisdictional agencies would continue. No additional deer management actions to reduce the deer population would occur under this alternative.

These controls would serve to protect important resources, but they would not affect the size of deer populations in the park. Deer populations would continue to remain at high levels and likely grow over time, although numbers would fluctuate annually due to winter temperatures, snow depths and duration of snow cover, food availability, reproduction and mortality rates due to herd health, and other factors.

**Landscaping Damage.** Private landowners adjacent to the park could experience increased deer browsing on plants in landscaped areas over the short and long term as food sources decreased within the park due to population pressures. Damage to landscaping may result in a decline in property values for affected landowners unless they undertake measures to replace damaged landscaping or pursue the protection mechanisms discussed below. These increases in the deer population could result in adverse, short- and long-term, moderate impacts.

**Protection Mechanisms and Costs.** Landowners would most likely incur additional costs for caging, repellents, and other forms of deer control to protect their landscaping as the deer population grows under this alternative. The time and monetary costs associated with acquiring additional protection measures would result in adverse, long-term, minor impacts to private landowners, depending on the number of landowners that used such measures.

#### **Cumulative Impacts**

Several factors have affected and may affect the landscaping in properties surrounding the park. The area around Rock Creek Park is densely developed, with very little open space. Development and activities within the park may cause increased habitat disruption, and as a result, more deer may forage outside the park during construction or times of disruption. This would result in short- and long-term minor impacts to adjacent landowners. Exotic plants both inside and outside the park have reduced deer forage, and other animals or pests may also damage landscaping. The socioeconomic impacts of all these activities would be both short and long term, adverse, and minor. Combined with the impacts of a continued high number of deer under alternative A, cumulative impacts would be long term, adverse, minor to moderate, and mostly localized to those properties along the park boundary.

#### **Conclusion**

Under alternative A, the continued high numbers of deer and likely long-term increase in the deer population in Rock Creek Park would result in additional damage to landscaping in the surrounding areas. Large fluctuations in annual deer populations could result in varying impacts, ranging from minor to moderate and adverse. Landowners would also incur additional costs for caging, repellents, and other

forms of deer control to protect their landscaping. Cumulative impacts would be adverse, long term, and minor to moderate due to the cost to replace landscaping and install deer protection mechanisms.

#### **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

##### **Analysis**

A combination of non-lethal actions would be implemented under alternative B, in addition to the actions described under alternative A, to protect forest seedlings, promote forest regeneration, and gradually reduce deer numbers in the park. The additional actions would include constructing large-scale fenced enclosures, and controlling doe reproduction through surgical sterilization and reproductive control. Repellents and small caged areas described under alternative A would continue to be used under alternative B.

Reproductive control of deer, if successful, would gradually reduce the population over the long term. However, deer numbers within the park would not be immediately reduced, and numbers would fluctuate annually. The forage range of the deer could expand due to reduced forage availability due to enclosures, resulting in greater deer browsing outside the park where food may be more plentiful. The number of deer that would seek food sources outside the park could be slightly greater under this alternative because the large-scale enclosures in the park would exclude deer from browsing on about 167 acres or about 10% of the main park reservation at any given time.

**Landscaping Damage.** Private landowners adjacent to the park could anticipate increased deer browsing on plants within landscaped areas over both the short and long terms. The degree of impact on landscaping could be greater than under alternative A because enclosures would prevent browsing on about 10% of the main park reservation at any one time and reduce the amount of forage in the park available to deer, which would result in the deer going outside the park for a food source. Adverse impacts would likely be moderate. The introduction of reproductive controls could reduce long-term impacts on landscaping to minor.

**Protection Mechanisms and Costs.** Landowners adjacent to the park would continue to incur additional costs for caging, repellents, and other forms of deer control to protect their landscaping. Because deer would be displaced from the park due to the enclosures, these costs would most likely be greater than in alternative A.

The time and monetary costs associated with additional protection measures would result in adverse, long-term, minor to moderate impacts to private landowners because protection costs could increase, similar to alternative A. The availability and effectiveness of reproductive controls in the future could reduce the intensity of these impacts because the deer population would decrease gradually, minimizing landscaping damage and reducing the need for protection mechanisms.

##### **Cumulative Impacts**

The cumulative impacts of alternative B would be similar to those described for alternative A, but with more intensity because of the continued reduction in available foraging areas within the park due to the construction of the large enclosures. This would force the existing deer population, which would not see any immediate decline due to the sterilization methods employed, to forage for food in adjacent properties, increasing the damage to landscaping and the expenditures needed to prevent and recover from deer damage. Over time, the deer population would decline as a result of sterilization of does in the herd; however, those effects would be slowly realized. The result of alternative B, in combination with other cumulative actions as described above, would be long term, adverse, and moderate.

## **Conclusion**

Under alternative B reproductive controls (if successful) would allow for only a gradual reduction in the number of deer, and there could be some displacement of deer from the park due to exclosures. The net effect on surrounding property could result in slightly greater damage to landscaping, the impacts of which would be long term and moderate. Landowners would also incur additional costs for caging, repellents, and other forms of deer control to protect their landscaping. Cumulative impacts would be long term, adverse, and moderate.

## **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

### **Analysis**

Under alternative C, sharpshooting (or capture and euthanasia) activities would quickly reduce the deer population, and subsequent actions would maintain the population at the desired density. This approach would primarily be implemented over 3 years, bringing the population down from the current level of approximately 82 deer per square mile to between 15 and 20 deer per square mile. Actions described under alternative A, such as small caging and use of repellents, would also continue.

**Landscaping Damage.** The removal of nearly 80% of the existing deer herd in Rock Creek Park in the short and long term would likely result in far fewer deer leaving the park to search for food because the habitat in the park could better support the reduced population. Acreage within the park would most likely provide sufficient browse for a reduced deer population. With this reduction in the deer population, the related reduction in landscaping damage would result in beneficial, long-term impacts to private landowners, assuming that park deer populations are currently foraging on private lands adjacent to the park. Adverse, short- and long-term impacts would be reduced from moderate under alternative A to negligible to minor under alternative C. However, if deer populations outside the park remained high, benefits would be more limited.

**Protection Mechanisms and Costs.** A corresponding decline in costs for caging, repellents, and other forms of deer control to protect landscaping could also occur as the park deer population was reduced. As a result, reduced time and monetary costs associated with protection measures would reduce adverse, long-term impacts to private landowners to minor because they might still incur protection costs, but the cost would likely decrease noticeably.

### **Cumulative Impacts**

The cumulative impacts of alternative C would be less intense than alternative A, due to the dramatic initial decline in deer population. Although some of the cumulative actions described in alternative A would reduce the availability of land available to deer for foraging, the reduced population would offset this impact; therefore, the deer population would be less likely to venture outside the park for food sources. Although some deer browsing-related damage would continue, it would be reduced, and the impacts would be reduced to a minor level. The result of alternative C, in combination with other cumulative actions, would result in overall long-term, adverse, and minor cumulative impacts to socioeconomics (neighboring landscaping).

## **Conclusion**

The reduction of the existing deer populations by approximately 80% in both the short and long term could result in fewer deer leaving the park and browsing landscaping on adjacent lands, assuming that these private lands are currently within the home range of the park deer population, with long-term beneficial effects that would reduce adverse impacts to negligible or minor levels. A corresponding decline in costs for caging, repellents, and other forms of deer control to protect landscaping could also

occur. Cumulative impacts would be beneficial compared to alternative A; long-term cumulative adverse impacts would be reduced to minor.

#### **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

##### **Analysis**

Under alternative D, a combination of certain additional lethal and non-lethal actions would be used to reduce deer herd numbers. The lethal actions would include both sharpshooting and capture/euthanasia, and these actions would be taken initially to quickly reduce the deer herd numbers. Reproductive control of does would also be implemented initially through sterilization. Population maintenance would be conducted via reproductive control, if feasible.

As demonstrated in the analysis for alternative C, direct reduction methods would be the most effective in limiting damage to landscaping resulting from deer. Non-lethal methods, such as small-scale caging and repellents that are analyzed in alternative A, would protect park resources from further damage, but would not reduce landscaping damage on lands adjacent to the park. Of the combined lethal and non-lethal methods under this alternative, the direct reduction method would most affect the degree of landscaping damage. Therefore, the impacts associated with alternative D would be the same as alternative C. Over the long-term, adverse impacts to adjacent landowners would be reduced to negligible or minor.

##### **Cumulative Impacts**

Cumulative impacts would be similar to those described for alternative C. Impacts associated with past, present, and future actions, when combined with the overall beneficial impacts of alternative D, would result in beneficial impacts compared to alternative A. Cumulative impacts would be long term, adverse and minor because some level of deer-browsing impacts would continue.

##### **Conclusion**

Of the combined lethal and non-lethal methods under this alternative, direct reduction methods would affect landscaping damage to the same degree as alternative C. Therefore, landscaping damage would be reduced, resulting in beneficial impacts. Deer browsing impacts would continue at some level, but adverse impacts to landowners, due to improved harvest yields and preserved landscaping, would be reduced to negligible or minor levels over the short and long term. Costs for caging, repellents, and other forms of deer control to protect landscaping would also decline. Cumulative impacts would be beneficial compared to alternative A, and adverse impacts would be reduced to minor.



## PARK MANAGEMENT AND OPERATIONS

Park management and operations refers to the current staff available to adequately protect and preserve vital park resources and provide for an effective visitor experience. This topic also includes the operating budget necessary to conduct park operations.

### METHODOLOGY AND INTENSITY THRESHOLDS

The discussion of impacts to park operations focuses on (1) the amount of staff available to ensure visitor and employee safety, and (2) the ability of park staff to protect and preserve resources given current funding and staffing levels. It was assumed that under all alternatives the park's annual budget would be increased to implement a particular alternative. However, this funding is not guaranteed; each alternative discusses the impacts of receiving or not receiving additional funding. Park staff knowledge was used to evaluate the impacts of each alternative, and the evaluation is based on the description of park operations presented in chapter 3. Definitions of impact levels are as follows:

- Negligible:** Park operations would not be affected.
- Minor:** Park operations would be affected, and the effect would be detectable, but current levels of funding and staff would be adequate and other park operations would not be reduced.
- Moderate:** Park operations would be affected, the effect would be readily apparent, and increased staff and funding would be needed or other park operations would have to be reduced and/or priorities changed.
- Major:** Park operations would be affected, the effect would be readily apparent, increased staff and funding would be needed or other park programs would have to be eliminated.

### AREA OF ANALYSIS

The area of analysis is Rock Creek Park, including the cumulative impacts analysis.

### IMPACTS OF THE ALTERNATIVES

#### ALTERNATIVE A: NO-ACTION ALTERNATIVE (EXISTING MANAGEMENT CONTINUED)

##### Analysis

Under alternative A, the existing deer management plan which calls for limited caging, use of repellents in landscaped areas, monitoring, and data management and research, would continue, with assistance from the Student Conservation Association (1 to 2 volunteers) and the NPS Center for Urban Ecology. No new deer management actions would be taken. These controls would serve to protect important resources, but they would not affect the size of the deer population in the park.

The park's deer population would continue at high levels and would likely grow over time, although numbers would fluctuate annually due to winter temperatures, snow depths and snow duration, food availability, reproduction and mortality rates due to herd health, and other factors. Existing park staff would be sufficient to continue performing current deer management functions at the present population level. However, as the deer population continued to grow, more time would have to be devoted to these activities, which would leave less time for other duties. Two resource management employees work with deer management activities, and these actions comprise about 10% to 15% of their time. Additional

management responsibilities, as well as any additional funding that might be needed to build and maintain additional caging and purchase repellents, would result in long-term, minor to moderate adverse impacts. Current deer management would become a permanent component of Rock Creek Park's resource management activities, as adverse impacts to forest health would continue indefinitely into the future. The NPS Center for Urban Ecology would continue to provide inventory and monitoring services. The use of the Student Conservation Association would be expected to continue, which includes payment of a stipend and provision of housing.

Under this alternative, Rock Creek Park staff would also monitor the costs of the deer management program, including costs related to staff time, training, administrative, legal, public relations, and monitoring. If deer management costs increased substantially, funds and personnel from other park divisions might have to be reallocated (e.g., from administration and maintenance), resulting in adverse, long-term, minor impacts to other divisions. Also, if a need arose for additional education and interpretation programs conducted at the park, present funding and staffing would need to be supplemented, resulting in a minor adverse effect.

### **Cumulative Impacts**

Needs related to park operations and maintenance have been, and would continue to be, affected by outside influences, as well as demands related to the implementation of other park plans and resource programs. Increased traffic on park roadways and continued high levels of visitation would continue to require staff time and resources to deal with road maintenance, accident response, and visitor needs and inquiries. U.S. Park Police would continue to assist the park with law enforcement, a long-term positive impact. As the cost of goods and services rises faster than the park's operating budget, staff continue to accomplish the park's mission and maintain the visitor experience with fewer financial resources. These demands result in long-term, minor adverse impacts to park operations.

Under alternative A, it is expected that funding would continue for current deer management activities, but the demand for those activities could increase if the deer population continued to grow and/or remain at high levels and cause impacts to park resources. Responding to other needs would result in reduced funding to carry out park activities. Therefore, the effects of all other actions that place demands on park management and operations, along with the expected demands of deer management, would result in, long-term, moderate adverse impacts to park operations and maintenance.

### **Conclusion**

Impacts to park operations and maintenance under alternative A would be adverse, long term, and minor to moderate. Because present deer management actions would continue, the park's deer population is expected to continue to fluctuate and remain at high levels or increase over the long term, resulting in long-term demands on park staff and funding for managing the deer herd and protecting other park resources. Past, present, and future activities, when combined with actions under this alternative, would result in adverse, long-term, moderate cumulative impacts.

## **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

### **Analysis**

Under this alternative several non-lethal actions would be implemented to protect forest resources and reduce deer numbers in the park, including the use of large-scale exclosures and doe reproductive control. Repellents and the small caged areas described under alternative A would continue to be used. The participation of the Center for Urban Ecology and the Student Conservation Association in park programs would be expected to continue.

Similar to alternative A, deer populations would continue to remain at high levels, pending the allocation of reproductive controls, and numbers would likely continue to fluctuate annually. The non-lethal management measures outlined under alternative B would require additional staff time and seasonal staff, for which additional funding would be needed. Additional temporary staff would likely be needed for the initial construction of the large enclosures, and additional staff time would be needed for long-term maintenance. It is anticipated that the construction of 14 exclosures would take up about 150 days to complete (K. Ferebee, pers. comm. 2008d). If staff from other park divisions were used, park operations in those divisions would be adversely affected during the construction period.

In addition to an increase in temporary staffing, additional funding would be required, as the initial cost of installing the 14 exclosures would be approximately \$227,700 for supplies and labor. After the initial construction, the exclosures would be relocated every 10 years, at an estimated cost of \$170,775 for supplies and labor. These costs would be in addition to the park's present budget.

Maintaining the large exclosures would require additional staff, especially if large storm events or natural disasters required the exclosures to be repaired or removed. Furthermore, to reduce impacts to visitors as much as possible, some exclosures would be located in more remote areas of the park, adding to maintenance costs. Additional staff time would be needed to inspect and maintain the exclosures, estimated at approximately four visits per year and assuming 48 days to cover all of the exclosures, the yearly labor cost would be approximately \$17,535. An additional \$10,317 per year would be estimated for materials and additional visits for weather-related maintenance needs. The additional staff time and funds required for regular maintenance of the large exclosures would result in increased funding needs, with adverse, long-term, moderate impacts.

Alternative B would include reproductive control of does, with sterilization completed in the first five years, at an estimated cost of \$225,000. Costs for continued reproductive control would depend on the number of deer treated and the current available technology. Assuming the use of leuprolide (or similar agent) as described in chapter 2, costs would be approximately \$1,000 per deer. If 10 does are treated, the annual cost would total \$10,000, with \$5,000 yearly monitoring costs.

Labor for the reproductive control efforts would be provided by qualified federal employees or authorized agents, including funding for a veterinarian to perform the surgery. This option would likely result in adverse, long-term, moderate impacts to the park budget because of the large amount of time and labor involved, most likely reducing the time available for other efforts. Impacts are expected to be adverse, long term, and moderate for reproductive control.

This alternative would also involve increased educational and interpretive activities, and would therefore require additional funding and/or additional staff time to implement these activities. Increased responses to inquiries about the actions taken under this alternative would likely increase the workload of park biologists, rangers, and the Superintendent. This would result in moderate adverse impacts to resource education and resource protection staff, which would decline to minor levels over time.

Overall, the activities associated with alternative B would result in adverse, long-term, moderate impacts for installing large exclosures, conducting reproductive control, and increased educational/interpretive activities.

### **Cumulative Impacts**

The same past, present, and future actions described under alternative A would continue under this alternative, including additional demands on the park's budget for other resource programs and to respond to natural phenomena. In conjunction with actions under this alternative, impacts to park management and operations would be long term, moderate, and adverse.

## **Conclusion**

Alternative B would result in, long-term, moderate adverse impacts on park management and operations from installing and maintaining large exclosures and implementing and monitoring reproductive controls. Past, present, and future activities, when combined with actions under this alternative, would result in adverse, long-term, moderate cumulative impacts.

## **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

### **Analysis**

Sharpshooting would be used to quickly reduce the herd size, with capture and euthanasia applied in certain circumstances. The existing deer population would be reduced over a period of three years to about 15 deer per square mile, or a park population of 69 deer. Additional deer would be removed in subsequent years to maintain the population. Alternative C would include the actions described under alternative A, including limited caging, use of repellents in landscaped areas, monitoring, and data management and research. It is assumed that the participation of the NPS Center for Urban Ecology and the Student Conservation Society in park programs would continue.

The addition of these lethal management measures would require additional staff time to accompany the qualified federal employees or authorized agents conducting sharpshooting activities. Removal activities would require obtaining permits, setting up bait stations, locating deer, sharpshooting, and handling the disposition of meat. In addition to the actual reduction activity, time would be required to coordinate the details of the reduction activity.

Costs to the park for direct reduction through sharpshooting would vary, depending on a number of factors, including the number of deer to be removed each year, access to deer, number and location of bait stations, training requirements, equipment availability, amount of data to be collected from the deer, and processing or disposal requirements. Based on similar removal efforts, the estimated cost for the park to implement direct reduction through sharpshooting would be \$200 per deer initially, increasing to \$400 per deer as the population decreased and more effort was required to locate deer, including actions to maintain the herd at the reduced level once the initial goal was achieved. Over the 15-year planning period for the deer management plan, sharpshooting efforts are estimated to cost approximately \$399,100, with a large portion of that total for support of USPP security and park closure requirements. The majority of project funding, including all deer reduction activities and management of these, would be the responsibility of the park. Any assistance offered by the park's staff would be considered part of regular duties, rather than project specific, and would not require additional project funding. Due to the amount of time required by park staff to participate in these activities and the funding increase that would need to be applied for, impacts would be adverse and moderate during the period of the reduction efforts.

Where direct reduction by sharpshooting was not possible due to safety concerns (e.g., near adjacent properties), capture and euthanasia would be implemented by qualified federal employees or authorized agents. Because this method would only be used in certain situations, the cost would vary depending on the conditions at each removal site, including the location of the removal, accessibility, type of trap or immobilization drug used, how deer were disposed of, and the type of euthanasia used. Based on experience of park personnel and the range of costs identified for capturing deer under the reproductive control action, the costs could range from \$100 to \$1,000 per deer, and an average of about \$500 per deer was assumed for costing purposes. This action would require increased funding and result in adverse, long-term, moderate impacts.

As part of this alternative, both deer population studies and vegetation monitoring would be conducted to document any changes in deer browsing and forest regeneration that may result from reduced deer numbers. This monitoring program would continue after the density goals were reached to determine if vegetation was showing signs of recovery. This monitoring would be similar to current park efforts that

are already scheduled to continue and would result in long-term minor impacts to park operations and maintenance.

This alternative would also involve increased educational and interpretive and management activities, and would therefore require additional funding and/or additional staff time to implement these activities. This would result in moderate adverse impacts to resource education and resource protection staff. Moderate adverse impacts could also be expected due to time needed to answer public inquiries about the actions taken, particularly sharpshooting. This need would likely decline over the years, and adverse impacts would be expected to be reduced to minor levels over time.

The combination of these lethal reduction alternatives would result in a greater reduction of deer over a shorter period of time, when compared to alternative A. As the number of deer declined in the park, the need for deer management and associated educational/interpretative activities would decline, allowing park staff to apply their efforts to other management areas. This would result in a reduction of adverse, long-term impacts from moderate to minor under this alternative.

### **Cumulative Impacts**

Cumulative impacts would be similar to those described under alternative A. Under alternative C, it is expected that funding would continue for current deer management activities and that funding for additional lethal management measures would be received, resulting in minor impacts as discussed above. With the expected funding needed for other resource programs and to respond to natural phenomena, the cumulative impact to park management and operations would be long term, adverse, and minor to moderate, depending on the severity of these future actions.

### **Conclusion**

Alternative C would result in adverse, moderate impacts during the period of direct reduction efforts because of the need for additional staff time for monitoring and coordinating activities. However, the use of qualified federal employees or authorized agents would reduce the amount of park staff time needed for implementation. With the greater reduction of deer over a shorter period of time, park staff would have more time to apply their efforts to other areas of the park when compared to alternative A, which would reduce adverse, long-term impacts from moderate to minor over time. Past, present, and future activities, when combined with actions under this alternative, would result in adverse, long-term, minor to moderate cumulative impacts.

## **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

### **Analysis**

Alternative D would include the actions described under alternative A plus direct reduction to initially reduce the deer herd. Then reproductive control would be used to maintain the herd at acceptable levels. The participation of the NPS Center for Urban Ecology and the Student Conservation Association in park programs would be expected to continue.

The lethal management measures under alternative D would be the same as those described under alternative C. Costs to the park would vary from \$200 to \$400 per deer, as described under alternative C. Over the 15-year life of the deer management plan, sharpshooting efforts would cost approximately \$241,900, with a large portion of that supporting USPP security and closure activities (assuming this occurs only in years 1-3). The majority of project funding, including all deer reduction activities, and management of these, would be the responsibility of the park. Any assistance offered by the park's staff would be considered part of regular duties. Impacts are expected to be adverse, long term, and moderate.

Where direct reduction by sharpshooting was not possible due to safety concerns, capture and euthanasia would be implemented by qualified federal employees or authorized agents. As described under

alternative C the costs would average about \$500 per deer, but could vary based on situation conditions. Although limited staff time would be required since actions would be carried out by qualified federal employees or authorized agents, park staff would be involved in coordinating activities and an increase in funding would be required, resulting in adverse, long-term, moderate impacts.

After the initial reduction in density, alternative D would use reproductive control of the park's deer population by the methods described under alternative B if feasible. Costs for reproductive control are estimated at \$567,000, assuming treatment of 41 does annually starting in year 4, including an annual \$5,000 cost for additional surveys. Park staff would need to spend additional time and labor to coordinate and monitor activities, resulting in adverse, long-term, moderate impacts.

This alternative would also involve increased educational and interpretive activities, and would therefore require additional funding and/or additional staff time to implement these activities. There would be moderate adverse impacts to resource education and visitor protection staff as a result, which would decline to minor adverse levels over time.

Overall, the combination of non-lethal and lethal management alternatives and the associated educational/interpretive activities would have adverse, long-term, moderate impacts to park management and operations during the period of direct reduction and reproductive control. Once the deer herd was reduced, more staff time would be available for other activities, resulting in adverse, long-term, minor impacts.

### **Cumulative Impacts**

Cumulative impacts would be similar to those described under alternative A. Under alternative D, funding would continue for current deer management activities, resulting in minor to moderate impacts as discussed above. With the expected funding needed for other resource programs and response to natural phenomena, the cumulative impact to park operations and maintenance would be adverse, long term, and minor to moderate, depending on the severity of these future actions.

### **Conclusion**

Alternative D would result in adverse, long-term, moderate impacts, as park staff involvement would be required for coordination and monitoring. Funding for these activities would be applied for and expected to be received. Once the deer herd was reduced, more staff time would be available for other activities, resulting in adverse, long-term, minor impacts. Past, present, and future activities, when combined with actions under this alternative, would result in adverse, long-term, minor to moderate cumulative impacts.

## UNAVOIDABLE ADVERSE IMPACTS

The NPS is required to consider if the alternative actions would result in impacts that could not be fully mitigated or avoided (NEPA section 101[c][ii]).

### **ALTERNATIVE A: NO-ACTION ALTERNATIVE (CONTINUE EXISTING MANAGEMENT)**

Under alternative A, there would be long-term, unavoidable adverse impacts to vegetation (including some wetland vegetation), deer and other wildlife, and rare or unique species due to the continued high number of deer in the park over time and the associated damage to park vegetation. In addition, there would be continued unavoidable minor adverse impacts to soils and water quality due to the removal of vegetation from deer browsing and subsequent erosion and sedimentation, and unavoidable adverse impacts to those wildlife species that depend on ground cover and seedlings for their food and/or cover. There would also be long-term unavoidable adverse impacts on cultural landscapes and on visitor use and experience, because of the lack of vegetation and the associated wildlife and scenery which many park visitors enjoy, and unavoidable adverse impacts to visitor safety related to deer-vehicle collisions. Unavoidable adverse impacts would continue on park management and operations, due to the demand on park staff related to continued deer monitoring and resource management.

### **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

Alternative B would include most of the unavoidable adverse impacts described for alternative A over the life of the plan, since the benefits of reproductive control would not be realized until much later, given the length of time needed to realize a reduction in deer herd numbers based solely on reproductive control. Unavoidable adverse effects may occur to other wildlife species affected by the exclosures. Unavoidable adverse impacts may occur to some sensitive plant species due to the continued high numbers of deer and their browsing; this would be mitigated somewhat by the use of the exclosures, however. Reproductive control may have some unavoidable adverse impacts if the actions taken were visible or disturbingly audible to park visitors. Providing interpretive materials may help mitigate some of this effect; however, reproductive control as proposed under this alternative could occur during relatively high visitor use periods and would require a substantial effort to treat the required number of deer. Unavoidable adverse impacts to park operations and management would increase compared to alternative A, due to the demands on staff for implementation of the program.

### **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

Unavoidable adverse impacts for this alternative would be greatly reduced compared to alternatives A and B, because the reduction in deer numbers would occur rapidly and the park's vegetation would begin to recover over the life of the plan. This would mitigate adverse effects to vegetation, deer and other wildlife, and sensitive/rare plants. Some wildlife that prefer more open habitat would be unavoidably impacted as the vegetation recovered. There may be some unavoidable adverse effects to visitors relating to the implementation of the sharpshooting or capture and euthanasia, if the visitors happened to be near areas where this was occurring and were disturbed by these actions. Conducting sharpshooting at night and providing interpretive materials would help mitigate some adverse effects. Unavoidable adverse impacts to park operations and management would increase compared to alternative A, due to the demands on staff for implementation of the program.

### **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

Unavoidable adverse impacts for this alternative would be essentially the same as those described for alternative C, although use of reproductive controls for long-term maintenance of the deer herd would

## *Environmental Consequences*

involve a greater commitment of staff and resources and result in greater unavoidable adverse impacts to park management and operations.

## **SUSTAINABILITY AND LONG-TERM MANAGEMENT**

In accordance with NEPA, and as further explained in Director's Order 12, consideration of long-term impacts and the effects of foreclosing future options should pervade any NEPA document. According to Director's Order 12, and as defined by the World Commission on Environment and Development, "sustainable development is that which meets the needs of the present without compromising the ability of future generations to meet their needs." For each alternative considered in a NEPA document, considerations of sustainability must demonstrate the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. This is described below for each alternative.

The NPS must consider if the effects of the alternatives involve tradeoffs of the long-term productivity and sustainability of park resources for the immediate short-term use of those resources. It must also consider if the effects of the alternatives are sustainable over the long term without causing adverse environmental effects for future generations (NEPA section 102(c)(iv)).

### **ALTERNATIVE A: NO-ACTION ALTERNATIVE (CONTINUE EXISTING MANAGEMENT)**

Alternative A would trade any long-term productivity for short-term use of park resources. The deer population would likely continue to grow over time or remain at high levels, and use the park's vegetation at the expense of the long-term productivity and sustainability of the vegetation and other affected wildlife in the park, as well as the park's cultural landscapes. Impairment of the park's vegetation, certain wildlife and wildlife habitat, and ground-dependent sensitive/rare species would likely occur over the long term.

### **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

Alternative B would involve a similar trade for short-term use of park resources at the expense of long-term productivity for the duration of the plan, since the reproductive controls would not reduce the numbers of deer in the park over the life of the plan. The construction of the exclosures would involve short-term impacts related to their construction and visual impacts to visitors, but they would help preserve some of the park's long-term productivity. They would only protect a small portion of the park's woody vegetation over time, and only 5% of the park's herbaceous vegetation at any one time. This 5% would meet the suggested need to protect a minimum of 5% to 10% of the park's forested area at any one time (Bowersox, pers. comm. 2005), and therefore, impairment of vegetation and certain wildlife or rare species is not expected over the long term. However, for this alternative to be truly sustainable, the reproductive control aspect must be continually managed and successful, and exclosures would need to be relocated to many areas of the park over time.

### **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

Under alternative C, there would be a short-term commitment of human resources and short-term impacts to the park's visitors and environment during deer removal actions, but with the result of long-term productivity of the park's vegetation and habitat and a sustainable use of the resources in the park. No impairment of park resources would occur, but to be sustainable, this alternative will require long-term management, including monitoring and adaptive management to protect park productivity.

### **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

Alternative D would have the same long-term sustainability characteristics as alternative C, except that it would require more resources focused on the reproductive control aspect, since it is experimental in a free-ranging population.



## **IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES**

The NPS must consider if the effects of the alternatives cannot be changed or are permanent (that is, the impacts are irreversible). The NPS must also consider if the impacts on park resources would mean that once gone, the resource could not be replaced; in other words, the resource could not be restored, replaced, or otherwise retrieved (NEPA section 102[c][v]).

### **ALTERNATIVE A: NO-ACTION ALTERNATIVE (CONTINUE EXISTING MANAGEMENT)**

Under alternative A, impacts to vegetation (particularly the forest understory) from continued overbrowsing by deer could result in irreversible impacts to Rock Creek Park's forests if no actions are ever taken to reduce deer numbers. Exotic plants that are not palatable to deer would continue to exploit openings in the understory, and animal species that rely on native ground vegetation might not remain in or return to Rock Creek Park if the forest understory does not regenerate. Deer browsing has already resulted in the reduction of understory plant species at Rock Creek Park. Even if caging were used to protect some of the sensitive species, it would be impossible to identify all individual plants, and overbrowsing of new plants located outside the caged areas could occur. In addition, the health of deer herd at Rock Creek Park could suffer irretrievable adverse effects if no action is taken.

### **ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS**

Alternative B has the potential for some irreversible impacts, if some areas of the park's forests are adversely affected to the point of nonregeneration or if invasive exotic plants take over some denuded areas before reproductive controls have had time to stabilize the deer herd numbers. Exclosures will not cover the entire park, and so some of the irreversible impacts described for alternative A would likely occur under alternative B as well.

### **ALTERNATIVE C: COMBINED LETHAL ACTIONS**

This alternative presents the least potential for irreversible or irretrievable commitments of resources. Although deer would be removed, the deer population would continue at a sustainable level. Because the herd would be reduced rapidly, there would be little chance that park vegetation (including sensitive/rare species) or other species that are dependent upon forest understory and native ground cover would be irretrievably lost, since forest regeneration would begin within the life of the plan.

### **ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS**

This alternative is essentially the same as alternative C, with very little potential for irreversible or irretrievable commitments of resources. Because the herd would be reduced rapidly, there would be little chance that park vegetation (including sensitive/rare species) or other species that are dependent upon forest understory and native ground cover would be irretrievably lost, since forest regeneration would begin within the life of the plan.



## CONSULTATION AND COORDINATION

The intent of the *National Environmental Policy Act* (NEPA) is to encourage the participation of federal and state-involved agencies and affected citizens in the assessment procedure, as appropriate. This section describes the consultation that occurred during development of this *Draft White-tailed Deer Management Plan / Environmental Impact Statement* (plan/EIS), including consultation with scientific experts and other agencies. This chapter also includes a description of the public involvement process and a list of the recipients of the draft document.

### HISTORY OF PUBLIC INVOLVEMENT

The public involvement activities for this plan/EIS fulfill the requirements of NEPA and the National Park Service (NPS) Director's Order 12 (NPS 2001).

### THE SCOPING PROCESS

The NPS divides the scoping process into two parts: internal scoping and external or public scoping. Internal scoping involved discussions among NPS personnel regarding the purpose of and need for management actions, issues, management alternatives, mitigation measures, the analysis boundary, appropriate level of documentation, available references and guidance, and other related topics.

Public scoping is the early involvement of the interested and affected public in the environmental analysis process. The public scoping process helps ensure that people have an opportunity to comment and contribute early in the decision-making process. For this planning document and impact statement, project information was distributed to individuals, agencies, and organizations early in the scoping process, and people were given opportunities to express concerns or views and to identify important issues or even other alternatives.

Taken together, internal and public scoping are essential elements of the NEPA planning process. The following sections describe the various ways scoping was conducted for this impact statement.

### INTERNAL SCOPING

The internal scoping process began on July 13, 2005, at Rock Creek Park, Washington, D.C. During the three-day meeting, NPS employees identified the purpose of and need for action, management objectives, issues, and impact topics. Various roles and responsibilities for developing the deer management plan were also clarified. The results of the meetings were captured in an "Internal Scoping Report," now on file as part of the administrative record.

In addition, the park had coordinated with many technical experts for over 10 years prior to starting the planning process and established a Science Team to provide input to this plan, as described in "Chapter 1: Purpose of and Need for Action." Comprised of subject matter experts, the Science Team was chartered to advise and provide technical recommendations to the NPS on matters regarding scientific data and analysis. The team met five times over a period of five months to review and supplement necessary background information and needed data. The team also recommended impact analysis techniques and various management options, and they provided technical review of draft documents. Members of the Science Team are listed with the document preparers in this chapter.

## **PUBLIC SCOPING**

### **Public Meetings and Comments**

In addition to internal scoping within the NPS and with other public officials, public scoping for the plan/EIS began with the publishing of the Notice of Intent in the Federal Register on September 20, 2006, and concluded on December 8, 2006. During this time, two public scoping meetings were held (November 1 and November 2, 2006) that included an open house, presentation by the NPS, and an opportunity for formal public comment. The purpose of these meetings was to solicit public input, especially on issues and ideas for alternatives. The meetings were held at the Rock Creek Nature Center in Washington, D.C. Notices of the meetings were posted on the NPS's Planning, Environment, and Public Comment (PEPC) website. Additionally, a newsletter was mailed in October 2006 to the project's preliminary mailing list of government agencies, organizations, businesses, and individuals. The newsletter announced the public scoping meetings and summarized the purpose of and need for a deer management plan, the plan objectives, and the history of Rock Creek Park's deer research and management.

During the comment period, 34 pieces of correspondence were received that contained 140 comments. The majority of the public comment received focused on various alternatives and alternative elements. Other comments expressed concern about the impacts to vegetation from the deer herd and while others encouraged the NPS to ensure that the proper methodologies and assumptions were made with regard to the deer population as well as other components of the Rock Creek Park ecosystem.

## **AGENCY CONSULTATION**

Letters initiating consultation under Section 7 of the Endangered Species Act and Section 106 of the National Historic Preservation Act, and and/or requesting information or comments, were sent to the following agencies:

- U.S. Fish and Wildlife Service – June 17, 2008
- Maryland Department of Natural Resources Wildlife and Heritage Service – October 27, 2008
- District Of Columbia Historic Preservation Office – June 18, 2008
- National Capital Planning Commission- June 18, 2008
- The Commission of Fine Arts – June 18, 2008

Copies of these letters are provided in appendix F. One response was received on July 18, 2008 from the District Historic Preservation Office; it is included at the end of appendix F. A copy of this draft plan/EIS will be sent to the District Historic Preservation Office to complete Section 106 compliance and to U.S. Fish and Wildlife Service to complete Section 7 consultation.

## **LIST OF RECIPIENTS OF THE DRAFT PLAN ENVIRONMENTAL IMPACT STATEMENT**

This plan/EIS will be sent to the following agencies, organizations, and businesses, as well as to other entities and individuals who requested a copy.

### **CONGRESSIONAL DELEGATES**

- Eleanor Holmes Norton, District of Columbia Delegate
- Christopher Van Hollen, Jr., 8th Congressional District, Maryland

- Donna F. Edwards, 4th Congressional District, Maryland
- Barbara Mikulski, U.S. Senate, MD
- Benjamin L. Cardin, U.S. Senate, MD

#### **FEDERAL AGENCIES**

- Chesapeake and Ohio Canal National Historic Park
- Smithsonian National Zoo and National Zoo Police
- State Department—Embassies
- U.S. Department of Agriculture, Wildlife Services
- U.S. Environmental Protection Agency
- U.S. Geological Survey
- U.S. Fish and Wildlife Service, Chesapeake Bay Field Office
- U.S. Navy, Naval Observatory
- U.S. Park Police
- U.S. Secret Service

#### **DISTRICT OF COLUMBIA AND LOCAL GOVERNMENTS**

- Advisory Neighborhood Commissions
- Commission of Fine Arts
- D.C. City Council
- D.C. Department of Environment, Fisheries and Wildlife Division
- D.C. Department of Health, Animal Disease Prevention Division
- D.C. Department of Recreation, Office of Planning and Policy
- D.C. Department of Transportation
- D.C. Fire and Emergency Services
- D.C. Historic Preservation Office, State Historic Preservation Officer
- D.C. Metropolitan Police Department
- D.C. Office Of Planning
- D.C. Office of Tourism and Promotion
- Maryland Department of Natural Resources, Wildlife and Heritage Service
- Maryland National Capital Park and Planning Commission – Montgomery County
- Metropolitan Washington Council of Governments
- National Capital Park and Planning Commission
- Washington Metropolitan Area Transit Authority

#### **ORGANIZATIONS/OTHER**

- AAA Potomac
- Adjacent Property Owners
- American Automobile Association, National Office
- American Recreation Coalition
- Animal Welfare Institute
- Arizona Bowhunters Association
- Audubon Naturalist Society Central Atlantic States
- Audubon Naturalist Society of the District of Columbia
- Blair Road Garden Association
- Chesapeake Bay Foundation, District of Columbia Office
- Chesapeake Bay Program Office, NPS

## *Consultation and Coordination*

- Chevy Chase Citizens Association
- Crestwood Citizen's Association
- Defenders of Wildlife
- Earth Justice
- Fort Reno Garden Association
- Fort Stevens Garden Association
- Friends of Animals
- Friends of Montrose and Dumbarton Oaks Park
- Friends of Peirce Mill
- Friends of Rock Creeks Environment (FORCE)
- Friends of the Earth
- Glover Park Garden Association
- Glover Park Citizens' Association
- Golf Course Specialists Inc
- Green Peace
- Hillandale Citizens Association
- Hillwood Museum
- Humane Society of the United States
- Interstate Commission of Potomac River Basin
- Izaak Walton League of America
- Jonathan Woodner C., Woodner Apts.
- Mamie D. Lee Garden Association
- Maryland Native Plant Society
- Maryland Ornithological Society
- Meadowbrook Riding Stables
- Melvin Hazen Garden Association
- National Park Foundation
- National Parks and Conservation Association
- National Wildlife Federation
- National Zoological Park, Smithsonian
- Nature Conservancy
- Oak Hill Cemetery
- Peabody Garden Association
- People for the Ethical Treatment of Animals (PETA)
- Potomac Appalachian Trail Club
- Rock Creek Garden Association
- Rollingwood Citizens Association
- Sierra Club, DC Chapter
- The Northwest Current
- The Shoreham North
- The Washington DC Examiner
- Tilden Gardens
- Trail Riders of Tomorrow (TROT)- 50
- Walter Reed Army Medical Center
- Washington Area Bicycle Association
- Washington City Paper
- Washington Human Society

*List of Preparers and Consultants Consultation and Coordination Consultation and Coordination*

- Washington Parks and People
- Washington Post
- Washington Regional Network for Livable Community
- Washington Tennis Foundation
- Washington Times
- Whitehaven Garden Association
- William H.G. Fitzgerald Tennis Center
- Woodland Normanstone Neighborhood Association

## SCIENCE TEAM MEMBERS

<b>Name</b>	<b>Title</b>	<b>Organization / Location</b>
Ken Ferebee	Natural Resource Management Specialist/Park Contact	NPS – Rock Creek Park
William McShea	Research Scientist	National Zoological Park (NZN)/WCS Joint Appalachian Forest Ecology Program
Bill Hamilton	Wildlife Ecologist in charge of deer management program	Maryland National Capital Park and Planning Commission (MNCPPC) Wheaton Regional Park Natural Resources Management Offices
Allan O’Connell, Jr.	Wildlife Biologist	USGS Patuxent Wildlife Research Center
Diane Pavek	National Capital Region (NCR) Botanist	NPS/NCR – Center for Urban Ecology
Scott Bates	NCR Wildlife Biologist	NPS/NCR – Center for Urban Ecology
Jim Sherald	Chief, Natural Resources and Science	NPS/NCR – Center for Urban Ecology
Sue Salmons	NCR Exotic Plant Management Team Liaison	NPS/NCR – Center for Urban Ecology
Shawn Carter	NCR Inventory and Monitoring Coordinator	NPS/NCR – Center for Urban Ecology
Beth Kunkel	Wildlife Biologist – Team Facilitator	Kimley–Horn and Associates, Inc.
Rusty Schmidt	Biologist	URS Corporation
Kevin Sullivan	Director for the states of Maryland; Delaware; and Washington, D.C.	U.S. Department of Agriculture (USDA), Wildlife Services
Zach Bolitho	Resources Planning Office Natural Resource Specialist	NPS – Gettysburg National Military Park and Eisenhower National Historic Site
Bert Frost	Deputy Associate Director	NPS – Natural Resource Stewardship and Science, Gettysburg
Jon Siemien	Program Manager for Fisheries and Wildlife Management in District of Columbia	District of Columbia – Department of Health Environmental Health Administration
Mary Pfaffko	Wildlife Biologist for Fisheries and Wildlife Management in District of Columbia	District of Columbia – Department of Health Environmental Health Administration
Michael Mayer	Wildlife Biologist	NPS Environmental Quality Division (EQD)
Randy Knutson	Wildlife Biologist for Indiana Dunes National Lakeshore (IDNL)	National Park Service, IDNL

## LIST OF PREPARERS AND CONSULTANTS

Name	Title	Education/Responsibility	Experience
<b>National Park Service</b>			
Ken Ferebee	Natural Resource Management Specialist, Rock Creek Park	B.S. in Forestry and Wildlife. Provided input and review; point of contact for Rock Creek Park.	19 years with NPS
James Sherald	Chief of Natural Resources and Science, Center for Urban Ecology	B.S. Ornamental Horticulture, M.S., Ph.D. in Plant Pathology. Provided input and review.	
Dan Sealy	Deputy Chief of Natural Resources and Science, Center for Urban Ecology	B.S. Natural Resource Management. Provided input and review.	33 years with NPS
Adrienne Coleman	Superintendent, Rock Creek Park	Manages Rock Creek Park.	22 years with NPS
Cindy Cox	Deputy Superintendent, Rock Creek Park	B.S. Ornamental Horticulture. Manages Rock Creek Park.	22 years with NPS
Scott Bates	Regional Wildlife Biologist NPS — Center for Urban Ecology	B.S. Biology; M.S. Wildlife Management. Provided technical input.	8 years with NPS NCR and 9 years with DoD as a wildlife biologist
Diane Pavek	Research Coordinator and Botanist	B.S. in Botany and Zoology; M.S., Ph.D. in Botany. Provided technical input.	25 years in botany; 9 years with NPS
Michael Mayer	Environmental Protection Specialist (EQD) – no longer with NPS	B.S. Wildlife and Fisheries Biology; M.S. Wildlife Conservation; J.D. Environmental Law. Responsible for NEPA policy, guidance, and technical review. Project manager, technical reviewer.	10 years
Melissa Stedeford	Environmental Protection Specialist (EQD)	B.S. Environmental Science; M.S. Environmental Science. Responsible for NEPA policy, guidance and technical review. Project manager.	3 years
<b>Kimley-Horn and Associates, Inc.</b>			
Beth Kunkel	Wildlife Biologist and Environmental Planner	B.S. Wildlife Management. Responsible for facilitation of Science Team meetings, helped developed action thresholds, prepared alternatives description (chapter 2).	18 years
<b>The Louis Berger Group, Inc.</b>			
Juanita Barboa	Technical Editor – The Final Word (subcontractor)	B.S. Technical Communication. Responsible for editing document.	17 years
Rebecca Byron	Planner/Environmental Scientist	B.S. Environmental Science and Policy; drafted affected environment	3 years

*Consultation and Coordination*

<b>Name</b>	<b>Title</b>	<b>Education/Responsibility</b>	<b>Experience</b>
		information for vegetation, safety, rare species.	
Lori Fox, AICP	Senior Planner	B.S. Natural Resources and Environmental Policy; M.C.P., Land Use, Environmental and Economic Development Planning. Responsible for internal and public scoping.	8 years
Joel Gorder, AICP	Planner and Environmental Scientist	B.S. Limnology, Biology, M.S., Urban and Regional Planning; Responsible for draft of soils and water quality affected environment	15 years
Dan Niosi	Environmental Scientist	B.A. Environmental Studies – Natural Resources. Responsible for the species sections of chapters 3 and 4	8 years
Nancy Van Dyke	Senior Consultant	B.A. Biology and Geography; M.S. Environmental Sciences. Responsible for project management and senior technical review and content additions to all sections.	26 years
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## **APPENDIX A. DEER POPULATION AND VEGETATION / REGENERATION MONITORING METHODS**

### **DEER POPULATION MONITORING METHODS**

Park staff will continue to use the Distance Sampling method to annually estimate the deer population density within the park (NPS 2004). Distance Sampling is a reliable analytical method for estimating population densities (Buckland et al. 2001; Thompson et al. 1998). It is conducted by an observer traveling along a transect and recording how far away deer are. The method models the way a person sees so that a proportion of deer further from the observer are expected to be missed. Unbiased estimates of population density can be obtained from the distance data if three assumptions are met: (1) deer on the line or point are detected with 100% certainty, (2) deer are detected at their initial location, and (3) distance measurements are exact (Buckland et al. 2001; Thompson et al. 1998; Underwood et al. 1998). Rock Creek Park uses laser range finders to ensure this last assumption.

A problem with Distance Sampling in past surveys has been the use of roads and trails as the transect. However, the use of roads and trails carries the risk of bias because of an unrepresentative sampling of available habitats (Buckland et al. 2001; Hiby and Krishna 2001).

Buckland et al. (2001) state that few studies have attempted to verify whether the resulting density estimates are unbiased in reference to the wider study area. McShea et al. (2007, unpublished report) used remote digital scouting cameras placed in seven distance categories to test for differences in deer activity with respect to roads used in distance surveys at Catoctin Mountain Park (nearly 100% forest cover). They found no significant difference in deer activity among the distance categories. These conditions are similar for Rock Creek Park.

After eight years of Distance Sampling from 2000 to 2007, National Park Service (NPS) staff at Rock Creek Park were able to detect population change at an annual rate of 4% (Bates 2008e).

Surveys are conducted at night during mid-November; surveys begin no earlier than 30 minutes after sunset (actual time sunset). Deer are most active at night. Most of the tree leaves have fallen by mid-November, allowing for observations at further distances from the road. Surveys take place on weekends because of the heavy commuter traffic on weekday evenings. Surveys are postponed if viewing conditions are poor or observer safety is threatened (e.g., heavy traffic).

Distance Sampling surveys are conducted for a minimum of three nights, depending on the size of the coefficient of variation estimated for the sampling results. Additional surveys are added when the variability in the data exceeds certain statistical standards: specifically, when the coefficient of variation associated with the number of deer groups encountered after three nights of sampling exceeds 20%, or if the detection probability variation exceeded 30%. This is the most important step in ascertaining sufficient sampling. The coefficient of variation and the detection probability variation will not be calculated until the second survey has been completed. The coefficients will be recalculated after each subsequent survey until the above-mentioned criteria are satisfied.

Spotlighting equipment is assembled and checked at least two weeks before the first survey. Laser rangefinders will also be checked for operability and battery life.

Ambient conditions will meet minimum standards (wind is less than 19 mph; rain is less than heavy; normal visibility is greater than two miles at the nearest airport [Reagan National Airport]; temperature is higher than 35°F at sunset), as reported from the nearest official National Oceanographic and Atmospheric Administration weather data site ([www.erh.noaa.gov/er/lwx/](http://www.erh.noaa.gov/er/lwx/)) before each survey. Surveys are postponed if ambient conditions exceed minimum standards during the survey route.

A minimum three-person crew, consisting of a driver, who serves as data recorder, and two observers, are required to execute each survey. Survey routes are driven at speeds ranging from 6 to 10 mph. Observers use handheld spotlights to illuminate the survey area on both sides of the transect extending the light out; one person observes each side of the transect. Upon detection of a deer, the observer directs the driver to position the vehicle such that the perpendicular distance (90° angle to the transect) is measured.

If the transect is curved, more than one perpendicular distance might be available; the shortest perpendicular distance should be measured (Hiby and Krishna 2001). In cases where a perpendicular distance is not possible, a radial distance may be measured. When measuring a radial distance, the bearing of the transect and the white-tailed deer (*Odocoileus virginianus*) location would be obtained using a handheld compass. The radial distance is multiplied by the sine of the angle (the difference of the bearing measurements) to obtain the perpendicular distance.

In all instances, the distance measured should be to the initial location of the deer prior to any movement. The distance is measured using a laser rangefinder and is measured to an individual deer or, in the case of a group of deer, to the deer closest to the center of a group. In order to detect deer directly on the transect, the driver observes the groups of deer on the transect line and records the distance of the deer or group, if any, from the transect line using the laser range finder.

Deer are categorized by group size (e.g., an individual deer is a group of one, and five deer are a group of five). Deer are partitioned into groups by using behavioral cues and the nearest neighbor criterion (LaGory 1986). For instance, deer that repeatedly look back at other deer are counted as part of a group. Additionally, if an individual deer is less than half the distance from the closest deer than from its next nearest neighbor, then that individual deer is counted as part of a group. When large groups of deer are seen in open fields, group classification is attempted before positioning the vehicle for a distance measurement, which minimizes a flight response. In cases where the deer run away, the observer will note the initial location of the group and obtain a distance measurement to the location of first detection. Data are recorded on a standard deer Distance Sampling datasheet or in a handheld data recorder. Demographic classification is collected only when bucks, does, and fawns are clearly identified; “unknown” is the demographic classification default.

Data is analyzed using the most current version of Distance (which is 5.0 in 2008) (Thomas et al. 2006). With the technical assistance of the National Capital Region Wildlife Biologist, models are generated that provide estimates of population density (deer per square mile) with well-defined confidence intervals. The minimum amount of data required includes the survey dates, park area, transect length, number in group, and distance.

## VEGETATION/REGENERATION MONITORING METHODS

Deer populations are managed based on the success of forest regeneration. Tree seedlings are monitored to determine at what point browsing impacts would warrant the implementation of the possible management action. Rock Creek Park has both long-term monitoring and exclosure (fenced) plots. Long-term monitoring plots show changes in the park’s vegetation over time. Exclosure plots show the size of the impact that deer are having on the vegetation.

Since 1990 various vegetation monitoring projects have been conducted at Rock Creek Park. In 1990, 26 long-term plots (no fencing), each 400 m<sup>2</sup>, were established and have been monitored once every four years since 1991. In 2000, 20 paired fenced and unfenced plots were installed in Rock Creek Park and Glover-Archbold Park to look specifically at the amount of deer browse on park vegetation. These plots are 1 × 4 m. The enclosed plot has an 8-foot woven wire fence surrounding it, and its companion plot is located 1 meter outside the fence. These 20 paired plots are measured annually. Of the 20 plots established in 2000, only 15 were measured in 2008. Trees have fallen on three plots, erosion has removed most of one plot next to a small creek, and the other plot was overgrown with nonnative vegetation.

The basic plot design for the long-term plots established in 1990 follows protocols adopted by Russel (1989) and Storm and Ross (1992) for public lands in the Mid-Atlantic States. Rock Creek Park (Reservation 339) was divided into three zones: north, central, and south. Plot locations were randomly selected using GIS. Ten plot locations were selected for each zone. Plots that landed on roads, buildings, or bodies of water were rejected. Twenty-six plots were chosen: 10 in the northern, 7 in the central, and 9 in the southern regions of the park.

The outside dimensions of the plot are 20 x 20 m, making it 1/25<sup>th</sup> of a hectare. The 20 × 20-m plots have two main diagonals that run from corners A to C and B to D. These diagonals each have a total length of 28.28 m, and a center located at 14.14 m. The “B” corner of the plot was established first and using a tape the “A” corner was established. A new tape was used at corner A and a 45 degree angle was approximated to side AB to establish diagonal AC. At the same time another tape was run from corner B approximately 45 degrees from line AB to establish diagonal BD. The center point of the plot was established at the intersection of the two diagonal tapes at the 14.14-m mark. The two diagonals were extended to 28.28 m to establish the remaining corners C and D. Once all corners and the center point were established, each plot was squared and a piece of rebar was driven into the ground to permanently mark corners A, C, D, and the center point. A reference bench mark with an aluminum dome was set at corner B. The plot number was stamped on the aluminum disc. A live, healthy tree was chosen near each corner of the plot as the place to locate a corner relocation tag. Each corner tag was marked with the plot number and letter of the corner.

Within the plot, smaller subplots were established to measure vegetation of different sizes: 10-m-square quadrants for trees and overall canopy cover, 10-m-linear transects for tree and shrub cover, 1-m-square subplots for herbaceous vegetation and tree seedlings, and 1.7-m-radius circular subplots to detect deer browse.

The long-term plots are measured the same time of year each July and August when the vegetation is fully developed. The first tapes are laid out from corner B to the other corners and then diagonally from opposite corners to reestablish the center point. Next, tapes are laid from the center point (10 m) of each side to divide the plot into four quadrants for tree sampling.

Reference photographs are taken of the center of the plot from the B corner, of the plot center from halfway to the B corner, and the entire 20 × 20-m area from the best angle. Photos should attempt to duplicate placement and orientation of previous years.

Tree sampling occurs in the four 10 × 10-m subplots represented by the quartering of the plot along its cardinal points. Measurements are taken on trees and shrubs at 1.4 m high and 1-cm or greater diameter at breast height (dbh) in each of the 10 × 10-m subplots. The heights of five live trees in each subplot are taken, giving a total of 20 tree heights for each plot.

Species data is entered onto standard data sheets. Trees and shrubs are identified by a six letter code, defined by the first three letters of the genus and species. For a tree branching below the 1.4-m mark, the dbh is taken for each stem equal to or greater than 5-cm dbh. Those greater than 5-cm dbh are treated as individual trees but are noted in the tree record. For situations such as shrubs with multiple stems that originate from the same base, the largest stem is chosen and its dbh taken. The vigor is noted for each tree by assigning a number as follows: 1 = living, 2 = dead, and 3 = injured.

The heights of the five tallest living trees in each of the four subplots are recorded. Clinometers are used to measure tree heights, but other instruments can be used. The five trees are visually identified in each subplot and marked with flagging, and a number from 1 to 5 is assigned to each tree in the subplot. The method of measuring tree heights should be recorded on the data sheet.

**Browse** is estimated as the amount of damage to woody twig ends that occurs during the non-growing season and is measured by the twig-count method (Shafer 1965). It is estimated or “read” by examining

the growing tips of all woody plants below 2.0 m in height in two randomly chosen circular subplots. Browsed and unbrowsed twigs are counted to determine a browsed/unbrowsed ratio.

A random distance (1–8 m) and direction (1–360 degrees) are generated using a random numbers table. The distance is measured in the direction of the bearing from the center of the plot to establish the center of the browse plot. The browse plot is a circle with a 1.69-m radius, giving an area of 9.3 m<sup>2</sup>. A tape or length of string is secured at the browse plot center and is used to circumscribe the sampling area. The numbers of woody twigs below 2.0 m that are browsed and unbrowsed are recorded. Species of each twig or stem are recorded.

**Shrub cover** is measured using two randomly generated transects within the plot, each 10 m long. The extent to which this line is directly covered by the leaves of any qualifying plant material provides an index of shrub cover within the plot. Two sets of random numbers are generated. The first ranges from 1 to 4 and represents one of the four sides of the 20 × 20-m plot. The second random number represents a point on the line, selected by the first random number, in centimeters. The side and location on that side are located, and a 10-m line is run toward the parallel side. Any woody growth intersecting the line is measured. Any intercept up to 2.0 m is measured to the nearest centimeter, even when the layers created by two different individuals overlap. The estimate of cover for each species is calculated by summing the intercept distance for a given species, dividing the result by 2000, and then multiplying by 100. The result is the percent cover.

**Tree canopy** coverage within each 10 × 10-m subplot is estimated with a densitometer. Counts of dots shown on the densitometer that are shaded by canopy foliage (including vines) are taken from the center of subplots in four directions: towards the marked quadrant corner, at 3 o'clock, toward the plot center, and at 9 o'clock.

**Seedling**, herbaceous, and substrate data are collected from 1 × 1-m plots selected at random from four possible positions in a given 2 × 2-m subplot within each quadrant of the 20 × 20-m plot. A 2 × 2-m subplot is located at the center point of the diagonal, formed by stretching a tape between the plot center and a plot corner (A–D). From this 2 × 2-m subplot, a randomly selected 1 × 1-m plot was selected to collect data.

All tree seedlings in each of the 1 × 1-m subplots are identified using the six letter identification code and counted, and the heights are measured in centimeters.

**Percent cover of substrate** in the 1 × 1-m plot is estimated by looking at the amount of horizontal space covered by each of four categories: rock/soil, moss/lichen, leaf litter, and herbaceous. The herbaceous cover should be identified to the species level if possible.

## DATA ANALYSIS

Repeated measures analysis of variance (ANOVA), implemented with the mixed models procedure within SAS (2003), tests for differences among regions, years, and their interactions for each variable (Littell et al. 1996). The subject factor for each ANOVA is plot nested within region. Four variance–covariance structures are modeled (compound symmetry, autoregressive, Toeplitz, and unstructured) and the best model is selected via AIC<sub>c</sub> comparisons (Littell et al. 1996). Residuals are tested for normality (Kery and Hatfield 2003) and, for many variables, a natural log transformation is used to help achieve normality.

For tree seedling counts and species richness, height class is also included in the model, along with the various interactions. A separate variance is fit for each seedling height class due to a possible pattern of different variances among height classes. Least square means and Tukey's multiple comparison procedure are used to sort out significant differences ( $P \leq 0.05$ ) among years for all variables.

To calculate tree seedling weighted measure and action threshold, see the section below.

Importance Values (Storm and Ross 1992) are calculated for the 10 most important tree species in each of the three regions of Rock Creek Park as of 1991, and then graphed for each region for each of the four years. Importance Values are calculated by taking the sum of the relative dominance, relative frequency, and relative density of each tree species over the plots in each region. As such, they represent a summary measure indicative of the “importance” of each species in the tree community in each region. Increases or decreases in the Importance Value of a species imply that the tree community is changing over time.

## **EXCLOSURES—METHODS**

The second method of vegetation monitoring is by paired fenced and unfenced plots. In 2000, twenty fenced (exclosure) plots and paired unfenced (control) plots, each 4 × 1 m in size, were established in Rock Creek Park and Glover-Archbold Park. Fenced plots are contained within a 5 × 15-foot fence made of woven wire fence, 8 feet high.

The paired plots were created using a stratified random design. Ten plots were located on long-term open vegetation plots that had been randomly selected; 10 were randomly located in other parts of the park where deer were known to be and that were not represented in the long-term plots. Percent cover per species, vertical distribution of vegetation in height classes, and dbh of trees greater than 2 m in height in each plot is recorded.

The paired plots are measured annually in July through early September. A series of 10 transects each 200 cm long and spaced 10 cm apart are laid out within each plot for a total of 200 points per plot. An observer carefully walks along transects and records vegetation that “hits” a vertical string attached to a plumb bob that is held perpendicular to the transect every 20 cm. All vegetation up to 2 m in height is included. At a given point, each species intercepted is recorded. Multiple hits on a species are not recorded. Points not intercepting vegetation are recorded as litter (leaf litter and woody debris less than 1 inch in diameter), wood (coarse woody debris, logs), soil, rock, or moss. For each species, the number of hits divided by 200 provides an estimate of percent cover.

The vertical distribution of vegetation is recorded in each of the following height classes: 0–30 cm, 30–110 cm, 110–200 cm. A Mylar grid comprised of 10 × 10-cm squares is suspended on the wire fence outside each plot, along the long edge. The recorder position themselves 1 m from the opposite edge of the plot and estimate the number of squares covered by foliage, to the nearest ¼ square. The number recorded is divided by the number of squares in each height class. The grid is moved four times along the sides of the fence to cover the entire plot.

The dbh of trees located within the fenced or unfenced plot are measured if greater than 2 m in height.

## **DATA ANALYSIS**

This section is being developed and will be completed by June 2009.

## **CALCULATING TREE SEEDLING ACTION THRESHOLDS**

Forest regeneration dynamics are influenced by environmental and demographic factors. At the seedling stage, tall tree seedlings have a greater likelihood of survival compared to small seedlings. Therefore, to reflect this difference in survival, the number of seedlings needed to ensure the regeneration of a forest, which is called a stocking rate or a **tree seedling weighted measure**, is calculated as the number of tree seedlings weighted by Height Class. A certain proportion of the monitoring plots must equal or exceed this number for sufficient regeneration. This is the **action threshold**, where management action will occur when that proportion is not met.

Stout (1998) recommends weighting the seedlings by size; so if a seedling is taller, it is worth more in the total. The sum of these weighted numbers of seedlings gives the stocking rate or a **tree seedling weighted measure**. For example, following Stout (1998), seedlings that measure less than 30 cm tall have a weight of 1, i.e., the total number of seedlings that are less than 30 cm tall is multiplied by 1. For heights from 30

to 100 cm, the number of seedlings is multiplied by 2. Seedlings from 100 to 150 cm tall have a weight of 15, and for heights greater than 150 cm, the number of seedlings is multiplied by 30. All of the weighted seedling numbers are added up, and this total is the tree seedling weighted measure per plot. In Rock Creek Park the Height Classes were measured in 25-cm intervals, so a weight of 2 is used for seedlings from 25 to 100 cm tall instead of from 30 to 100 cm tall. Otherwise, the weights are identical to those recommended by Stout (1998).

Using a weight of 2 for tree seedlings starting at a height of 25 cm instead of 30 cm may lead to a slightly higher estimated tree seedling threshold for Rock Creek Park, but the bias is probably small, and this modification is conservative given the low stocking rates found in Rock Creek Park. Since the actual seedling heights were measured during 2007, future calculations of stocking rate will follow Stout (1998) without modification.

Stout (1998) recommends that for successful forest regeneration, 67% of the plots (or 18 out of 26 plots in Rock Creek Park) must reach or exceed a tree seedling threshold of 51 per plot at low deer densities (13–21 deer per square mile) and more than 153 per plot at high deer densities (56–64 deer per square mile). These are the **action thresholds** for the management of white-tailed deer.

<b>Action thresholds for tree seedlings in 67% of plots required for successful forest regeneration<sup>1</sup></b>	
<b>Deer density<sup>2</sup></b> (deer/mile <sup>2</sup> )	<b>Tree seedling threshold for 18 or more plots</b> (0.0016 ha each)
Low (13–21)	≤ 51
High (56–64)	≤ 153

<sup>1</sup>Stout 1998

<sup>2</sup>Horsley et al. 2003

ha = hectare (about 2.47 acres)

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## **APPENDIX B. CHRONIC WASTING DISEASE**

This appendix summarizes guidance provided by the National Park Service (NPS) in response to chronic wasting disease (CWD), and it outlines management options available to parks for implementation in the absence of a specific CWD plan.

As of December 2008, CWD has been diagnosed in only two national parks — Rocky Mountain and Wind Cave national parks. However, several national park system units are at high risk because of their proximity to known CWD cases in many areas of the United States. The closest outbreak of CWD is approximately 90 miles from Rock Creek Park centered near Slanesville, West Virginia. There is a high likelihood that the disease will be detected in other areas of the country following increases in disease surveillance as well as disease spread. CWD presents population decline risks to wild cervids and incompletely understood risks to domestic animal and human health. Therefore, CWD has become an issue of national importance to wildlife managers and other interested publics, as well as NPS managers.

### **NPS POLICY AND GUIDANCE**

#### **DIRECTOR'S CWD GUIDANCE MEMORANDUM (JULY 26, 2002)**

The NPS director provided guidance to regions and parks on NPS response to CWD in a memorandum dated July 26, 2002. Even though the memo pre-dates current CWD distribution in the national park system, the guidance remains pertinent. The guidance addresses surveillance, management, and communication regarding the disease. It also strictly limits human assisted translocation of deer and elk into or out of national park system units. Deviation from the guidance memo requires a waiver approved by the director.

#### **A NATIONAL PARK SERVICE MANAGER'S REFERENCE NOTEBOOK TO UNDERSTANDING CHRONIC WASTING DISEASE (VERSION 4: JULY 2007)**

This notebook serves as an informational reference that summarizes some of the most pertinent CWD literature, management options, and policies as they pertain to units of the national park system. It is not meant to be an all-inclusive review of current literature or management options. CWD is an emerging disease, and the knowledge base is continuing to expand. This document will be updated as necessary to include information pertinent to the NPS.

#### **HUMAN CONSUMPTION OF ELK AND DEER MEAT GATHERED FROM AREAS WITH ENDEMIC CHRONIC WASTING DISEASE (DECEMBER 22, 2005; REVISED JULY 2007)**

This document provides an overview of the issues surrounding CWD as it relates to public health, and includes NPS recommendations for the use of cervid meat for human consumption from parks affected by CWD surveillance and management actions within or near areas where CWD has been identified.

### **DESCRIPTION AND DISTRIBUTION**

CWD is a slowly progressive, infectious, self propagating, neurological disease of captive and free-ranging mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), Rocky Mountain elk (*Cervus elaphus nelsoni*), and moose (*Alces alces*). The disease belongs to the transmissible spongiform encephalopathy (TSE) group of diseases (similar to scrapie and bovine spongiform encephalopathy). CWD is the only TSE currently found in free-ranging animals. TSEs are characterized by accumulations of abnormal prion (proteinaceous infectious particle) proteins in neural and lymphoid tissues (Prusiner 1982, 1991, 1997).

There is evidence that human-associated movement of cervids has aided in the spread of the disease in captive, and likely free-ranging, deer and elk (Miller and Williams 2003; Salman 2003; Williams and

Miller 2003). Localized artificial concentration of cervids in areas with few natural predators likely aids in disease transmission (Spraker et al. 1997; Samuel et al. 2003; Farnsworth et al. 2005). There is strong evidence to suggest that anthropogenic factors, such as land use, influence CWD prevalence (Farnsworth et al. 2005). Therefore, human influences are likely a significant component of observed CWD distribution and prevalence.

As of December 2008, CWD had been found in captive/farmed cervids in 11 states and 2 Canadian provinces and in free-ranging cervids in 10 states and 2 provinces. The historic area of CWD infection encompasses northeastern Colorado, southeastern Wyoming, and the southwest corner of the Nebraska panhandle (Williams and Miller 2002; Williams et al. 2002b). However, with increased surveillance that has occurred since 2001, the disease has been found with increasing frequency in other geographically distinct areas (Joly et al. 2003).

### **CLINICAL SIGNS**

The primary clinical signs of CWD in deer and elk are changes in behavior and body condition (Williams et al. 2002b). Signs of the disease are progressive. Initially only someone who is quite familiar with a particular animal or group of animals would notice a change in behavior. As the clinical disease progresses over the course of weeks to months, animals demonstrate increasingly abnormal behavior and additional clinical signs (Williams and Young 1992). Affected animals can lose their fear of humans, show repetitive movements, and/or appear depressed but quickly become alert if startled. Affected animals rapidly lose body condition, despite having an appetite (Williams et al. 2002b). In the end stages of the disease they become emaciated. Once an animal demonstrates clinical signs, the disease is invariably fatal. There is no treatment or preventative vaccine for the disease.

### **DIAGNOSIS AND TESTING**

CWD was initially diagnosed in deer and elk by testing a portion of the brain (histopathology techniques) (Williams and Young 1993). While this method is effective at diagnosing relatively advanced cases, it is not sensitive enough to detect early disease stages (Spraker et al. 1997; Peters et al. 2000).

In contrast, immunohistochemistry (IHC) is a sensitive, specific, and reliable test that can be used to identify relatively early stages of chronic wasting disease. This technique can detect CWD prions in many tissues (brain, retropharyngeal lymph nodes, and tonsils) (O'Rourke et al. 1998).

In addition to immunohistochemistry, which takes several days to complete, new rapid tests also employ antibody technology to diagnose CWD. Each has various advantages and disadvantages. Only certified laboratories can perform immunohistochemistry or the rapid CWD tests.

No test available is 100% sensitive for CWD, which means that a negative test result is not a guarantee of a disease-free animal.

### **TRANSMISSION**

There is strong evidence that CWD is infectious and is spread by direct lateral (animal to animal) or indirect transmission (Miller et al. 2000; Miller and Williams 2003). Bodily secretions such as feces, urine, and saliva have all been suggested as possible means of transmitting the disease between animals and disseminating infectious prions into the environment (Miller et al. 2000; Williams et al. 2002b; Williams and Miller 2003). Maternal transmission cannot be ruled out, but it does not play a large role in continuing the disease cycle in either deer or elk (Miller et al. 1998; Miller et al. 2000; Miller and Williams 2003; Miller and Wild 2004).

Like other contagious diseases, CWD transmission increases when animals are highly concentrated. High animal densities and environmental contamination are important factors in transmission among captive cervids. These factors may also play a role in transmission in free-ranging animals (Miller et al. 2004).

Management actions that increase mortality rates in diseased populations can retard disease transmission:

- 1) It reduces the average lifetime of infected individuals. Reduced lifespan, in turn, can compress the period of time when animals are infectious, thereby reducing the number of infections produced per infected individual.
- 2) The effect of reduced intervals of infectivity is amplified by reductions in population density. Both of these mechanisms may retard the transmission of disease. If these mechanisms cause the number of new infections produced per infected individual to fall below one, then the disease will be eliminated from the population (Tompkins et al. 2001).

## **DISPOSAL OF CWD INFECTED ORGANIC MATERIAL**

Discarding known or suspect CWD-contaminated organic material, such as whole or partial carcasses, is likely to become an important issue for national park system units in the future. Each state, Environmental Protection Agency region, and refuse disposal area is likely to have different regulations and restrictions for disposal of potentially infected tissues. Currently there is no national standard for disposal. Because infected carcasses serve as a source of environmental contamination (Miller et al. 2004), it is recommended that known and suspect CWD-positive animals be removed from the environment.

Given the type of infectious agent (prions), there are limited means of effective disposal. In most cases, however, off-site disposal of infected material is recommended in approved locations. The available options for each park will vary and will depend on the facilities present within a reasonable distance from the park. Disposal of animals that are confirmed to be infected should be disposed of in one of the following ways:

- **Alkaline Digestion** — Alkaline digestion is a common disposal method used by veterinary diagnostic laboratories. This method uses sodium hydroxide or potassium hydroxide to catalyze the hydrolysis of biological material (protein, nucleic acids, carbohydrates, lipids, etc.) into an aqueous solution consisting of small peptides, amino acids, sugars, and soaps. During this process the prion proteins are destroyed.
- **Incineration** — Incineration is another disposal method commonly used by veterinary diagnostic laboratories. This method burns the carcass at intense temperatures (600 – 1000 degrees centigrade).
- **Landfill** — The availability of this option varies by region, state, and local regulations. Therefore, local landfills must be contacted for more information regarding carcass disposal, to determine if they can and will accept CWD positive carcasses or carcass parts.

## **MANAGEMENT**

Chronic wasting disease has occurred in a limited geographic area of northeastern Colorado and southeastern Wyoming for over 30 years. Relatively recently, it has been detected in captive and free-ranging deer and elk in several new locations, including Nebraska, South Dakota, New Mexico, Utah, new areas of Wyoming and Colorado, and east of the Mississippi River in Wisconsin, Illinois, West Virginia, New York, and most recently Michigan.

The NPS does not have a single overarching plan to manage chronic wasting disease in all parks. However, it has provided guidance to parks in how to monitor for and minimize the potential spread of the disease, as well as remove infected animals from specific areas. Generally, two levels of action have been identified, based on risk of transmission: (1) when CWD is not known to occur within a 60-mile radius from the park, and (2) when the disease is known to occur within the park or within a 60-mile radius.

The chance of finding CWD in a park is related to two factors: the risk of being exposed to the disease (the likelihood that the disease will be introduced into a given population), and the risk of the disease being amplified once a population of animals has been exposed. The first risk is important for national park system units where no CWD cases have been identified within 60 miles of their border. The second risk applies to units where chronic wasting disease is close to or within their borders, as well as in proactive planning efforts. By evaluating the risk of CWD exposure and amplification, managers can make better decisions regarding how to use their resources to identify the disease.

Actions available to identify CWD are linked to the risk factors present in and around the park. When risk factors are moderate, surveillance for chronic wasting disease can be less intense (e.g., opportunistic) than when risk is high (NPS 2005e). When the risk is higher, surveillance (e.g., targeted) should be increased. Other management actions that are in place for the host species may limit risk of exposure or transmission by maintaining appropriate population densities. Whether CWD is within 60 miles of a unit or not, coordination with state wildlife and agriculture agencies is strongly encouraged.

### **OPPORTUNISTIC SURVEILLANCE**

Opportunistic surveillance involves taking diagnostic samples for testing from deer found dead or harvested through a management activity within a unit of the national park system. Cause of death may be culling, predation, disease, trauma (hit by car), or undetermined. Opportunistic surveillance has little, if any, negative impact on current populations. Unless deer are culled, for either population management or research goals, relatively small sample sizes may be available for opportunistic testing. Animals killed in collisions with vehicles may be a biased sample that could help detect CWD. Research has indicated that CWD-infected mule deer may be more likely to be hit by vehicles than non-CWD infected deer (Krumm et al. 2005).

Opportunistic surveillance is an excellent way to begin surveying for presence of CWD without changing management of the deer population. This is a good option for park units where CWD is a moderate risk but where it has not yet been encountered within 60 miles of the park.

### **TARGETED SURVEILLANCE**

Targeted surveillance entails lethal removal of deer that exhibit clinical signs consistent with CWD. Targeted surveillance has negligible negative effects on the entire population, removes a potential source of CWD infection, and is an efficient means of detecting new centers of infection (Miller et al. 2000). One limitation to targeted surveillance is that environmental contamination and direct transmission may occur before removal. Additionally, there is no available method to extrapolate disease prevalence when using targeted surveillance because actions are focused only on those individuals thought to be infected. Targeted surveillance is moderately labor intensive and requires educating park staff in recognition of clinical signs and training in identifying and removing appropriate samples for testing, as well as vigilance for continued observation and identification of potential CWD suspect animals. Training is available through the NPS Biological Research Management Division. Targeted surveillance is recommended in areas with moderate to high CWD risk (within 60 miles of known CWD occurrence) or in park units where CWD has already been identified.

### **POPULATION REDUCTION**

Population reduction involves randomly culling animals within a population in an attempt to reduce animal density, and thus decrease transmission rates. In captive situations, where animal density is high, the prevalence of CWD can be substantially elevated compared to that seen in free-ranging situations. Thus, it is hypothesized that increased animal density and increased animal-to-animal contact, as well as increased environmental contamination, enhance the spread of CWD. Therefore, decreasing animal densities may decrease the transmission and incidence of the disease. However, migration patterns and

social behaviors may make this an ineffective strategy if instead of dispersing across the landscape, deer and elk stay in high-density herds in small home ranges throughout much of the year (Williams et al. 2002b). Population reduction is an aggressive and invasive approach to mitigating the CWD threat. It has immediate and potentially long-term effects on local and regional populations of deer and the associated ecosystem. This may be an appropriate response if animals are above population objectives and/or the need to know CWD prevalence with a high degree of accuracy is vital.

## **COORDINATION**

Regardless of which surveillance method is used, each park should cooperate with state wildlife and agriculture agencies in monitoring CWD in park units, working within the park's management policies. CWD is not contained by political boundaries, thus coordination with other management agencies is important.

Additionally, as stated above, the NPS Biological Resource Management Division provides assistance to parks for staff training (e.g., sample collection, recognizing clinical signs of CWD) and testing (e.g., identifying qualified/approved labs or processing samples).

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## **APPENDIX C. REVIEW OF WHITE-TAILED DEER FERTILITY CONTROL**

### **INTRODUCTION**

Managing the overabundance of certain wildlife species has become a topic of public concern (Rutberg et al. 2004). Species such as Canada geese (*Branta canadensis*), coyotes (*Canis latrans*), and white-tailed deer (*Odocoileus virginianus*) have become either locally or regionally overabundant throughout the United States (Fagerstone et al. 2002). In addition, traditional wildlife management techniques such as hunting and trapping are infeasible in many parks and suburban areas, forcing wildlife managers to seek alternative management methods.

The use of reproductive control in wildlife management has been assessed for several decades. Its use has gained more attention, as the public has become more involved in wildlife management decisions. Interest in reproductive control as an innovative alternative to traditional management methods, has led to the current state of the science (Baker et al. 2004). Often, the use of reproductive control is promoted in urban and suburban areas where traditional management tools, such as hunting, are publicly unacceptable or illegal due to firearm restrictions (Kilpatrick and Walter 1997; Muller, Warrnen, and Evans 1997).

In order for reproductive control agents to effectively reduce population size, treatment with an agent must decrease the reproductive rate to less than the mortality rate. In urban deer populations, mortality rates are generally very low (approximately 10%). Therefore, it would be necessary to treat 70-90% of the female deer, with a highly efficacious product, to effectively reduce or halt population growth (Rudolph, Porter, and Underwood 2000).

The purpose of this document is to provide NPS managers at Rock Creek Park with: (1) a brief overview of reproductive control options as they pertain to white-tailed deer; (2) an outline of the primary advantages, disadvantages and challenges related to the application of wildlife fertility control agents including population management challenges, regulatory issues, potential logistical issues, and consumption issues; (3) evaluate current fertility control agents against criteria established by the park for use of a reproductive control agent; and (4) provide a relatively comprehensive list of literature to refer to for additional information. This document is not intended to be exhaustive but to provide a scientifically sound basis for understanding and evaluating deer management alternatives that include reproductive control of does.

It is important to note that some of the most critical elements of a successful population level fertility control program focus on ecological and logistical questions rather than on the biological action of fertility control agents in individual animals. These issues can lead to less than optimal results when analyzing fertility control as a method of population regulation in free-ranging wildlife populations. It should also be noted that technology is changing rapidly in this field of research and updated information should be reviewed prior to implementation of a deer management program that involves fertility control.

### **CURRENT TECHNOLOGY**

The area of wildlife contraception is constantly evolving as new technologies are developed and tested. For the sake of brevity, this appendix will only discuss reproductive control as it applies to female deer. There is a general understanding in white-tailed deer biology that managing the female component of the population is more important than managing the male component. Based on the polygamous breeding behavior of white-tailed deer, treating males with reproductive control would be ineffective if the overall goal is population management (Warren 2000).

There are three basic categories of reproductive control technology: (1) immunocontraceptives (vaccines), (2) non-immunological methods (pharmaceuticals), and (3) physical or chemical sterilization.

## IMMUNOCONTRACEPTIVES

It is suggested that immunocontraceptive vaccines offer significant promise for future wildlife management (Rutberg et al. 2004). Immunocontraceptive treatment involves injecting an animal with a vaccine that “stimulates its immune system to produce antibodies against a protein (antigen) involved in reproduction” (Warren 2000). In order to provide for sufficient antibody production, an adjuvant is combined with the vaccine. An adjuvant is a product that increases the intensity and duration of the immune system’s reaction to the vaccine. There are two primary types of antigens used in reproductive control vaccines in deer: porcine zona pellucida (PZP) and gonadotropin releasing hormone (GnRH).

Neither PZP nor GnRH vaccines are 100% effective in preventing pregnancy. Curtis et al. (2002) demonstrated approximately 85-90% efficacy for both GnRH and PZP immunocontraceptive vaccines in white-tailed deer. Over a 13-year period on Assateague Island National Seashore, contraceptive efficacy in PZP-treated horses ranged from 92 to 100% (Kirkpatrick and Turner 2008). However, efficacy generally decreases as antibody production wanes. Decreases in pregnancy rates can usually be expected for 1-2 years post-treatment with immunocontraceptive vaccines. How long infertility lasts is strongly related to the conjugate antigen design, the adjuvant used, and how the vaccine is delivered (Miller et al. 2008).

**Porcine Zona Pellucida (PZP).** The majority of immunocontraceptive research in wildlife has been conducted using PZP vaccines. PZP vaccines stimulate production of antibodies directed towards specific outer surface proteins of domestic pig eggs. Pig eggs are sufficiently similar to many other mammals’ eggs that antibodies produced will cross-react with the vaccinated animal’s own egg. PZP antibodies prevent fertilization, presumably by blocking the sperm attachment site on the zona. This type of vaccine stimulates an immune response to the egg coat proteins and is therefore only effective in female deer. There are currently two PZP vaccine products being developed, one is simply called PZP and the other SpayVac®. SpayVac® (ImmunoVaccine Technologies, Halifax), uses a liposome preparation of PZP (with adjuvant) and has been evaluated in a variety of species, including white-tailed deer (Brown et al. 1997, Fraker et al. 2002, Locke et al. 2007, Rutberg and Naugle 2009). The other PZP vaccine, often referred to as “native” PZP, does not use liposome technology but also has been used extensively in white-tailed deer and other species in the course of investigating its effectiveness (Rutberg and Naugle 2008a; Kirkpatrick et al. 1997; Turner, Kirkpatrick, and Liu 1992, 1996; Walter et al. 2002a, 2002b).

PZP vaccines have been tested in more than 70 captive wildlife species with variable success in preventing reproduction for variable durations of time (Kirkpatrick et al. 1997, 1996b). The native PZP vaccine has also been tested extensively in free-ranging white-tailed deer (Rutberg and Naugle, 2008a, Naugle et al. 2002, Rudolph et al. 2000, Rutberg et al. 2004, Walter et al. 2002a, 2002b, Walter et al. 2003). Native PZP was first used successfully to control reproduction in white-tailed deer in 1992 (Turner et al. 1992). Potential benefits of this vaccine include the ability to deliver the vaccine remotely, safety in pregnant deer and non-target species (e.g. dogs, horses) (Barber and Fayerer-Hosken 2000), and the availability of at least some long-term data on population level effects. The currently available PZP vaccine formulation is effective for two years (Turner et al. 2007), though longer multiyear applications are also being studied.

SpayVac® provides the same advantages as native PZP but may result in infertility for up to seven years (Miller et al. 2009). Potential advantages of SpayVac® compared to the native PZP vaccine are: “1) a more rapid immune response, 2) higher antibody titers, 3) a higher proportion of antibodies that bind to target sites, and 4) longer duration of efficacy” (Fraker and Bechert 2007). Although little long-term data on population level effects exists for SpayVac®, it is assumed they are similar to those for the native PZP formulation.

There are few field studies that have evaluated population-level effects of fertility control (Rutberg et al. 2004, Hobbs et al. 2000, Rudolph et al. 2000). Research evaluating the effectiveness of PZP in reducing the size of deer populations has focused on moderate to high density deer populations of relatively small

size (< 300-500 individuals). Within these populations, long-term (> 10 years) data indicates that population size of long-lived species (e.g. deer, horses) may be gradually decreased using PZP treatments (Kirkpatrick and Turner 2008, Rutberg and Naugle 2008a). Rutberg and Naugle (2008a) reported a 27% decline in the size of a small, suburban deer population (approximately 250 deer) between 1997 and 2002, as a result of PZP treatments and potentially other stochastic events. However, level of success in reducing population size, reported for white-tailed deer, varies widely. For example, deer density on Fire Island National Seashore was significantly reduced in some areas but reduced very little in other areas (Rutberg and Naugle 2008a, Underwood 2005). Success in controlling deer populations is dependent on a variety of factors including population size (ability to treat a sufficient number of does), “vaccine effectiveness, accessibility of deer for treatment, and site-specific birth, death, immigration, and emigration rates” (Rutberg and Naugle 2008a).

Additionally, PZP-treated wildlife may experience increased body condition and a longer life span compared to untreated individuals as a result of reduced energetic costs of pregnancy and lactation (Warren 2000, Hone 1992). For example, at Assateague Island National Seashore, the life span of horses treated with PZP has been extended from an average age at death of 20 years to 26-30 years (Kirkpatrick and Turner 2008, Zimmerman 2009 pers. comm.). Longer life span may extend the time needed to observe a decline in population size (Kirkpatrick and Turner 2008; Rutberg and Naugle 2008a). Additional research is needed to determine how fast a population can be reduced, how deep a reduction can be achieved, and what landscapes are best suited to use of fertility control as a management tool (Rutberg and Naugle 2008a).

Challenges to the use of PZP include behavioral impacts, frequency of treatment (need for booster shots), use of meat for human consumption, and the need to permanently mark treated animals. PZP based vaccines often cause abnormal out of season breeding behavior in treated deer populations (Fraker et al. 2002; McShea and Rappole 1997), as treatment with PZP leads to repeated estrous cycling in females and associated behavioral changes. This may result in late pregnancies, higher fawn mortality, and possibly an extended breeding season or rut (Fraker et al. 2002; McShea et al. 1997). Additionally, any effect that could extend the rut also has the potential for secondary effects to the individual deer. Increased attempts to breed may result in increased deer movements. This may be problematic in areas with high vehicle use, as there could be increases in deer-vehicle collisions. However, the only known research evaluating this specific issue reported that deer treated with PZP were at no greater risk of being involved in a deer-vehicle collision than untreated deer (Rutberg and Naugle 2008b). It should be noted that in a small number of cases, permanent infertility in horses has been reported in association with SpayVac® (Fraker 2009). Additional research is needed to evaluate the potential for sterility in white-tailed deer.

Successful field application of a fertility control program requires both an effective agent and a practical delivery system (Cowan et al. 2002). Although PZP vaccines may be successfully delivered remotely through darting, the PZP vaccine also currently require periodic boosters in order to maintain infertility, usually two injections, at least three weeks apart, during the first year. The need for booster shots leads to significant logistical issues when working with free-ranging white-tailed deer, particularly when the number of deer to be treated is high. New research involving controlled-release native PZP formulations incorporates primer and booster immunizations into one injection and may extend the period of infertility (Turner et al. 2008). Turner et al. (2008) provides an overview of the current status of research related to controlled-release components of native PZP contraceptive vaccines. SpayVac® currently does not require an immediate booster and may prove to be easier to implement since booster shots would only be required every 3-7 years (Fraker 2009). It is expected that development of a long-acting, single shot treatment will improve the ability of NPS units to implement this vaccine as a deer management tool.

If a product is intended for use in a food-producing animal, it must be tested for safety to human consumers, and the edible animal products must be free of unsafe drug residues (<http://www.fda.gov/cvm/aboutona.htm>; Accessed 1/30/09). The Food and Drug Administration (FDA),

Office of New Animal Drug Evaluation is the current regulatory agency responsible for this determination for PZP vaccines. FDA has not yet determined whether PZP vaccine components pose a human health risk. Although FDA approval is the standard for drugs being considered for human consumption, PZP may still be used under an Investigational New Animal Drug (INAD) exemption as a research tool. It is expected that regulatory authority for PZP vaccines will shift to the Environmental Protection Agency (EPA) in the near future. Once it becomes transferred to EPA regulation and until it becomes an EPA-registered contraceptive for wild deer, it would have to be used in a research context under an EPA “experimental use” permit.

Until approved by the FDA or registered by the EPA, treated animals should be permanently marked so as not to enter the human food chain. Marking is also required for long-term monitoring of contraceptive efficacy, determining which deer have been treated during implementation, and evaluating management success through an adaptive management approach. At Fire Island National Seashore, treated deer are only marked temporarily using dye packs and therefore researchers have been unable to assess reproduction in treated deer or contraceptive efficacy since 1995 (Rutberg and Naugle 2008a). Additionally, NPS units are mandated to cooperate and coordinate with state agencies to manage cross boundary wildlife resources whenever possible (43 CFR part 24). Therefore, parks should also consult with appropriate state agencies regarding marking of treated animals in areas where deer may cross park boundaries.. The disadvantages of permanent marking are primarily related to the substantial additional labor and costs of the first year’s capture and marking of treated animals, sustainability over the long-term, and associated stress to individual deer (compared to remote delivery).

Finally, there is general agreement that because of the logistical difficulties of treating significant numbers of deer that controlling large, free-ranging populations of wild ungulates solely with a contraception vaccine is impractical and unlikely to succeed (Rutberg et al. 2004, McCullough 1996, Garrott 1991 and 1995, Curtis et al. 1998, Warren et al. 1992 and 2000, Rudolph et al. 2000, Cowan et al. 2002, Merrill et al. 2003). There is also agreement that fertility control as a sole means of managing populations cannot reduce wildlife population size rapidly (Rutberg and Naugle 2008a, Kirkpatrick and Turner 2008). The few long-term (> 10 years) research projects evaluating population level effects of PZP on long-lived species (horses and deer) support this statement. At Assateague Island National Seashore, PZP treatments were successful in reducing the wild horse population 16% (from 160 to 135 individuals) between 1994 and 2009 (15 years). The park expects to reach the target population size of 135 horses in another 8-9 years (Zimmerman 2009 pers. comm.). At Fire Island National Seashore, park managers report a 33% reduction in overall deer population size (from approximately 600 to 400 individuals) between 1994 and 2009 (Bilecki 2009 pers. comm.). In the most intensively treated areas of the park deer population size decreased up to 55% over 15 years (Rutberg and Naugle 2008a). Therefore, the appropriateness of fertility control as a deer management tool also is heavily dependent on specific park objectives and the purpose and need for management.

Additional information on PZP may be obtained at:

[http://www.aphis.usda.gov/wildlife\\_damage/nwrc/research/reproductive\\_control/index.shtml](http://www.aphis.usda.gov/wildlife_damage/nwrc/research/reproductive_control/index.shtml) OR  
<http://www.pzpinfo.org>.

**Gonadotropin Releasing Hormone (GnRH) Vaccines.** GnRH is a small neuropeptide (a protein-like molecule made in the brain) that plays a necessary role in reproduction. It is naturally secreted by the hypothalamus (a region of the brain that regulates hormone production), which directs the pituitary gland to release hormones (luteinizing hormone and follicle stimulating hormone) that control the proper functioning of reproductive organs (Hazum and Conn 1998). In an attempt to interrupt this process, research has focused on eliminating the ability of GnRH to trigger the release of reproductive hormones. One solution that has been investigated is a vaccine that, when combined with an adjuvant, stimulates the production of antibodies to GnRH. These antibodies likely attach to GnRH in the hypothalamic region

and prevent the hormone from binding to receptors in the pituitary gland, thus suppressing the secretion of reproductive hormones and preventing the release of eggs/sperm.

The use of GnRH vaccines has been investigated in a variety of both wild and domestic ungulates (hoofed mammals) (Curtis et al. 2002; Miller et al. 2000; Miller, Rhyan, and Drew 2004). In recent years, a great deal of research has been done on their effectiveness. One such GnRH vaccine being researched and developed is GonaCon™. Regulatory authority for GnRH vaccines was moved from the FDA to the EPA in 2006. Although not yet commercially available, GonaCon™ is expected to be submitted for EPA approval in 2009, as a contraceptive “pesticide” for managing white-tailed deer populations (Fagerstone et al. 2008, USDA 2008). Approval could occur within 12-18 months and it is expected to be registered as a “Restricted Use” product (USDA 2008). Labeling is likely to require hand injection, since an effective remote delivery system has yet to be developed, as well as permanent marking of treated individuals.

As with PZP, GonaCon™ has been shown to successfully control reproduction in wildlife species including white-tailed deer (Miller et al. 2000). Potential benefits of this vaccine include a longer-lasting contraceptive effect and possibly the lack of repeated estrous cycles. In white-tailed deer, GnRH is estimated to be approximately 85-100% effective in preventing pregnancy during the first year post-treatment (Miller et al. 2008, USDA 2008), however long-term field efficacy data currently does not exist (USDA 2008). The contraceptive effect typically last two years but may last for up to four years in some individuals (Fagerstone et al. 2008, USDA 2008). GnRH applications are currently being researched to determine the potential for use as a wildlife management tool (USDA 2008).

Repeated estrous cycling and other behavioral changes in white-tailed deer have not been documented in association with GnRH vaccines due to their mode of action (Curtis et al. 2008). Preventing the release of eggs results in no estrous cycle and may reduce breeding behaviors in female deer (Killian et al. 2008). However, Killian et al. (2008) reported that behavioral expressions of estrus were only decreased for 1-2 years post-treatment and increased in subsequent years despite does remaining infertile.

GnRH vaccines have many of the same challenges associated with PZP including frequency of treatment (booster shots), human consumption issues, and the need to permanently mark treated animals. Additionally, as with PZP, immune response to the adjuvant also may cause difficulties with a population of treated deer when determining the Johne’s disease status (a gastrointestinal disease of potential regulatory importance for domestic livestock).

Although longer-acting (1-4 years), infertility in deer treated with GnRH vaccines is reversible as antibody levels wane. Studies of penned and free-ranging deer indicated GonaCon™ was 88-100% effective in year 1 and 47-70% effective in the second year post-treatment (Fagerstone et al. 2008). As with PZP, multiple injections or booster shots are needed to increase the contraceptive efficacy and longevity of the vaccine (Fagerstone et al. 2008). However, with GnRH vaccines booster shots may be required less frequently. Research is expected to continue to improve the single-shot, multiyear vaccine (Miller et al. 2008).

It is currently unknown how issues related to human consumption will be addressed by the EPA. EPA approval requires Toxicology or Human Health Hazard studies to evaluate potential threats to humans based on the duration and route of exposure to pesticides (Fagerstone et al. 2008). It should be noted that the adjuvant used in GonaCon™, an adaptation of the commercially available vaccine Mycopar™, is approved for use in food animals and that the FDA had indicated that ‘in general, the components of this product do not raise a human food safety concern’ (Fagerstone et al. 2008). However, until GonaCon is EPA-registered and product labeling known, treated animals should be permanently tagged to avoid entry into the human food chain and promote identification of treated versus untreated individuals. Once EPA-registered as a contraceptive ‘pesticide’, it is possible that product labeling will require permanent marking of treated animals. As indicated above, the disadvantages of permanent marking are primarily

related to the substantial additional labor and costs of the first year's capture and marking of treated animals, sustainability over the long-term, and associated stress to individual deer (compared to remote delivery).

Other challenges to use of GnRH vaccines including health effects on target (deer) and non-target species, lack of information related to effectiveness at the population level in free-ranging deer, and lack of an adequate remote delivery application. Killian et al. 2006a concluded that GonaCon™ was safe for deer and that there were no adverse health impacts associated with unintentional repeated vaccination. However, a variety of health problems have been associated with certain types of GnRH adjuvants (e.g. Freund's Complete Adjuvant) ranging from granulomas to loss of primary and secondary sexual characteristics (males) and occasionally death (Curtis et al. 2008, Killian et al. 2006). A granuloma is a localized inflammatory response to components of the GnRH adjuvant that may occur at the site of injection for up to three years post-treatment (Curtis et al. 2008). This is the most commonly reported physiological side effect of GnRH vaccines, including GonaCon™ (USDA 2008). There is little information regarding vaccination of pregnant animals and although GnRH vaccines are not believed to be harmful to non-target species, there is little information regarding the theoretical human and non-target species health risks.

Overall, no significant, long-term impacts to health or changes in behavior have been consistently documented in female deer in association with GnRH vaccines (USDA 2008, Killian et al. 2006). However, GnRH vaccines are not recommended for use in male deer due to an increased mortality rate (compared to treated female deer) and impacts associated with loss of primary and secondary sexual characteristics such as smaller gonads, failure of antlers to harden and shed velvet, malformed (atypical) antlers, and associated changes in breeding behaviors (Curtis et al. 2008, Miller et al. 2000c).

As stated above, GnRH applications are currently being researched to determine the potential for use as a wildlife management tool (USDA 2008). Long-term field efficacy data currently does not exist (USDA 2008) and thus questions still remain regarding whether populations can be reduced, how deep a reduction could be achieved, how fast reduced would occur, and what landscapes would be best suited to use of fertility control as a management tool (Rutberg and Naugle 2008a).

Lastly, successful field application of a fertility control program requires both an effective agent and a practical delivery system (Cowan et al. 2002). The ability to deliver contraceptive vaccines using a remote delivery application is an important logistical issue. A well-developed system of remote delivery eliminates the need to capture and handle deer after initial immunizations and may substantially reduce implementation costs. Additionally, as described under PZP, there is general agreement that controlling large, free-ranging populations of wild ungulates solely with a contraception vaccine (PZP or GnRH) is impractical, unlikely to succeed (McCullough 1996, Garrott 1991 and 1995, Curtis et al. 1998, Warren et al. 1992 and 2000, Rudolph et al. 2000, Cowan et al. 2002, Merrill et al. 2003), and cannot reduce wildlife population size rapidly. Therefore, the appropriateness of fertility control as a deer management tool also is heavily dependent on specific park objectives and the purpose and need for management.

Additional information may be obtained at:

[http://www.aphis.usda.gov/wildlife\\_damage/nwrc/research/reproductive\\_control/index.shtml](http://www.aphis.usda.gov/wildlife_damage/nwrc/research/reproductive_control/index.shtml)

## **NON-IMMUNOLOGICAL REPRODUCTIVE CONTROL METHODS**

This group of reproductive control agents includes GnRH agonists, GnRH toxins, steroid hormones, and contraceptives.

**GnRH Agonists.** GnRH agonists are highly active analogs of GnRH which are similar in structure and action to the endogenous hormone. These agonists attach to receptors in the pituitary gland. By attaching to the receptors, these agonists reduce the number of binding sites available and thereby temporarily suppress the effect of the GnRH. As a result of this suppression, reproductive hormones are not released

(Aspden et al. 1996; D'Occhio, Aspden, and Whyte 1996). Continuous administration of the agonist is necessary to maintain infertility. This can be accomplished with controlled-release formulations or surgically implanted pumps in addition to daily administration.

Not all agonists have the same effects in all species. In fact, some can have an effect that is the opposite of what is intended. The wide variation in response is likely due to a combination of type of agonist, dose, treatment regime, reproductive status, sex, and species (Becker and Katz 1997). Therefore, it is important to fully understand the effects of a product on a given species. Although many GnRH agonists are used in human as well as veterinary medicine only a few have been investigated in wildlife species (Becker and Katz 1997, Vickery 1986). GnRH agonists have been tested primarily in mule deer and elk and been shown to both suppress reproductive hormones and prevent pregnancy (Baker et al. 2005, Baker et al. 2004). Additionally, GnRH agonists have not been documented as causing behavioral changes when applied to female deer (Baker et al. 2004). Researchers believe this may be a useful tool in the future for preventing pregnancy in white-tailed deer as well.

- Leuprolide acetate: Leuprolide is one GnRH agonist that has been studied. Tests reveal that when it is administered as a controlled-release formulation, it results in 100% pregnancy prevention in treated female elk and mule deer (Baker et al. 2002, 2004, Conner et al. 2007). In addition, the treatment is reversible, and the effects last only for a specific period of time (90-120 days) (Baker et al. 2004; Trigg et al. 2001). Advantages of leuprolide acetate are that it is 100% effective in preventing pregnancy, is safe for human consumption (Baker et al. 2004), can be delivered remotely (Baker et al. 2005), does not result in physiological side effects, and short-term behavioral effects are minimal (Conner et al. 2007).

Leuprolide has been FDA-approved for use in humans and can be used with a veterinary prescription under the Animal Drug Use and Clarification Act of 1994. The prescribing veterinarian and the client (NPS unit) must clearly understand how and why the drug would be used in an off-label manner. It is the responsibility of the prescribing veterinarian to give an appropriate meat withdrawal period (the time it takes for the animal to metabolize and clear the drug from its tissue) for food-producing animals that may enter the human food chain.

The need to deliver leuprolide through a subcutaneous hand injection has traditionally been considered a significant barrier to the long-term application of this drug as a wildlife management tool. However, Baker et al. (2005) recently developed a successful dart delivery system that may extend the practical application of this contraceptive. This research also demonstrated the effectiveness of leuprolide when delivered via an intramuscular injection.

Treatment using leuprolide differs from GnRH vaccines in that it does not require an adjuvant and does not induce an antibody reaction. Therefore, inflammatory responses to adjuvant components and other physiological effects, often observed with immunocontraceptives, have not been observed in association with leuprolide. It does, however, require a slow release implant that remains under the skin or in the muscle for the duration of the treatment effectiveness. Additionally, leuprolide is not likely pose a threat to the environment or nontarget species (Baker et al. 2004), however, this hypothesis has not been extensively researched.

In addition to the paucity of information specific to use of leuprolide in white-tailed deer, there are significant challenges to the practical application of leuprolide to control or stabilize deer populations. As stated above, contraceptive efficacy lasts only 90-120 days (Baker et al. 2004; Trigg et al. 2001) and therefore females must be treated within a very short timeframe prior to the breeding season (Conner et al. 2007). If a female is not retreated then she has the same chances of becoming pregnant as an animal that was never treated. The need to treat a potentially large number of individuals within a very short period of time, on an annual basis, reduces the

feasibility of leuprolide as a wildlife management tool, particularly for large, free-ranging deer populations.

- **Histrelin acetate:** Histrelin acetate has been found to be effective in suppressing a key reproductive hormone in white-tailed deer (Becker and Katz 1995). However, testing was administered using a mini-pump that was surgically implanted under the animal's skin. This is an infeasible route of administration in free-ranging animals. In the future, a delivery system with slow release characteristics may help to make this a more feasible option for free-ranging wildlife. It is likely that histrelin acetate will also suppress ovulation and pregnancy in white-tailed deer, although this remains to be tested.

**GnRH Toxins.** GnRH toxins consist of a cellular toxin that is combined with a GnRH analog (or analogue). A GnRH analog is a synthetic peptide drug modeled after the human hypothalamic gonadotropin-releasing hormone which allows the toxin to attach to GnRH receptors. The toxin is then carried to the receptors in the pituitary gland and is internalized or absorbed. Once absorbed, the toxin disrupts the production of cellular proteins and can lead to cellular death. When this occurs, the production of reproductive hormones (leuteinizing hormone and follicle stimulating hormone) is affected. This process has been studied in male dogs (Sabeur et al. 2003), domestic sheep (Nett et al. 1999), rats (Kovacs et al. 1997), and female mule deer (Baker et al. 1999) but the technology is still in the developmental stages.

**Steroid Hormones.** The field of wildlife contraception began with research examining the manipulation of reproductive steroid hormones. Treatments using steroids can include administering high doses of naturally occurring hormones, such as estrogen or progesterone. However, the treatment usually entails the application of synthetic hormones, such as norgestomet, levangesterol, and melangestrol acetate. Available products are administered via slow release implants or repeated feeding have demonstrated variable efficacy and duration of infertility. Most products that are available are used in domestic animal or zoological veterinary medicine and have not been used widely in free-ranging wildlife. Some issues related to using steroids include difficulties in treating large numbers of animals for extended periods of time, negative side effects experienced by the treated animals, and concerns over the consumption of treated animals by nontarget species, including humans. Animals treated with steroids must be permanently marked to prevent entry into the human food chain.

**Contraceptives.** Contraceptives are products that terminate pregnancy. Progesterone is the primary gestational hormone for maintaining pregnancy in mammals. Many contraceptives act by preventing progesterone production or blocking its effect, thereby affecting pregnancy. The primary contraceptive that has been researched for use in domestic animals and white-tailed deer is an analog of Prostaglandin F<sub>2α</sub> (PGF<sub>2α</sub>) (Becker and Katz 1994; DeNicola, Kesler, and Swilhart 1997; Waddell et al. 2001). Lutalyse® is a commercially available form of PGF<sub>2α</sub>. Unlike many of the other alternatives, there are no issues related to consumption of the meat when it has been previously treated with this product. Challenges with contraceptives include timing of administration, efficacy, potential to rebreed if breeding season is not finished, and the potential for aborted fetuses on the landscape.

**Sterilization.** Sterilization can be either a surgical or chemical treatment process. Chemical sterilization, disrupting reproductive organs using tissue irritating agents, is typically performed on males as a contraceptive measure. Surgical sterilization is an invasive procedure generally performed on females. Successful implementation is generally 100% effective in preventing pregnancy and this method is common in managing domestic animal fertility. Implementation requires capture, general anesthesia, and surgery conducted by a qualified veterinarian which is generally considered labor intensive and costly and calls into question the long-term sustainability of sterilization as a wildlife management tool, except under limited circumstances.

Depending on the method of sterilization, this procedure may have behavior effects on both male and female deer. If gonads are removed, then the source of important reproductive hormones will be removed.

This is likely to change deer social interactions. If gonads are not removed, females will continue to ovulate and show behavioral signs of estrus and consequently may extend the breeding season.

Additionally, the majority of research involving sterilization as a wildlife management tool has made assumptions that may limit its general applicability. These assumptions are: “(1) complete control in targeting and sterilizing segments of the population, (2) deterministic models reliably predict outcomes, (3) no behavioral changes occur due to sterilization, and (4) population closure” (Merrill et al. 2006: 268). Rarely can these assumptions be met in free-ranging wildlife populations. In open populations, where there may be significant immigration and imprecise control over the capture process, it is unlikely that sterilization would be an effective means of reducing populations (Merrill et al. 2006).

Conditions that may contribute to successful use of sterilization to reduce abundant deer populations include small population size and demographic closure (or nearly so) (Merrill et al. 2006). It should also be noted that reversibility is often considered a desirable trait for long-term wildlife management methods. Therefore, the appropriateness of sterilization as a deer management tool also is heavily dependent on specific park objectives and the purpose and need for management.

## **EVALUATION OF FERTILITY CONTROL AGENTS BASED ON SELECTION CRITERIA ESTABLISHED BY ROCK CREEK PARK**

Five criteria were established for Rock Creek Park that reflect minimum desired conditions for using a reproductive control agent. Only when these criteria are met would reproductive control be implemented. These criteria assume that the agent poses no significant health risk to the deer.

1. There is a federally approved fertility control agent for application to free-ranging populations;
2. The agent provides multiple year (more than three years) efficacy to minimize the cost and labor required to administer the drug to a large number of deer every year ;
3. The agent can be administered through remote injection to avoid capturing the animal and to increase the efficiency of distribution;
4. The agent would leave no hormonal residual in the meat (meat would be safe for human consumption); and
5. Overall there is substantial proof of success in a free-ranging population, based on science team review.

**TABLE C-1. EVALUATION OF FERTILITY CONTROL AGENTS BASED ON SELECTION CRITERIA FOR ROCK CREEK PARK**

Agent	Criterion 1 Federally Approved	Criterion 2 Multi-year efficacy	Criterion 3 Administered Remotely	Criterion 4 Meat Safe for Humans	Criterion 5 Success in Free- ranging Populations
Immunocontraceptives					
"Native" PZP	No	No <sup>a</sup>	Yes	No	No
SpayVac®	No	Possibly <sup>b</sup>			
GnRH	No	Possibly <sup>c</sup>	No	No	No
GnRH Agonists					
Leuprolide Acetate	No	No	Yes	Yes	No
Histrelin Acetate	No	No	No	Yes	No
GnRH Toxins	No	Unknown	Unknown	Unknown	No
Steroid Hormones	No	No	No	No	No
Contraceptives	No	No	Yes	Yes	No

a Initial research on one-shot, multiyear PZP vaccine has demonstrated 88.3% efficacy in Year 1 and 75% efficacy in the second year post-treatment (Turner et al. 2008). Research is currently on-going to evaluate effectiveness in year 3 and beyond. Dr. Allen Rutberg has indicated that "based on the design of the vaccine and our experience with horses, it's unlikely that the vaccine would have much effect past the third year" (Rutberg 2009). However, research on this vaccine is still developing and is expected to continue into the future.

b SpayVac® has demonstrated 80%-100% efficacy for up to 5-7 years in horses and deer (Fraker 2009, Miller et al. 2009, Killian et al. 2006). The term "possibly" is used because long-term studies (>5 years) have been conducted only in captive deer and had a small sample size in each treatment group (N=5) (Miller et al. 2009).

c Recently published research on one-shot, multiyear GnRH vaccine in penned/captive deer indicates GonaCon™ is 88-100% effective in Year 1 and 47-100% effective in year 2 and 25-80% effective up to 5 years post-treatment (Miller et al. 2008). The term "possibly" is used because the multi-year formulation has been used only in captive deer, had a small sample size, and lacks confidence intervals on the data.

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## APPENDIX D. ADAPTIVE MANAGEMENT PHASES

The USDI Adaptive Management Technical Guide (Williams et al. 2007) suggests a two-phase approach to adaptive management, as illustrated below:

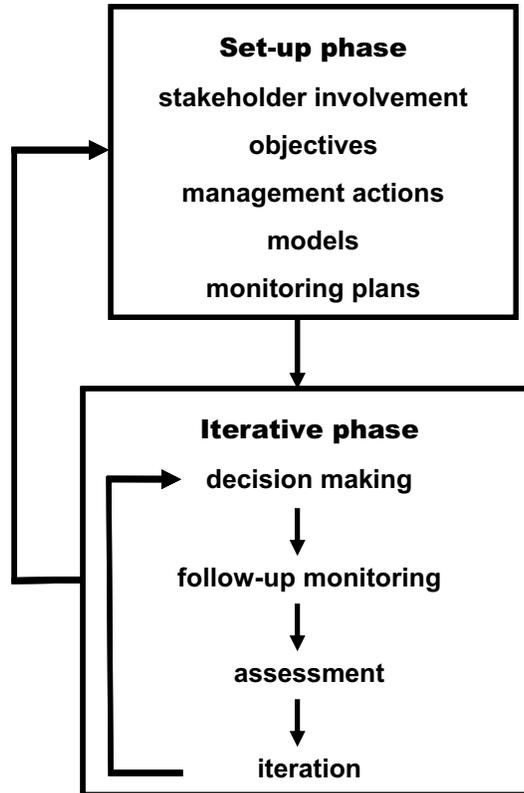


Figure D-1. The two-phase approach to adaptive management (modified from Williams et al. 2007, per Williams, pers. comm., September 16, 2008)

To implement adaptive management, certain elements must be put into place (the set-up phase), and then used in a cycle of iterative decision-making (the iterative phase) (Williams et al. 2007). For the Rock Creek White-tailed Deer Management Plan, the following are the phases and steps that follow the USDI guidance, with notations made that are specific to this plan.

### SET-UP PHASE

**Step 1: STAKEHOLDER INVOLVEMENT** – Without active stakeholder involvement, an adaptive management process is unlikely to be effective. Stakeholders were identified during internal scoping and were conferred with during the public scoping process. The park completed this step at public scoping meetings held in November 2006 as part of the National Environmental Policy Act (NEPA) process. Interested members of the public, local government representatives, D.C. Fish and Wildlife personnel, and the media attended these meetings. Information about the plan has been posted to the park’s website throughout the process to continue to keep the public informed. In addition, the NPS convened a team of government scientists (science team) to assist in developing density parameters and metrics to measure effectiveness in meeting plan objectives.

**Step 2: OBJECTIVES** – Objectives were prepared at the internal scoping meeting as part of the NEPA process and are detailed in chapter 1. Thresholds/metrics relating to vegetation condition and deer density were developed to measure success in meeting plan objectives.

**Step 3: ALTERNATIVES** – Alternative management actions were defined in an alternatives development meeting held in February 2007, using input from the public scoping comments and the science team. Elements of the alternatives were discussed and refined by the interdisciplinary team throughout the NEPA process. These actions were developed to test management hypotheses relating to deer management.

**Step 4: MODELS** – Operational models were developed to illustrate the natural resource system. Hypotheses relating to deer management, and specifically related to optimal deer density, are captured in these models, which predict different outcomes and impacts depending on actions taken. Questions that will generate hypotheses for modeling at Rock Creek Park include:

What is the magnitude of the white-tailed deer effects on the forest growth and survival of tree seedlings? (Proposed monitoring: paired plots)

What is the change in forest vegetation over time? (Proposed monitoring: permanent vegetation plots)

What is the density of deer in Rock Creek Park over time? (Proposed monitoring: Distance Sampling)

**Step 5: MONITORING PLANS** – Monitoring programs are created to collect data related to the testing of hypotheses and enhance operational models. The data is used later in the iterative phase to assess whether the objectives are being met. The vegetation data in the deer exclosures and the long-term vegetation monitoring plots would be used in this assessment. Monitoring data are documented and made available to the public.

## ITERATIVE PHASE

**Step 1: DECISION-MAKING** – A management action would be recommended by the park (preferred alternative) and a decision made by the Regional Director. A Record of Decision is completed. A plan is developed to implement the selected alternative and to monitor the results (changes in the resources expected from reduced deer density).

**Step 2: FOLLOWUP MONITORING** – The park will implement the monitoring plan and collect data on key elements that will measure the success of the selected action and of the park meeting its objectives.

**Step 3: ASSESSMENT** – The park will evaluate the results of the monitoring, comparing actual outcome with desired condition or objectives. Monitoring data is analyzed and made available to the public. Based on the assessment, the park may change models, modify the action (e.g., increase or decrease the number of deer taken) or make adjustments in monitoring (look at different parameters or species to measure).

**Step 4: ITERATION** – This step can lead back to the set-up phase if substantial changes are needed or to Step 1 of the iterative phase if there is a need to adjust the management action through subsequent decision-making.

## References for Appendix D

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**APPENDIX E. AVIAN SPECIES IDENTIFIED  
DURING BREEDING BIRD SURVEYS  
AS POTENTIAL BREEDING SPECIES**

**Table 1. AVIAN SPECIES IDENTIFIED DURING BREEDING BIRD SURVEYS  
AS POTENTIAL BREEDING SPECIES**

Species	1993	1994	1995	1996	1997	1998	2001	2002
Mallard				✓			✓	
Cooper's hawk				✓		✓		
Red-shouldered hawk								✓
Red-tailed hawk				✓			✓	✓
American woodcock			✓	✓				
Rock dove			✓					
Mourning dove	✓	✓	✓	✓	✓	✓	✓	✓
Yellow-billed cuckoo		✓	✓	✓				
Eastern screech owl	✓							
Chimney swift							✓	
Red-bellied woodpecker	✓	✓	✓	✓	✓	✓	✓	✓
Northern flicker	✓	✓	✓	✓	✓	✓	✓	✓
Downy woodpecker	✓	✓	✓	✓	✓	✓	✓	✓
Hairy woodpecker	✓	✓	✓	✓	✓	✓	✓	✓
Pileated woodpecker	✓	✓	✓	✓	✓	✓	✓	✓
Eastern wood-pewee	✓	✓	✓	✓	✓	✓	✓	✓
Eastern Phoebe	✓	✓	✓	✓	✓	✓	✓	✓
Acadian flycatcher	✓	✓	✓	✓	✓	✓	✓	✓
Great crested flycatcher	✓	✓	✓	✓	✓	✓	✓	✓
Eastern kingbird			✓	✓				
Red-eyed vireo	✓	✓	✓	✓	✓	✓	✓	✓
Yellow-throated vireo	✓			✓		✓	✓	✓
Blue jay	✓	✓	✓	✓	✓	✓	✓	✓
American crow	✓	✓	✓	✓	✓	✓	✓	✓
Tufted titmouse	✓	✓	✓	✓	✓	✓	✓	✓
Carolina chickadee	✓	✓	✓	✓	✓	✓	✓	
White-breasted nuthatch	✓	✓	✓	✓	✓	✓	✓	✓
Carolina wren	✓	✓	✓	✓	✓	✓	✓	✓
Blue-gray gnatcatcher	✓	✓	✓	✓	✓	✓	✓	✓
Veery	✓	✓	✓	✓	✓	✓	✓	✓
Wood thrush	✓	✓	✓	✓	✓	✓	✓	✓
American robin	✓	✓	✓	✓	✓	✓	✓	✓
Gray catbird	✓	✓		✓	✓	✓	✓	✓
Northern mockingbird			✓					
Brown thrasher	✓							
European starling		✓			✓		✓	✓
Northern parula						✓		
Black-and-white warbler				✓	✓		✓	✓
Yellow-throated warbler				✓		✓		
Hooded warbler	✓	✓	✓	✓				

Species	1993	1994	1995	1996	1997	1998	2001	2002
Worm-eating warbler	✓							
Ovenbird	✓	✓	✓	✓	✓	✓	✓	✓
Louisiana waterthrush				✓	✓		✓	
Common yellowthroat			✓	✓	✓			✓
Yellow-breasted chat					✓			
American redstart	✓			✓				
Summer tanager				✓				
Scarlet tanager	✓	✓	✓	✓		✓	✓	✓
Eastern towhee	✓	✓	✓	✓	✓	✓	✓	✓
Northern cardinal	✓	✓	✓	✓	✓	✓	✓	✓
Indigo bunting			✓		✓		✓	
Song sparrow				✓	✓		✓	✓
Common grackle	✓	✓				✓	✓	✓
Brown-headed cowbird	✓	✓	✓	✓	✓	✓	✓	✓
House finch		✓	✓		✓	✓		
House sparrow				✓				

Source: Wireless Telecommunications Plan, Rock Creek Park - February 2008

**Table 2. WASHINGTON DC AUDUBON CHRISTMAS BIRD COUNT ROCK CREEK PARK - 1980–2002 ANNUAL AVERAGE**

Species	Carter Barron	Nature Center	Species	Carter Barron	Nature Center
Mallard	2.2	5.0	Winter wren	0.1	0.6
Wood duck	0.2	0.8	Brown creeper	0.3	1.4
Barred owl	—	0.0	Northern mockingbird	3.2	2.6
Great horned owl	0.0	0.3	Mourning dove	3.6	12.3
Eastern screech owl	0.4	0.8	Rock dove	25.2	4.0
American crow	18.5	38.0	European starling	33.5	21.3
Fish crow	0.4	0.3	Ovenbird	—	0.1
Herring gull	0.3	—	House sparrow	22.7	15.4
Ring-billed gull	40.7	11.5	Eastern towhee	0.0	1.0
American kestrel	—	0.0	White-throated sparrow	10.7	21.9
Belted kingfisher	0.2	0.2	Song sparrow	1.7	8.0
Red-shouldered hawk	0.0	0.1	Dark-eyed junco	11.7	16.1
Red-tailed hawk	0.4	0.7	Purple finch	0.0	0.4
Sharp-shinned hawk	0.2	0.2	House finch	5.5	19.3
Cooper's hawk	0.1	—	American goldfinch	4.4	5.4
Turkey vulture	0.1	0.4	Northern cardinal	8.2	16.0
Black vulture	0.0	0.0	Evening grosbeak	—	0.1
Northern flicker	0.2	1.3	Field sparrow	—	0.2
Red-bellied woodpecker	4.9	9.6	American tree sparrow	—	0.0
Downy woodpecker	3.9	8.7	Fox sparrow	—	0.0
Hairy woodpecker	0.5	1.0	Brown-headed cowbird	—	0.0
Pileated woodpecker	0.8	2.3	Red-winged blackbird	—	1.9

*Avian Species Identified during Breeding Bird Surveys as Potential Breeding Species*

<b>Species</b>	<b>Carter Barron</b>	<b>Nature Center</b>	<b>Species</b>	<b>Carter Barron</b>	<b>Nature Center</b>
Yellow-bellied sapsucker	0.3	0.7	Common grackle	0.1	28.0
White-breasted nuthatch	6.0	11.9	Blue jay	2.1	3.2
Red-breasted nuthatch	0.0	0.3	Cedar waxwing	1.3	3.5
Golden-crowned kinglet	0.6	3.6	American robin	3.3	2.6
Ruby-crowned kinglet	0.5	0.1	Hermit thrush	—	0.0
Tufted titmouse	13.3	30.7	Gull spp.	0.4	0.1
Carolina chickadee	12.5	43.0	Kinglet spp.	0.3	—
Carolina wren	4.1	8.8			
<b>Total Individuals:</b>	<b>247.0</b>	<b>366.2</b>			
<b>Total Species:</b>	<b>21.2</b>	<b>27.3</b>			



## **APPENDIX F. LETTERS OF CONSULTATION**





# United States Department of the Interior



## NATIONAL PARK SERVICE

National Capital Region

Rock Creek Park

3545 Williamsburg Lane, N.W.

Washington, D.C. 20008-1207

IN REPLY REFER TO:

H3019 (NCA-ROCR)

JUN 17 2008

Mary Ratnaswamy, Program Supervisor  
U.S. Fish and Wildlife Service  
Chesapeake Bay Field Office  
177 Admiral Cochrane Drive  
Annapolis, Maryland 21401

Dear Ms. Ratnaswamy:

The National Park Service (NPS), Maryland National Capital Parks and Planning Commission (MNCPPC), and the District of Columbia Department of the Environment (DCDOE) are currently collaborating on an Environmental Impact Statement (EIS) for white-tailed deer management. The EIS will include an assessment of the park's deer population and a range of herd management alternatives to preserve park resources. The NPS is the lead agency and MNCPPC and DCDOE are Cooperating Agencies. In accordance with Section 7 of the Endangered Species Act, we wish to begin informal consultation with your agency so that we may fully evaluate the potential effects of deer management actions on federally listed species.

The EIS formally began with publication of the Notice of Intent on September 20, 2006. Two public scoping meetings were held in November 2006 and we are now working on the Draft EIS. Based on results of internal and public scoping, we have defined the geographic scope of the management actions considered in the EIS to include the entire administrative unit of Rock Creek Park. The EIS will govern deer management on park areas capable of sustaining a deer population.

We wish to request the most current list of Rare, Threatened and Endangered species that potentially inhabit Rock Creek Park, along with any pertinent critical habitat designations. We also understand that the Kenk's amphipod (*Stygobromus kenki*), which is known to occur in Rock Creek Park, was recently denied listing as endangered because its petition did not present substantial scientific or commercial information to demonstrate listing was warranted at that time.

For more technical information on the EIS, call or e-mail Natural Resource Specialist Ken Ferebee on 202-895-6221, [ken\\_ferebee@nps.gov](mailto:ken_ferebee@nps.gov). You may also wish to visit the website at [www.nps.gov/rocr](http://www.nps.gov/rocr) which provides a link in which to view documents related to the EIS.

Sincerely,

*par*  
Adrienne A. Coleman  
Superintendent, Rock Creek Park



IN REPLY REFER TO:

# United States Department of the Interior



NATIONAL PARK SERVICE  
National Capital Region  
Rock Creek Park  
3545 Williamsburg Lane, N.W.  
Washington, D.C. 20008-1207

NI615 (NCA-ROCR)

JUN 18 2008

David Maloney, State Historic Preservation Officer  
Historic Preservation Office  
Office of Planning  
801 North Capitol Street, NE, #400  
Washington, D.C. 20002

Dear Mr. Maloney:

The National Park Service (NPS), Maryland National Capital Parks and Planning Commission (MNCPPC), and the District of Columbia Department of the Environment (DCDOE) are currently collaborating on an Environmental Impact Statement (EIS) for white-tailed deer management. The EIS will include an assessment of the park's deer population and a range of herd management alternatives to preserve park resources. The NPS is the lead agency, and MNCPPC and DCDOE are Cooperating Agencies. In accordance with the National Historic Preservation Act of 1966 (NHPA), as amended, and the regulations of the Advisory Council on Historic Preservation, the NPS wishes to formally begin consultation with your office. We will be submitting the Draft EIS to your office for your review. The NPS wishes to coordinate the Section 106 review with its responsibilities under the National Environmental Protection Act (NEPA) as identified in 36 CFR 800.3(a)(2)(b). In accordance with 36 CFR 800.8(c)(2)(i), the Draft EIS will serve as the Determination of Effect for cultural resources under Section 106 of the NHPA.

The EIS formally began with publication of the Notice of Intent on September 20, 2006. Two public scoping meetings were held in November 2006 and we are now working on the Draft EIS. Based on results of internal and public scoping, we have defined the geographic scope of the management actions considered in the EIS to include the entire administrative unit of Rock Creek Park. The EIS will govern deer management on park areas capable of sustaining a deer population.

If you have any questions regarding the project, please contact Cultural Resource Specialist Simone Monteleone Moffett at (202) 895-6011. Please forward all Section 106 compliance concerns to my office. You may also wish to visit the website at [www.nps.gov/rocr](http://www.nps.gov/rocr) which provides a link in which to view documents related to the EIS. We look forward to hearing from you soon.

Sincerely,

for Adrienne A. Coleman  
Superintendent, Rock Creek Park

Bcc:  
ROCR- CCox  
ROCR- MHagerty  
ROCR-SMoffett  
rocr.files.deer

GOVERNMENT OF THE DISTRICT OF COLUMBIA  
HISTORIC PRESERVATION OFFICE  
OFFICE OF PLANNING



July 18, 2008

Ms. Adrienne A. Coleman  
National Park Service  
National Capital Region  
3545 Williamsburg Lane, NW  
Washington, DC 20008-1207

RE: Environmental Impact Statement for White-Tailed Deer Management, Rock Creek Park

Dear Ms. Coleman:

Thank you for contacting the DC State Historic Preservation Office (SHPO) regarding the above-referenced undertaking. We have reviewed the project information in accordance with Section 106 of the National Historic Preservation Act and are writing to provide our initial comments regarding effects on historic properties.

As you are aware, Rock Creek Park is listed in the National Register of Historic Places and the DC Inventory of Historic Sites. Therefore, we look forward to reviewing the Environmental Impact Statement (EIS) and to assisting the National Park Service in its efforts to ensure that its white-tailed deer management strategies will not have an adverse effect on historic properties.

If you should have any questions or comments regarding this matter, please contact me at [andrew.lewis@dc.gov](mailto:andrew.lewis@dc.gov) or 202-442-8841. Otherwise, we thank you for providing this opportunity to comment and we look forward to receiving the EIS as soon as it becomes available.

Sincerely,

A handwritten signature in black ink, appearing to read "C. Andrew Lewis".

C. Andrew Lewis  
Senior Historic Preservation Specialist  
DC State Historic Preservation Office

08-233



# United States Department of the Interior



IN REPLY REFER TO:

NATIONAL PARK SERVICE  
National Capital Region  
Rock Creek Park  
3545 Williamsburg Lane, N.W.  
Washington, D.C. 20008-1207

N1615 (NCA-ROCR)

JUN 18 2008

Marcel Acosta, Acting Executive Director  
National Capital Planning Commission  
401 9th Street, NW, Suite 500  
Washington, D.C. 20004

Dear Mr. Acosta:

The National Park Service (NPS), Maryland National Capital Parks and Planning Commission (MNCPPC), and the District of Columbia Department of the Environment (DCDOE) are currently collaborating on an Environmental Impact Statement (EIS) for white-tailed deer management. The EIS will include an assessment of the park's deer population and a range of herd management alternatives to preserve park resources. The NPS is the lead agency, and MNCPPC and DCDOE are Cooperating Agencies.

The EIS formally began with publication of the Notice of Intent on September 20, 2006. Two public scoping meetings were held in November 2006 and we are now working on the Draft EIS. Based on results of internal and public scoping, we have defined the geographic scope of the management actions considered in the EIS to include the entire administrative unit of Rock Creek Park. The EIS will govern deer management on park areas capable of sustaining a deer population. We would appreciate any comments or suggestions you may have regarding important factors that should be considered and if there are any concerns within the project area that your agency feels needs to be addressed, please inform us.

If you have any questions regarding the project, please contact Cultural Resource Specialist Simone Monteleone Moffett at 202-895-6011. Please forward all concerns to my office. You may also wish to visit the website at [www.nps.gov/rocr](http://www.nps.gov/rocr) which provides a link in which to view documents related to the EIS. We look forward to hearing from you soon.

Sincerely,

*Adrienne A. Coleman*  
Adrienne A. Coleman  
Superintendent, Rock Creek Park

Bcc:  
ROCR-CCox  
ROCR-MHagerty  
ROCR-SMoffett  
rocr.files.deer



IN REPLY REFER TO:

# United States Department of the Interior



## NATIONAL PARK SERVICE

National Capital Region

Rock Creek Park

3545 Williamsburg Lane, N.W.

Washington, D.C. 20008-1207

N1615 (NCR-ROCR)

JUN 18 2008

Thomas Luebke, Secretary  
The Commission of Fine Arts  
National Building Museum  
401 F Street, NW, Suite 312  
Washington, D.C. 20001

Dear Mr. Luebke:

The National Park Service (NPS), Maryland National Capital Parks and Planning Commission (MNCPPC), and the District of Columbia Department of the Environment (DCDOE) are currently collaborating on an Environmental Impact Statement (EIS) for white-tailed deer management. The EIS will include an assessment of the park's deer population and a range of herd management alternatives to preserve park resources. The NPS is the lead agency, and MNCPPC and DCDOE are Cooperating Agencies.

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Sincerely,

par Adrienne A. Coleman  
Superintendent, Rock Creek Park

Bcc:  
ROCR- CCox  
ROCR- MHagerty  
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IN REPLY REFER TO:

# United States Department of the Interior



NATIONAL PARK SERVICE  
National Capital Region  
Rock Creek Park  
3545 Williamsburg Lane, N.W.  
Washington, D.C. 20008-1207

OCT 27 2008

N1615 (NCA-ROCR)

Lori A. Byrne  
DNR Wildlife and Heritage Service  
580 Taylor Avenue  
Tawes Office Building E-1  
Annapolis, Maryland 21401

Dear Ms. Byrne:

The National Park Service (NPS), Rock Creek Park, Maryland National Capital Parks and Planning Commission (MNCPPC) and the District of Columbia Department of the Environment (DCDOE) are currently collaborating on an Environmental Impact Statement (EIS) for white-tailed deer management. The EIS will include an assessment of several alternatives to manage an increasing deer population in the park in order to preserve park resources. The NPS is the lead agency; MNCPPC and DCDOE are Cooperating Agencies.

Rock Creek Park is located within the District of Columbia but does share boundaries with Montgomery County, Maryland and the lower portion of Rock Creek Regional Park (see enclosed park brochure). We would like to request a list of any known rare, threatened, or endangered species that are known to exist or potentially could be found in the areas of common boundary between the NPS and Maryland. This species list will be incorporated into the impact analysis of the management alternatives being developed.

This National Environmental Protection Act (NEPA) process was started in 2006 and is targeted for completion in 2009-2010. A Draft EIS will be released to the public for comment in 2009. Please contact Natural Resource Specialist Ken Ferebee on 202-895-6221 if you have any questions or require additional information. Thank you for your assistance.

Sincerely,

Adrienne A. Coleman,  
Superintendent, Rock Creek Park

Enclosure:  
Rock Creek Park brochure

**COPY FOR YOUR  
INFORMATION**

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## GLOSSARY

**Action Alternative** — An alternative that proposes a different management action or actions to address the purpose, need, and objectives of the plan; one that proposes changes to the current management. Alternatives B, C, and D are the action alternatives in this planning process. See also: “No-Action Alternative.”

**Adaptive Management** — The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from research and the period evaluation of management actions and the conditions they produce to either reinforce the viability of objectives, strategies, and actions prescribed in a plan or to modify strategies and actions in order to more effectively accomplish management objectives.

**Affected Environment** — A description of the existing environment that may be affected by the proposed action (40 CFR 1502.15).

**Antibody** — An immunoprotein that is produced by lymphoid cells in response to a foreign substance (antigen), with which it specifically reacts.

**Antigen** — A foreign substance, usually a protein or polysaccharide, which stimulates an immune response upon introduction into a vertebrate animal.

**Anthracnose** — Any of several plant diseases caused by certain fungi and characterized by dead spots on the leaves, twigs, or fruits.

**Biobullet** — A single dose, biodegradable projectile comprised of an outer methylcellulose casing containing a solid, semi-solid, or liquid product (usually a vaccine or chemical contraceptive), propelled by a compressed-air gun.

**Blight** — Any of numerous plant diseases that result in sudden and conspicuous wilting and dying of affected parts, especially young growing tissues.

**Bluetongue Virus** — An insect-transmitted, viral disease of ruminant animals, including white-tailed deer, which causes inflammation, swelling, and hemorrhage of the mucous membranes of the mouth, nose, and tongue.

**Browse Line** — A visible delineation at approximately six feet below which most or all vegetation has been uniformly browsed.

**Caging** — Small scale fencing that is placed around individual plants to protect them from deer browsing; caging is common to all alternatives in this document.

**Carrying Capacity** — The maximum number of organisms that can be supported in a given area or habitat.

**Cervid** — A member of the deer family, such as white-tailed deer, mule deer, elk, moose, and caribou.

**Chronic Wasting Disease (CWD)** — A slowly progressive, infectious, self-propagating neurological disease of captive and free-ranging deer, elk, and moose. CWD belongs to the transmissible spongiform encephalopathy (TSE) group of diseases and is characterized by accumulations of abnormal prion proteins in neural and lymphoid tissue.

**Contragestive** — A product that terminates pregnancy.

**Cultural Landscape** — A geographic area (including both cultural and natural resources and the wildlife or domestic animals therein) associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values.

**Cumulative Impacts** — Those impacts on the environment that result from the incremental effect of the action when added to the past, present, and reasonable foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

**Deer Herd** — The group of deer that have common characteristics and interbreed among themselves. For the purposes of this plan, this term is synonymous with deer population.

**Deer Population** — See Deer Herd, above.

**Demographic** — Referring to the intrinsic factors that contribute to a population's growth or decline: birth, death, immigration, and emigration. The sex ratio of the breeding population and the age structure (the proportion of the population found in each age class) are also considered demographic factors because they contribute to birth and death rates.

**Depredation** — Damage or loss.

**Direct Reduction** — Lethal removal of deer; includes both sharpshooting and capture/euthanasia.

**Distance Sampling** — An analytical method to estimate population density that involves an observer traveling along a transect and recording how far away objects of interest are.

**Endemic** — Native to or confined to a particular region.

**Ecosystem** — An ecological system; the interaction of living organisms and the nonliving environment producing an exchange of materials and energy between the living and nonliving.

**Epizootic Hemorrhagic Disease (EHD)** — An insect-borne viral disease of ruminants that causes widespread hemorrhages in mucous membranes, skin, and visceral organs.

**Environment** — The sum total of all biological, chemical, and physical factors to which organisms are exposed; the surroundings of a plant or animal.

**Environmental Assessment (EA)** — A concise public document, prepared in compliance with NEPA, that briefly discusses the purposes and need for an action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

**Environmental Consequences** — Environmental effects of project alternatives, including the proposed action, any adverse environmental effects which cannot be avoided, the relationship between short term uses of the human environment, and any irreversible or irretrievable commitments of resources which would be involved if the proposal should be implemented (40 CFR 1502.16).

**Environmental Impact Statement (EIS)** — A detailed written statement required by Section 102(2)(C) of NEPA, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short term uses of the environment versus the maintenance and enhancement of long term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

**Ethnographic Resource** — Any site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it.

**Euthanasia** — Ending the life of an animal by humane means.

**Exclosure** — A large area enclosed by fencing to keep out deer and allow vegetation to regenerate.

**Exotic Species** — Any introduced plant, animal or protist species that is not native to the area and may be considered a nuisance; also called non-native or alien species.

- Extirpated Species** — A species that is no longer present in an area where it once lived.
- Exsanguination** — The action or process of draining blood.
- Fenced Plot** — An area enclosed by a fence to keep deer out so vegetation can grow without the influence of deer browsing.
- Folliculogenesis** — the maturation of the ovarian follicle (see below)
- Follicle** — one of the small ovarian sacs containing an immature egg
- Follicle Stimulating Hormone** — a hormone synthesized and secreted by the pituitary gland that (in females) stimulates the growth of immature follicles to maturation.
- Forest Regeneration** — For the purposes of this plan, the regrowth of forest species and renewal of forest tree cover such that the natural forest sustains itself without human intervention.
- Genetic Variability** — The amount of genetic difference among individuals in a population.
- Habitat** — The environment in which a plant or animal lives (includes vegetation, soil, water, and other factors).
- Hectare** — A metric unit of area equal to 2.471 acres.
- Herbaceous Plants** — Non-woody plants; includes grasses, wildflowers, and sedges and rushes (grass-like plants).
- Herbivore** — An animal that eats a diet consisting primarily of plant material.
- Histopathology** — The study of the microscopic anatomical changes in diseased tissue.
- Home Range** — The geographic area in which an animal normally lives.
- Hypothesis** — A tentative explanation for an observation or phenomenon that can be tested by further investigation.
- Immunocontraception** — The induction of contraception by injecting an animal with a compound that produces an immune response that precludes pregnancy.
- Immunocontraceptive** — A contraceptive agent that causes an animal to produce antibodies against some protein or peptide involved in reproduction. The antibodies hinder or prevent some aspect of the reproductive process.
- Impairment (NPS Policy)** — As used in NPS Management Policies, "impairment" means an adverse impact on one or more park resources or values that interferes with the integrity of the park's resources or values, or the opportunities that otherwise would exist for the enjoyment of them, by the present or a future generation. Impairment may occur from visitor activities, NPS activities in managing a park, or activities undertaken by concessioners, contractors, and others operating in a park. As used here, the impairment of park resources and values has the same meaning as the phrase "derogation of the values and purposes for which these various areas have been established," as used in the General Authorities Act.
- Impairment (Clean Water Act)** — As used in conjunction with the Clean Water Act and associated state water quality programs, a water body is "impaired" if it does not meet one or more of the water quality standards established for it. This places the water body on the "impaired waters list", also known as the "303(d) list" for those pollutants that exceed the water quality standard.
- Infrared** — The range of invisible radiation wavelength just longer than the red in the visible spectrum.
- Irretrievable** — A term that applies to the loss of production, harvest, and consumptive or nonconsumptive use of natural resources. For example, recreation experiences are lost irretrievably when

an area is closed to human use. The loss is irretrievable, but the action is not irreversible. Reopening the area would allow a resumption of the experience.

**Irreversible** — A term that describes the loss of future options. Applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity that are renewable only over long periods of time.

**Landscape/Habitat Fragmentation** — The breaking up of large, contiguous blocks of habitat or landscape into small, discontinuous areas that are surrounded by altered or disturbed lands.

**Leuprolide** — A reproductive control agent that prevents secondary hormone secretion, which stops the formation of eggs and ovulation. Leuprolide is a GnRH agonist (see appendix C for additional details).

**Luteinizing Hormone** — a hormone which triggers ovulation in females.

**Monitoring** — A process of collecting information to evaluate if an objective and/or anticipated or assumed results of a management plan are being realized (effectiveness monitoring) or if implementation is proceeding as planned (implementation monitoring).

**National Environmental Policy Act of 1969** — A law that requires all Federal agencies to examine the environmental impacts of their actions, incorporate environmental information, and utilize public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements and prepare appropriate NEPA documents to facilitate better environmental decision making. NEPA requires Federal agencies to review and comment on Federal agency environmental plans/documents when the agency has jurisdiction by law or special expertise with respect to any environmental impacts involved (42 U.S.C. 4321-4327) (40 CFR 1500-1508).

**Naturally Regenerating and Sustainable Forest** — A forest community that has the ability to maintain plant and animal diversity and density by natural (non-human facilitated) tree replacement.

**No-Action Alternative** — The alternative in which baseline conditions and trends are projected into the future without any substantive changes in management (40 CFR 1502.14(d)). Alternative A is the no-action alternative in this planning process.

**Opportunistic Surveillance** — Taking diagnostic samples for CWD testing from deer found dead or harvested through a management activity within a national park unit.

**Paired Plot** — Two plots used for monitoring that include a fenced and an unfenced plot.

**Palatability** — The property of being acceptable to the taste or sufficiently agreeable in flavor to be eaten.

**Parasitism** — A symbiotic relationship in which one species, the parasite, benefits at the expense of the other, the host.

**Penetrating Captive Bolt Gun** — A gun with a steel bolt that is powered by either compressed air or a blank cartridge. When fired, the bolt is driven into the animal's brain and renders it instantly unconscious without causing pain.

**Population (or Species Population)** — A group of individual plants or animals that have common characteristics and interbreed among themselves and not with other similar groups.

**Prion** — Proteinaceous infectious particle; a microscopic particle similar to a virus but lacking nucleic acid, thought to be the infectious agent for certain degenerative diseases of the nervous system such as CWD.

**Record of Decision (ROD)** — A concise public record of decision prepared by a federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives, a statement

as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation (40 CFR 1505.2).

**Recruitment** — Number of organisms surviving and being added to a population at a certain point in time.

**Reproductive Control** — A method or methods used to limit the numbers of animals in a population by decreasing the reproductive success of the animals, such as contraception or sterilization.

**Rut** — An annually recurring condition or period of sexual excitement and reproductive activity in deer; the breeding season.

**Sapling** — A young tree, generally not over 4 inches in diameter at breast height.

**Scoping** — An early and open process for determining the extent and variety of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).

**Seedling** — A young plant grown from seed; a young tree before it becomes a sapling.

**Seral** — A phase in the sequential development of a climax community.

**Sex Ratio** — The proportion of males to females (or vice versa), in a population. A sex ratio of 50:50 would mean an equal number of does and bucks in a deer population.

**Sharpshooting** — The authorized shooting of animals by specially trained professionals using appropriate weapons for means of effective and efficient lethal control.

**Species Diversity** — The variety of different species present in a given area; species diversity takes into account both species richness and the relative abundance of species.

**Species Richness** — The number of species present in a community.

**Spotlight Survey** — A method used to estimate deer numbers in an area by shining spotlights at night and counting the number of deer observed. This technique provides an estimate of deer numbers but not density.

**Sterilization** — a surgical technique leaving a male or female unable to reproduce.

**Targeted Surveillance** — Lethal removal of deer that exhibit clinical signs of CWD, such as changes in behavior and body condition, and testing to determine if CWD is present.

**Transect** — A line along which sampling is performed.

**Transmissible Spongiform Encephalopathies (TSEs)** — A group of diseases characterized by accumulations of abnormal prion proteins in neural and lymphoid tissues, which cause distinctive lesions in the brain and result in death.

**Turbidity** — Visible undissolved solid material suspended in water.

**Unfenced Plot** — A specific unfenced area that allows effects on deer browsing to be seen and to be measured.

**Ungulate** — A hoofed, typically herbivorous, animal; includes horses, cows, deer, elk, and bison.

**Vaccine** — A suspension of killed or attenuated microorganisms that, when introduced into the body, stimulates an immune response against that microorganism.

**Vascular Plant** — A plant that contains a specialized conducting system consisting of phloem (food-conducting tissue) and xylem (water-conducting tissue). Ferns, trees, and flowering plants are all vascular plants.

*Glossary*

**Viable White-tailed Deer Population** — A population of deer that allows the forest to naturally regenerate, while maintaining a healthy deer population in the park.

**Woody Plants** — Plants containing wood fibers, such as trees and shrubs (see “Herbaceous Plant”).

## ACRONYMS

APHIS	Animal and Plant Health Inspection Service
ATF	Alcohol, Tobacco, and Firearms
AVMA	American Veterinary Medical Association
BSE	bovine spongiform encephalopathy (mad cow disease)
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CJD	Creutzfeldt-Jakob disease
CLI	cultural landscape inventory
CLR	cultural landscape report
CSO	combined sewer overflow
CWD	chronic wasting disease
dB	decibel
dBa	A-weighted decibel scale
DC	District of Columbia
DCDOH	District of Columbia Department of Health
DM	Departmental Manual
DO	Director's Order
EA	Environmental Assessment
EHD	Epizootic Hemorrhagic Disease
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FDA	U.S. Food and Drug Administration
FEMA	Federal Emergency Management Agency
FLIR	Forward Looking Infrared Surveys
FMP	Fire Management Plan
FSH	follicle stimulating hormone
GCIV	GonaCon® immunocontraceptive vaccine
GIS	Geographic Information System
GMP	general management plan
GnRH	gonadotropin releasing hormone
IHC	immunohistochemistry

## *Acronyms*

K	soil erodibility factor
Ldn	day-night average sound level
LH	luteinizing hormone
LTCP	long-term control plan
M-NCPPC	Maryland National Capital Park and Planning Commission
NBS	National Biological Survey
NCPC	National Capital Planning Commission
NCR	National Capital Region
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NPS	National Park Service
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
PEPC	Planning, Environment, and Public Comment
PFO1	palustrine forested broad-leaved deciduous
plan/EIS	Draft White-tailed Deer Management Plan and Environmental Impact Statement
PZP	porcine zona pellucida
SOF	Statement of Findings
TMDL	Total Maximum Daily Load
TSE	transmissible spongiform encephalopathy
USC	United States Code
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USPP	U.S. Park Police
WASA	D.C. Water and Sewer Authority

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