

Environmental Consequences



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 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:

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- 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

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

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 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 and Beach Drive 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 and Beach Drive Combined sewer overflow improvements (D.C. Water)
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 and Beach Drive

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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 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	Increasing deer population Urban development Park management and operations Rabies, West Nile virus Illegal camping Poaching Dumping Traffic/Vehicle collisions Visitor uses Exotic plant control Off-trail users / social trails Nonnative wildlife / unrestrained pets Range expansion (large mammals) Fish passage Improvements Scientific research	Same as past action, plus epizootic hemorrhagic disease (deer), testing for Chronic wasting disease	Same as past actions plus: Possible rabies vaccine trials More development – Metropolitan Branch Trail Chronic wasting disease (deer) West Nile virus
Rare, Unique, Threatened or Endangered Species	Rock Creek Park	Exotic plant control Adjacent property landscaping Park landscaping Vandalism (fire) Dumping Illegal camping Traffic/Vehicle collisions Visitor uses Off-trail users / social trails Boundary encroachment Increasing deer population Gypsy moth management Nonnative wildlife / unrestrained pets Range expansion (large mammals) Fish passage Improvements Groundwater pollution Scientific research	Same as past actions plus: dogwood anthracnose, gypsy moth management—monitoring	Same as current actions plus: Hydrologic regime changes Asian longhorned beetle (<i>Anoplophora glabripennis</i>), West Nile virus

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 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 and Beach Drive
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 and Beach Drive 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 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), Long Range Interpretive Plan (NPS 2010b), 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 fall 2010. 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 (K. 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 and Beach Drive. 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 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. In addition, D.C. Water’s 10-year capital improvement program through fiscal year 2010 addresses wastewater treatment, CSO, stormwater, and sanitary sewer, as well as water service. D.C. Water’s plans include improving 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. As of 2011, D.C. Water has begun to improve drainage conditions by separating several combined sewers along Rock Creek Parkway.

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 overflowed by about 400 jet airplane arrivals or departures on weekdays and 300-350 on Saturdays and Sundays (D. Pavsek, 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.

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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 encompassing 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 19 years, with 27 long-term plots established in 1990. In 2000, 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 2007, 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 2007 had at least 153 seedlings per plot, which is considered the minimum for successful forest regeneration under high deer densities. Data from all nine years of monitoring (Krafft and Hatfield 2011) show that vegetation in plots protected from deer herbivory showed significantly greater vegetative cover compared to open plots, and this effect was most pronounced for woody and shrub cover. With respect to vegetation thickness, the nine-year monitoring of paired plots indicates that protection from deer herbivory produced significantly higher levels of vegetation in the exclosed plots compared to the paired unfenced control plots for both the low (0 to 30 centimeters, or 0 to about 12 inches) and middle (30 to 110 centimeters, or about 12 to 43 inches) height classes. 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 Beach Drive 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 under the no action alternative.

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 (T. 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 to the extent needed to allow for forest regeneration could be many 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.

Numerical reductions of white-tailed deer populations have been achieved with fertility control in at least two instances (Rutberg and Naugle 2008). However, these studies cannot be taken as evidence that fertility control can be used in Rock Creek Park to reduce the deer population to the density that will allow the forest to regenerate. These studies focused on a fenced population and a relatively small segment of an intensively managed island population, and both study areas occupied less than 1 square mile. Also, the reductions achieved in these studies (27% over 5 years and 58% over 10 years) indicate that the amount of reduction in deer density needed to achieve the desired forest regeneration would take a long time to occur, and forest regeneration would not be successful within the life of this plan. Thus, there is no empirical research that supports the conclusion that existing fertility control technology in a free-ranging population contiguous with other deer herds (such as what occurs in Rock Creek Park) would have the desired outcome and meet plan objectives in support of forest regeneration.

Modeling efforts (Hobbs et al. 2000; Rudolph et al. 2000; Merrill et al. 2006) and a comparison of field efforts that used lethal (Frost et al. 1997) and non-lethal methods (Rutberg and Naugle 2008) have also shown that fertility control and sterilization are not as effective or efficient as culling when the goal is to reduce white-tailed deer populations. 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.

The benefit of this alternative would be proportional to the population reduction, with the greatest benefit achieved when the population was lowered to the point where successful forest regeneration could occur. Forest regeneration would not be expected outside the large exclosures during the life of this plan.

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, 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. 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 (T. Bowersox, pers. comm. 2005), and would introduce reproductive controls that could reduce deer numbers gradually over an extended period of time. 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 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 147 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 2009 levels. It is expected rapidly reduced deer browsing pressure (dropping from 67 deer per square mile to about 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 1998; 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 2007, and none of the plots that were measured in 2007 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. The vegetation would also be more resilient in the face of any climate change. 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 enclosure 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.

ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS (PREFERRED ALTERNATIVE)

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 147 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 67 deer per square mile (2009) 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 1998; 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, the abundance and diversity of woody vegetation throughout the park could thrive and recover, and the vegetation would be more resilient in the face of any climate change. 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 about 70 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.

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 enclosures 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 there is no park-specific data connecting deer and the loss of vegetative ground cover, studies have shown that large herbivores, including white-tail deer, have known direct effects on ecosystems through trampling (Persson et al. 2000), soil compaction (Heckel et al. 2010), and known indirect effects such as soil degradation (Wardle et al. 2001). Park-specific data from Culver and Sereg (2004) showed water quality degraded at several of the springs along Rock Creek. Under alternative A it is expected that the deer population would increase or remain at high levels 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 D.C. Water's 10-year capital improvement program through fiscal year 2010. DC Water 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 and Beach Drive, 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.

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. As previously described under “Vegetation,” the use of reproductive control could reduce the deer population to a limited extent if it was successfully implemented, but this would require many years to actually reduce the population, based on modeling efforts (Hobbs et al. 2000; Rudolph et al 2000; Merrill et al 2006) as well as a comparison of field efforts that used lethal (Frost et al. 1997) and non-lethal methods (Rutberg and Naugle 2008). 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 slightly.

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 a 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 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 slightly.

ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS (PREFERRED ALTERNATIVE)

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 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 slightly offset cumulative impacts outside the park.

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.

AREA OF ANALYSIS

The area of analysis for assessing impacts on wetlands 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

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. Park-specific data from Culver and Sereg (2004) showed water quality degraded at several of the springs along Rock Creek. 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 and Beach Drive, 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.

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, this would require many years to actually reduce the population, based on modeling efforts (Hobbs et al. 2000; Rudolph et al 2000; Merrill et al 2006) as well as a comparison of field efforts that used lethal (Frost et al. 1997) and non-lethal methods (Rutberg and Naugle 2008). 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.

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 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 slightly.

ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS (PREFERRED ALTERNATIVE)

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 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 slightly.

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. It is important to note that impacts to deer, as with other wildlife, are analyzed in terms of the desired conditions for the deer population as a whole, including its overall health and ability to function in as natural a condition as possible. Thus, destruction of individual animals and reduction of the herd size alone are not necessarily adverse impacts, if the effect is to improve the overall condition of the deer population as part of the natural ecosystem.

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 of available forage and the high density would make individuals susceptible to starvation. 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 the deer herd 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.

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. . As previously described under “Vegetation,” the use of reproductive control could reduce the deer population to a limited extent if it was successfully implemented, but this would require many years to actually reduce the population, based on modeling efforts (Hobbs et al. 2000; Rudolph et al 2000; Merrill et al 2006) as well as a comparison of field efforts that used lethal (Frost et al. 1997) and non-lethal methods (Rutberg and Naugle 2008). 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. Based on these factors, it is expected that reproductive controls could stop population growth, but would not reduce the numbers of deer to the 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 D). 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 of 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.

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 67 deer per square mile (2009) to about 15 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 the deer herd 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 the deer herd.

ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS (PREFERRED ALTERNATIVE)

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 D). 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 67 deer per square mile (2009) to about 15 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.

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. This study is applicable to Rock Creek Park because it was conducted at Shenandoah National Park, another NPS unit that does not manage deer populations. The study documented the statistically significant increase of low forest guild birds as the understory recovered from excessive deer browsing. This included several species that nest at Rock Creek Park (ovenbird [*Seiurus aurocapillus*], eastern towhee [*Pipilo erythrothalmus*], veery [*Catharus fuscescens*], and wood thrush [*Hylocichla mustelina*]). 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). Heavy deer browsing also degrades habitat and results in a lack of cover for small mammals, making them vulnerable to predation from hawks, owls, foxes, skunks, raccoons, and coyotes. McShea (2000) found a higher abundance of chipmunks (*Tamias striatus*) and white-footed mice (*Peromyscus leucopus*) in deer exclosures in low mast years, suggesting that deer predation on acorns during low mast years affects small mammal abundance.

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).

Deer impacts to herpetofauna (reptiles and amphibians) and invertebrates have not been well studied. The only documented study took place at Cuyahoga Valley National Recreation Area, an urban NPS unit with a deer population similar to Rock Creek Park. Greenwald et al. (2008) placed coverboards within and outside of deer exclosures and found higher numbers of redback salamanders (*Plethodon cinereus*), and slugs outside of the exclosures. One theory for this result was that soils outside of the exclosures had more nutrients that came from deer droppings and that this attracted the salamanders and snails, in turn attracting the garter snakes that feed on salamanders and slugs. The authors also theorized that given the lack of vegetative cover outside of the exclosures, the coverboards were serving as a refuge for the

salamanders and slugs. Given the small sample size (12 paired plots) and different theories for the results, more research is needed. The authors also noted that redback salamanders and garter snakes are species that do well in disturbed habitats. Species that favor undisturbed habitats were not found outside of the exclosures.

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 species, or understory shrubs for food, cover, or nesting habitat (such as ovenbird, veery, towhee, and wood thrush) could be severely reduced or eliminated over time, resulting in potentially major adverse effects. Impacts to wetland-dwelling herpetofauna and species that depend on the middle to upper canopy, such as woodpeckers and owls, 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 Beach Drive 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 and small mammals), 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 exclosures and reproductive control of does. Small caged areas and repellents would be implemented, as under alternative A.

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 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 exclosures. 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, as previously described under “Vegetation,” the use of reproductive control could reduce the deer population to a limited extent if it was successfully implemented, but this would require many years to actually reduce the population, based on modeling efforts (Hobbs et al. 2000; Rudolph et al 2000; Merrill et al 2006) as well as a comparison of field efforts that used lethal (Frost et al. 1997) and non-lethal methods (Rutberg and Naugle 2008). 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. Based on these factors, it is expected that reproductive controls could stop population

growth, but it would not be possible to achieve the desired deer 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, wood thrush, and eastern towhee), 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, 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.

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, wood thrush, and eastern towhee), 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.

ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS (PREFERRED ALTERNATIVE)

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, wood thrush, and eastern towhee), 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 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; 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.

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. The act of monitoring of the deer population and use of cages for rare, unique, threatened, or endangered plants 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. 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 found 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., Acadian flycatcher [*Empidonax vireescens*], American woodcock [*Scolopax minor*], and eastern towhee [*Pipilo erythrophthalmus*]), as well as some small mammals (e.g., eastern chipmunk [*Tamias striatus*]), and possibly some reptiles (e.g., corn snake [*Elaphe guttata guttata*], 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 amphibians.

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 platypterus*), 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*]; 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 leibii*], or eastern red bat [*Lasiurus borealis*]). However, some of these species (e.g., birds, snakes, 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. Ground disturbance and erosion caused by off-trail use by visitors, pets, and horses could also adversely affect surface springs inhabited by the federally listed Hay's amphipod. Disease (e.g., rabies and West Nile virus) may also affect some species, and cell towers may result in bird collisions, which has been 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" and "Vegetation"). 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. However, as previously described under “Vegetation,” the use of reproductive control could reduce the deer population to a limited extent if it was successfully implemented, but this would require many years to actually reduce the population, based on modeling efforts (Hobbs et al. 2000; Rudolph et al 2000; Merrill et al 2006) as well as a comparison of field efforts that used lethal (Frost et al. 1997) and non-lethal methods (Rutberg and Naugle 2008). It is expected that reproductive controls could stop population growth, but it would not be possible to achieve the desired deer 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., Acadian flycatcher, American woodcock, and eastern towhee), as well as some small mammals (e.g., eastern chipmunk), reptiles (e.g., corn snake, eastern hognose snake, eastern worm snake, northern copperhead, northern ringneck snake, and northern fence lizard), and amphibians (e.g., marbled salamander [*Ambystoma opacum*] 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; 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, 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.

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. 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 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 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 enclosures 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., Acadian flycatcher, American woodcock, and eastern towhee), as well as some small mammals (e.g., eastern chipmunk), reptiles (e.g., corn snake, eastern hognose snake, eastern worm snake, northern copperhead, northern ringneck snake, and northern fence lizard), and amphibians (e.g., marbled 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; 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.

ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS (PREFERRED ALTERNATIVE)

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 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, 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., Acadian flycatcher, American woodcock, and eastern towhee), as well as some small mammals (e.g., eastern chipmunk), reptiles (e.g., corn snake, eastern hognose snake, eastern worm snake, northern copperhead, northern ringneck snake, and the northern fence lizard), and amphibians (e.g., marbled 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; 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, 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.

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.

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 longer term and allow for regeneration of native plant communities outside the enclosures, with long-term beneficial minor impacts to the park's cultural landscapes, but, as described under the "Vegetation" analysis, this benefit would not be experienced during the life of this plan. 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 enclosures 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 enclosures 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.

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 67 deer per square mile (as of 2009) to about 15 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.

ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS (PREFERRED ALTERNATIVE)

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.

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 Beach Drive 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.

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 both inside and outside the exclosures as described under alternative A.

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. Construction of the exclosures would require approximately 150 days. 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. Residents and visitors would experience minor, short-term, adverse noise impacts due to construction of fencing and exclosures 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 exclosures 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.

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. However, use of noise suppressors will be required (see chapter 2), which would bring the noise level 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.

ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS (PREFERRED ALTERNATIVE)

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 noise impacts would vary based on several factors, including proximity to the firearm and perceived annoyance level. In all cases, noise suppression devices would be used to reduce impacts. 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.

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.

Based on the results of the Littlejohn visitor use survey (1999), 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. However, based on the most common reasons for visiting the park (exercise, escaping the city, spending time with family and friends), there may be little impact from large numbers of deer to this group of visitors, since their activities would not be dependent on the presence of natural cover or denser vegetation.

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 outcompete 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 large 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. Rabies and West Nile virus could be expected to occur in the park, and this could affect wildlife that the public has come to view. Deer would continue to host ticks, which could carry Lyme disease that could affect visitors if they are bitten by an infected tick. 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 and Beach Drive, 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 park roads 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 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 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 enclosures would be constructed to allow reforestation. 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. 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. 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 enclosures, which would probably not be detectable from vehicles. To protect park resources and minimize visual impacts of the enclosures, 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, as described under "Vegetation," 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, beyond the life of this plan.

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 (PREFERRED ALTERNATIVE)

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 (PREFERRED ALTERNATIVE)

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 (PREFERRED ALTERNATIVE)

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 67 deer per square mile (2009) to about 15 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 (PREFERRED ALTERNATIVE)

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 implementation 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 enclosures 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 enclosures would be approximately \$236,808 (2009 adjusted estimates provided throughout this section) for supplies and labor. After the initial construction, the enclosures would be relocated every 10 years, at an estimated cost of \$177,606 for supplies and labor. These costs would be in addition to the park's present budget.

Maintaining the large enclosures would require additional staff, especially if large storm events or natural disasters required the enclosures to be repaired or removed. Furthermore, to reduce impacts to visitors as much as possible, some enclosures 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 enclosures, estimated at approximately four visits per year and assuming 48 days to cover all of the enclosures, the yearly labor cost would be approximately \$18,236. An additional \$10,730 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 enclosures 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 four years, at an estimated cost of \$180,000. 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 enclosures, 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 about 70 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 Association 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 \$393,400, 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 (PREFERRED ALTERNATIVE)

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 \$232,600, 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 \$570,000, assuming treatment of 41 does annually starting in year 4, including an annual \$5,200 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
(PREFERRED ALTERNATIVE)**

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 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.

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 (T. Bowersox, pers. comm. 2005). 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. 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 (PREFERRED ALTERNATIVE)

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 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. Enclosures 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 (PREFERRED ALTERNATIVE)

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



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 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 final 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.

PUBLIC REVIEW OF THE DRAFT PLAN/EIS

The draft plan/EIS was made available for review through a Notice of Availability (NOA) on July 10, 2009. Following the release of the draft plan/EIS, the public comment period was open between July 13, 2009 and October 13, 2009. This public comment period was announced through the park's website (www.nps.gov/rocr), posted on park kiosks, through postcards that were sent to interested parties, elected officials, and appropriate local and state agencies. Due to the high level of public interest, the comment period was later extended until November 2, 2009, through a park press release and subsequent Federal Register notice. The draft plan/EIS was made available through several outlets, including the NPS Planning, Environment, and Public Comment (PEPC) website at <http://parkplanning.nps.gov/ROCR>, as well as on CD or hard copy obtainable upon request from the park. Thirty hard copies and 51 CDs of the draft plan/EIS and 38 letters announcing the availability of the document on PEPC were mailed to interested parties, elected officials, and appropriate local and state agencies. A limited number of hard copies were made available at the Cleveland Park Public Library, the Chevy Chase Public Library, the Tenley-Friendship Public Library, the Georgetown Public Library, the Martin Luther King Junior Memorial Library, the Petworth Public Library, and the Palisades Public Library. The public was encouraged to submit comments regarding the draft plan/EIS through the NPS's PEPC website, at the public meeting, or by mailing a letter to the park.

In addition to the public review and comment period, one public meeting was held on September 2, 2009, from 6:30 p.m. to 9:00 p.m. at the Rock Creek Park Nature Center in Washington, D.C. This public meeting was held to obtain community feedback on the draft plan/EIS for deer management at Rock Creek Park. Release and availability of the draft plan/EIS, as well as the public meeting, were advertised as described above.

A total of 127 attendees signed in during the meeting. The meeting began with a brief open-house format where attendees had the opportunity to ask questions and observe displays illustrating the study area; the purpose, need, and objectives of the plan; and summaries of the four proposed alternatives, as well as deer population monitoring, vegetation monitoring, and impacts. Following the open-house format, park staff made a formal presentation explaining the specifics of the plan and the proposed alternatives. The presentation was followed by a formal public comment period/hearing that allowed attendees to provide their comments on the draft plan/EIS.

Attendees could fill out comment forms and submit them at the meeting or mail them to the park at any time during the public comment period, which ended November 2, 2009. Those attending the meeting also received a public meeting informational handout, which provided additional information about the

NEPA process, a comparison of actions under each proposed alternative, and additional opportunities for commenting on the project, including directing comments to the NPS PEPC website.

During the comment period, 414 pieces of correspondence were received, one of which was a form letter containing 339 signatures, and one of which was a petition with 540 signatures for a total of 1,293 signatures on all correspondence. Correspondence was received by the following methods: email, hard copy letter via U.S. mail, comment sheet submitted at the public meetings, transcript recorded during the public meeting, or entered directly into the Internet-based PEPC system. Once all the correspondence was entered into PEPC, each was read, and specific comments within each piece of correspondence were identified. A total of 2,118 comments were derived from the correspondence received.

To categorize and address comments, each comment was given a code to identify the general content of a comment and to group similar comments together. A total of 90 codes were used to categorize the comments received on the draft plan/EIS. During coding, comments were also classified as substantive or non-substantive. A substantive comment is defined in the NPS Director's Order 12 Handbook as one that does one or more of the following (NPS 2001, Section 4.6A):

- Question, with reasonable basis, the accuracy of information presented in the EIS;
- Question, with reasonable basis, the adequacy of the environmental analysis;
- Present reasonable alternatives other than those presented in the EIS; and/or
- Cause changes or revisions in the proposal.

As further stated in Director's Order 12, substantive comments "raise, debate, or question a point of fact or policy. Comments in favor of or against the proposed action or alternatives, or comments that only agree or disagree with NPS policy, are not considered substantive." While all comments were read and considered and were used to help create the final plan/EIS, only those determined to be substantive were analyzed for creation of concern statements for response from the NPS. Under each code, all substantive comments were grouped by similar themes, and those groups were summarized with a concern statement prepared for responses. Members of the NPS planning team responded to the concern statements and the responses are included in appendix G. Appendix G includes a content analysis report, concern response report, and comment letters received from businesses, organizations, and agencies.

Approximately 63% of the comments received related to 4 of the 90 codes. These codes were related to general lethal reduction, the combined non-lethal alternative, the combined lethal alternative, and the preferred combined lethal and nonlethal alternative, and were all non-substantive. The majority of the comments were categorized under code *AL3075 – Oppose Lethal Reduction (Non-Substantive)*, which accounted for 18.76% of the total comments received. Comments under code *AL2025 – Support of Alternative B: Non-Lethal Actions (Non-Substantive)* were the second most common comment, representing 16.73% of the total comments made. Comments under code *AL4050: Oppose Alternative D: Combined Lethal and Non-Lethal Actions (NPS Preferred) (Non-Substantive)* were the third most common comment, representing 14.03% of the total comments made. The fourth most comments fell under code *AL2045 – Oppose Alternative C: Combined Lethal Actions (Non-Substantive)*, with 13.83% of the total comments. Of the 1,293 signatures, 386 (29.85%) came from commenters in the state of Maryland, 171 (13.23%) came from within the District, and 562 (43.46%) came from the Commonwealth of Virginia. The remaining pieces of correspondence came from eight other states, except for commenters who stated they resided in "UN." The majority of comments (97.76%) came from unaffiliated individuals, with 0.31% of the comments coming from conservation/preservation organizations.

All comments received were carefully considered and incorporated into the final plan/EIS. Changes made in the final plan/EIS as a result of public comment are factual in nature and did not result in changes to the NPS preferred alternative or the outcome of the impact analysis for any of the management alternatives considered.

Consultation and Coordination

This final plan/EIS will be made available for public inspection for a 30-day no-action period, which begins with the publication of the EPA Notice of Availability. After the 30-day no action period, a record of decision (ROD) will be prepared that will document approval of the plan, select the alternative to be implemented, and set forth any stipulations required for implementation. The ROD will be signed by the Regional Director of the National Capital Region, after which Notice of availability of the ROD will be published in the Federal Register. This publication will complete the NEPA process, at which time the NPS will begin to implement the selected alternative.

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 H. One response was received on July 18, 2008 from the District Historic Preservation Office; it is included at the end of appendix H. A copy of the draft plan/EIS was 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.

Copies of this final plan/EIS will be sent to all of these agencies.

LIST OF RECIPIENTS OF THE FINAL 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
- 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

Consultation and Coordination

- 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
- 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

Name	Title	Organization / Location
Ken Ferebee	Natural Resource Management Specialist/Park Contact	NPS – Rock Creek Park
William McShea	Research Scientist	National Zoological Park (NZP)/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 (former)	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) (former)
Randy Knutson	Wildlife Biologist for Indiana Dunes National Lakeshore (IDNL)	National Park Service, IDNL

LIST OF PREPARERS AND CONSULTANTS

Name	Title	Education/Responsibility	Experience
National Park Service			
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.	21 years with NPS
James Sherald	Former 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.	37 years; (retired)
Dan Sealy	Deputy Chief of Natural Resources and Science, Center for Urban Ecology	B.S. Natural Resource Management. Provided input and review.	35 years with NPS (retired)
Scott Bates	Regional Wildlife Biologist NPS — Center for Urban Ecology	B.S. Biology; M.S. Wildlife Management. Provided technical input.	10 years with NPS NCR and 9 years with DoD as a wildlife biologist
Diane Pavcek	Research Coordinator and Botanist	B.S. in Botany and Zoology; M.S., Ph.D. in Botany. Provided technical input.	25 years in botany; 11 years with NPS
Michael Mayer	Environmental Protection Specialist (EQD) – (former NPS employee)	B.S. Wildlife and Fisheries Biology; M.S. Wildlife Conservation; J.D. Environmental Law. Responsible for NEPA policy, guidance, and technical review. Former Project manager, technical reviewer.	12 years
Melissa Stedeford	Environmental Protection Specialist (EQD)	B.S. Environmental Science; M.S. Environmental Science. Project manager. Responsible for NEPA policy, guidance and technical review.	5 years
Kimley-Horn and Associates, Inc.			
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).	20 years
The Louis Berger Group, Inc.			
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.	30 years

Name	Title	Education/Responsibility	Experience
Dan Niosi	Environmental Scientist (formerly with Louis Berger)	B.A. Environmental Studies – Natural Resources. Responsible for the species sections of chapters 3 and 4.	10 years
Joel Gorder, AICP	Planner and Environmental Scientist (formerly with Louis Berger)	B.S. Limnology, Biology, M.S., Urban and Regional Planning; Responsible for draft of soils and water quality affected environment.	17 years
Jeff Gutierrez	Planner/Environmental Scientist	B.A. Environmental Studies Responsible for comment analysis coding and reporting.	4 years
Lucy Bambrey	Senior Cultural Resources Specialist (formerly with Louis Berger)	M.A. Anthropology. Responsible for cultural landscapes sections.	31 years
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.	10 years
Rebecca Byron	Planner/Environmental Scientist	B.S. Environmental Science and Policy; Masters of Urban and Regional Planning. Responsible for draft affected environment information for vegetation, safety, rare species; completed comment analysis .	5 years
Juanita Barboa	Technical Editor – The Final Word (subcontractor)	B.S. Technical Communication. Responsible for editing document.	19 years

OTHER REVIEWERS

Name	Title	Experience
N a t i o n a l P a r k S e r v i c e		
Tara Morrison	Superintendent, Rock Creek Park	13 years with NPS
Adrienne Coleman	Superintendent, Rock Creek Park (former)	22 years with NPS
Cindy Cox	Deputy Superintendent, Rock Creek Park	24 years with NPS
Simone Moffett	Cultural Resources Program Manager	4 years with NPS
Nick Bartolomeo	Chief Ranger	14 years with NPS