

AFFECTED ENVIRONMENT

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

VEGETATION

CURRENT VEGETATION STATUS AND ROLE OF DEER

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

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

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

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



Corner marker of long-term plot

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

OVERVIEW OF ROCK CREEK PARK VEGETATION

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

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



Forest vegetation at Rock Creek Park

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

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

FOREST COMMUNITIES

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

Rock Creek Park Units District of Columbia

Figure 5. Vegetation - 1998

Legend

-  Park Boundary
-  District Boundary
-  Interstate
-  Major Road

Vegetation Legend

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

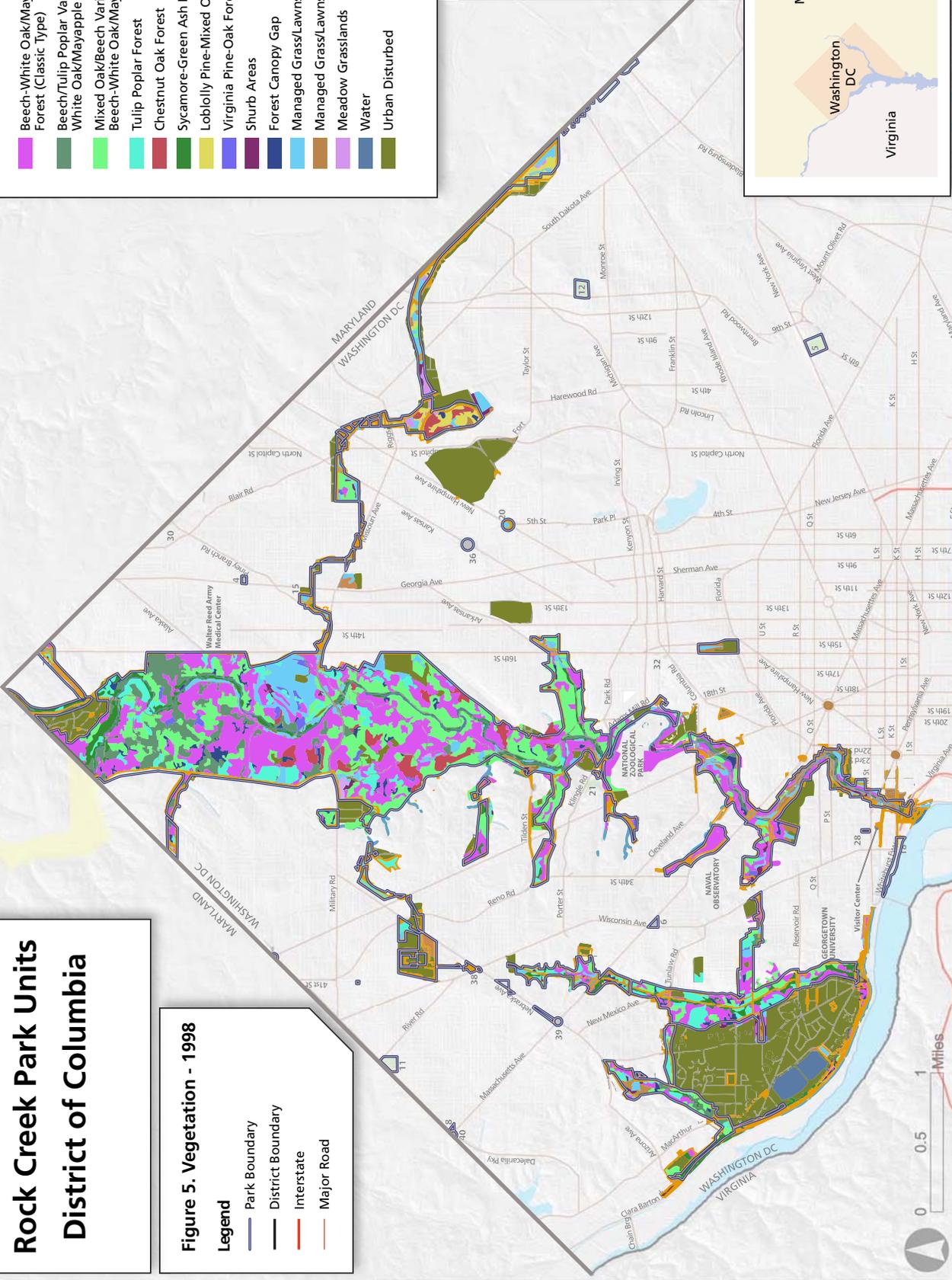
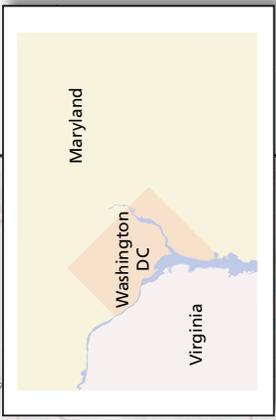


TABLE 13. FOREST ASSOCIATIONS FOUND WITHIN ROCK CREEK PARK

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

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

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

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

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

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

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

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

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

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

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

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

EXOTIC INVASIVE SPECIES

BACKGROUND

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

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

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

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

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

EXOTIC INVASIVE SPECIES IN ROCK CREEK PARK

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

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

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

SOILS AND WATER QUALITY

SOILS

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

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

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

WATER QUALITY

ROCK CREEK WATERSHED OVERVIEW

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

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

EXISTING WATER QUALITY

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



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

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

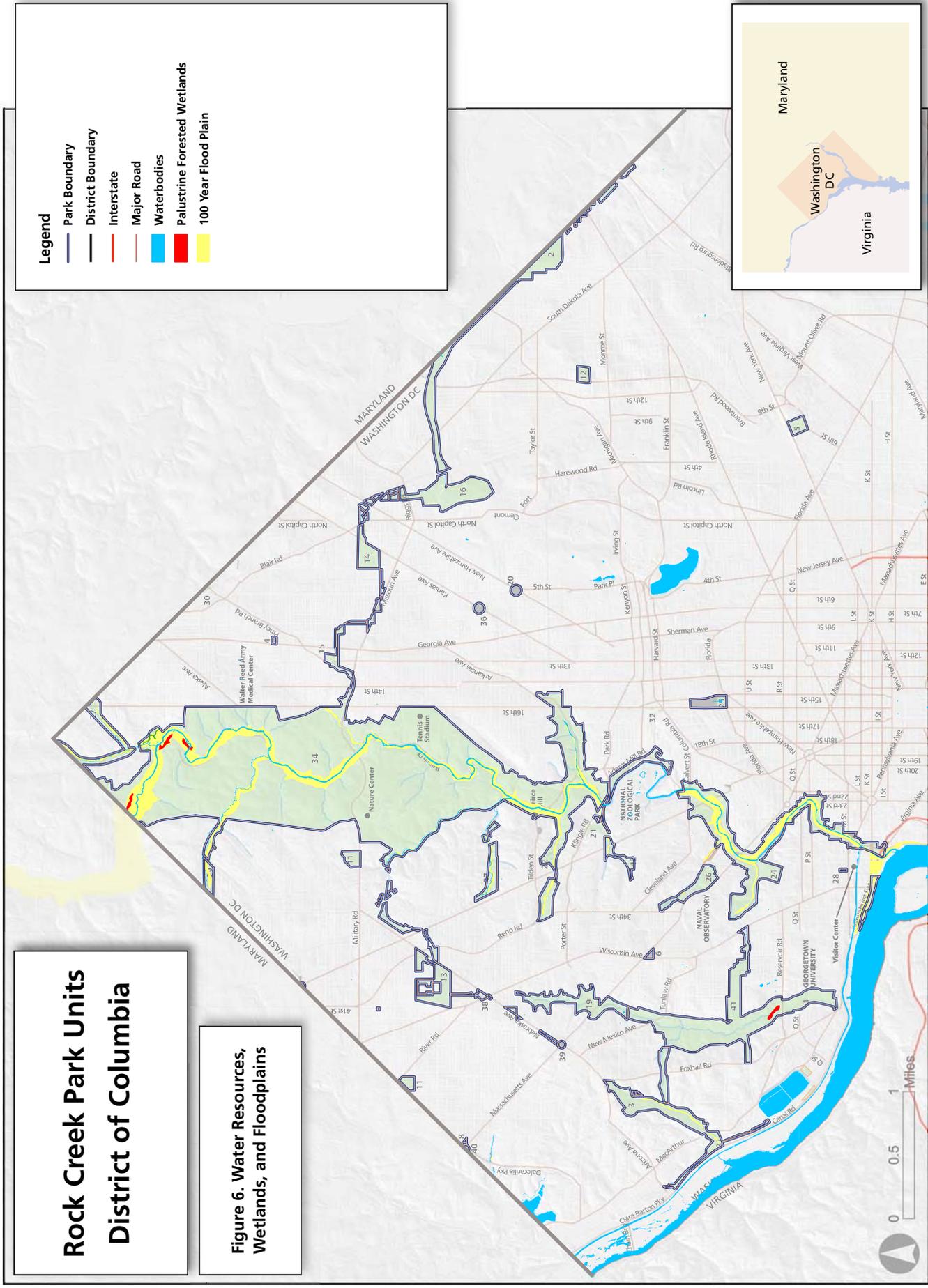
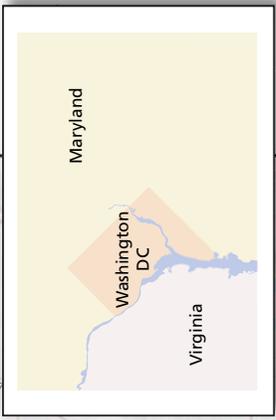
STREAM DESIGNATIONS AND WATER QUALITY STANDARDS

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

Rock Creek Park Units District of Columbia

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

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



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

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



Combined sewer outfall in the park

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

WETLANDS AND FLOODPLAINS

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

WETLANDS

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

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

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

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

FLOODPLAINS

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

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

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

WILDLIFE AND WILDLIFE HABITAT

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

WHITE-TAILED DEER

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

General Ecology

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

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



Radio collared deer

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

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

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

Home Range and Deer Movement Outside the Park

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



Radio telemetry

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

Population Size and Density

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

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

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

Factors that Can Affect Deer Health

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

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

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

Diseases of Concern

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

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

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

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

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

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

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

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

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

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

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

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

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

OTHER WILDLIFE

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

Mammals



Coyote

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

Reptiles and Amphibians

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

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

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

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

Birds

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

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

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

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

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

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



Brown thrasher

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

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

Fish

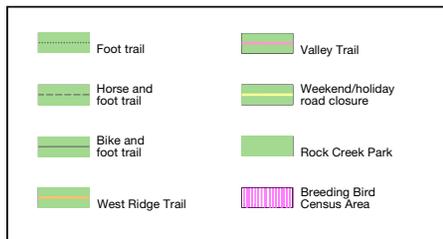
According to the park's *General Management Plan* (NPS 2005a), surveys by the District of Columbia have found approximately 35 species of fish in Rock Creek.

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

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



United States Department of the Interior/National Park Service WASO/January '03/000-00000



Rock Creek Park Washington, DC

Figure 7. Breeding
Bird Census Area

Source: www2.nature.nps.gov/stats/

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

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

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

Nonnative Species

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

CURRENT STATUS OF WILDLIFE AND THE ROLE OF DEER

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

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

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

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

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

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

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

RARE, UNIQUE, THREATENED, OR ENDANGERED SPECIES

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

FEDERAL AND STATE-LISTED AMPHIPODS

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

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

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

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

OTHER STATE-LISTED PLANT AND ANIMAL SPECIES

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

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



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

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

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

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

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

Affected Environment

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

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

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

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

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

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

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

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

S? = The species has not yet been ranked.

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

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

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

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

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

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

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

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

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

Affected Environment

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

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

Affected Environment

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

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

CULTURAL LANDSCAPES

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

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

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

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

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

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

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

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

In addition, cultural landscape reports have been published for:

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

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

ROCK CREEK PARK AND ROCK CREEK AND POTOMAC PARKWAY

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

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

GLOVER-ARCHBOLD PARK AND WHITEHAVEN PARKWAY

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

TRAFFIC CIRCLES AND OTHER SMALL PARCELS

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

SOUNDSCAPES

NATURAL AND HUMAN NOISE LEVELS

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

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

Affected Environment

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

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

TABLE 17. COMMON NOISE SOURCES AND LEVELS

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

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

dB = decibels

TABLE 18. PERCEPTIONS OF INCREASES IN DECIBEL LEVEL

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

Source: MN Pollution Control Agency 1999

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

NOISE ATTENUATION

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

Distance

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

Air Absorption

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

Barriers and Hills

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

Trees

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

NOISE LEVELS AT ROCK CREEK PARK

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

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

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

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

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

FIREARM NOISE

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

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

NOISE LEVELS AND PERCEIVED ANNOYANCE

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

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

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

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

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

VISITOR USE AND EXPERIENCE

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

VISITATION

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

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

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

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

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

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

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

Rock Creek Park Units District of Columbia

Figure 8. Visitor Use Areas

Legend

- Park Boundary
- District Boundary
- Interstate
- Major Road

Visitor Use

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

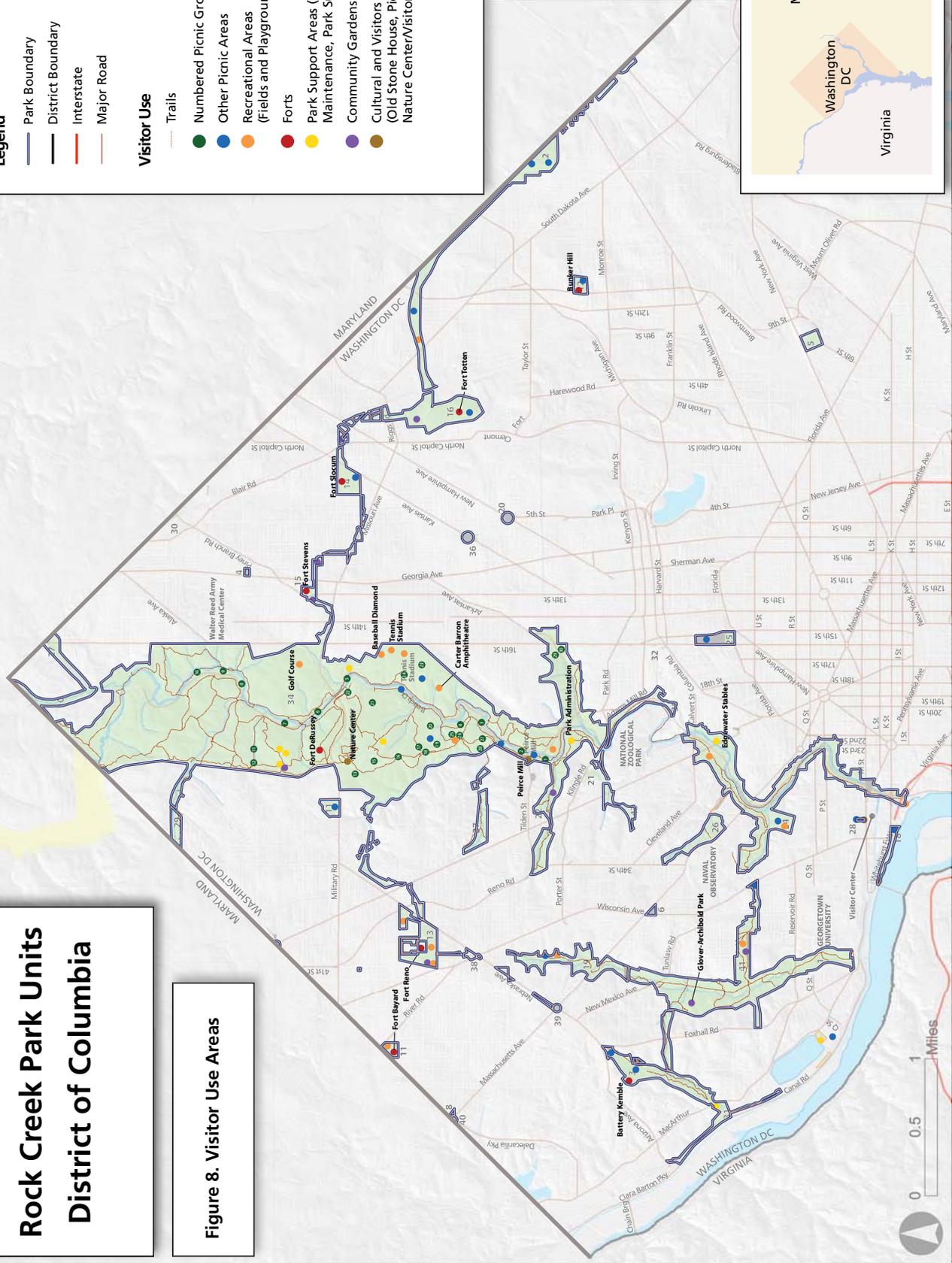
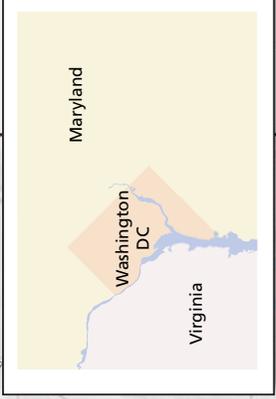


FIGURE 9. ANNUAL VISITATION AT ROCK CREEK PARK

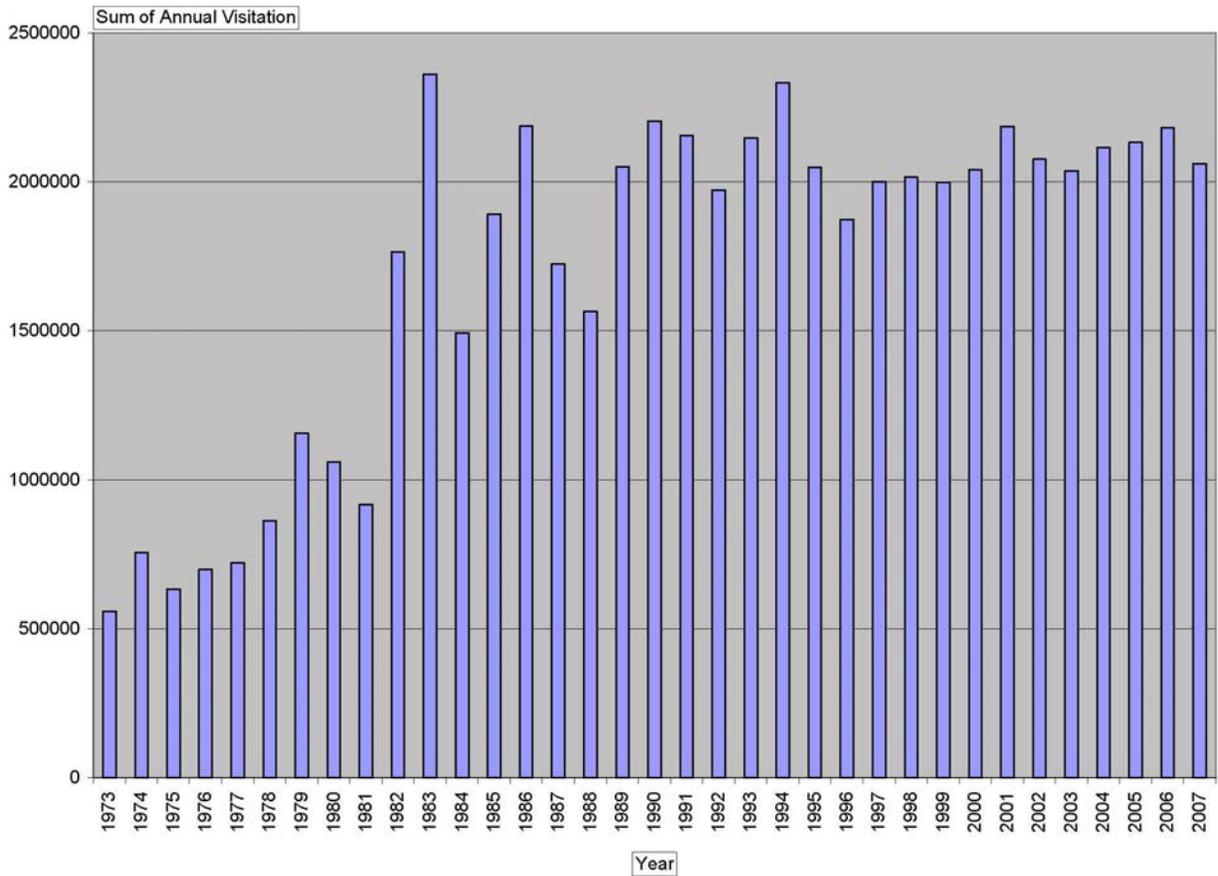


TABLE 19. MONTHLY RECREATIONAL VERSUS NON-RECREATIONAL USE OF ROCK CREEK PARK

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

Source: NPS 2007b.

VISITOR ACTIVITIES

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

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

TABLE 20. REASONS FOR VISITING ROCK CREEK PARK

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

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

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

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

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

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

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

Birding

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

Fishing

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

Biking and Hiking

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



Tennis

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

Nature Center

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

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

Horseback Riding

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

Golf

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

Community Gardens

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

Motorized Recreation

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



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

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

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

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

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

VISITOR AND EMPLOYEE HEALTH AND SAFETY

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

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

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

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

VISITOR HEALTH AND SAFETY

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

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

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

DEER/VEHICLE COLLISIONS

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

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

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

EMPLOYEE HEALTH AND SAFETY

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

TABLE 21. EMPLOYEE INJURY RATES FOR RECENT YEARS

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

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

SOCIOECONOMIC RESOURCES

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

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

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

TABLE 22. DISTRICT OF COLUMBIA CENSUS TRACT DATA

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

Data Source: U.S. Census Bureau 2007; NeighborhoodInfo DC 2007c

The damages that deer may inflict upon landscaping and its subsequent relationship to property values and cost to property owners are discussed below.

LANDSCAPING AND PROPERTY VALUES

The median property value of owner-occupied units in the District of Columbia was \$157,200 as of the 2000 census. Between 1995 and 2005, areas around Rock Creek Park units experienced an increase in property values ranging from 2.7% (the area around the northern half of the main Rock Creek Park) to 5.8% (the area around the southern portion of the Rock Creek Park and Potomac Parkway). In the area around Glover-Archbold Park and Whitehaven Parkway, home values increased by 5.2% during that time period (Neighborhoodinfo DC 2007a). Although home prices are increasing, sales of single-family homes throughout the city have declined overall and were down 11.6% in the third quarter of 2006 from the prior year (Neighborhoodinfo DC 2007b).

Landscaping can have a significant impact on property values, enhancing the resale value of a property by up to 15%, with a treed lot selling for 7% to 14% more than a lot without trees (Nuss 2000). Furthermore, landscaping expenditures are often easily recovered when selling, with 100% to 200% of landscaping costs typically recovered (Taylor 2003). Therefore, improvements to landscaping may be seen as a successful way to improve property values.

Unfortunately, deer can often have a highly destructive effect on landscaping. Their diet experiences seasonal variation, which is typically a function of what is available. Browse, which refers to trees, shrubs, and vines, makes up a substantial part of the diet of the average deer. As habitat dwindles due to development pressure and as deer populations grow, deer may turn to surrounding residential areas for food, particularly in late fall, winter, and early spring, when other food sources may be scarce. An average adult deer consumes approximately 6 to 10 pounds of food per day during late spring, summer, and fall (McDonald and Hollingsworth 2007), which may result in increased pressure on surrounding landscaped areas from deer browsing if available natural habitat cannot support the population. In many residential areas surrounding protected areas, such as Rock Creek Park, deer cause virtually year-round damage to landscaping, which can be costly to replace. Currently, the District Department of the Environment considers overbrowsing to be a serious conservation threat (DDOE 2006).

Deer damage shrubs and landscape vegetation by eating the buds, leaves, flowers, and twigs, and by rubbing on the bark. In home gardens, deer often eat leaves, flowers, stems, or other edible parts. Other less frequent damage includes trampling of plants and damage to trees and shrubs caused by antler rubbing (West Virginia University 1985). Damage typically extends to an average of 6 feet, which is as high as deer can reach. Nearby Fairfax County, Virginia, estimates annual damage to landscaping resulting from deer at approximately \$1 million (Fairfax County Park Authority 2004).

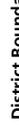
Rock Creek Park began compiling a list of people who inquired about the impacts of deer on neighboring landscaping in the early 1990s. This list served as a mailing list and did not track the number of complaints or inquiries the park received on the subject. Calls are received each year about deer issues and the majority involved concerns about deer consuming landscaping plants or road kill clean-up. There have been no reported incidences of deer aggression towards park visitors or park neighbors. This list has not been regularly updated and staff at Rock Creek Park Headquarters continue to handle any complaints, but do not keep records (Armstead, pers. comm. 2007).

PARK MANAGEMENT AND OPERATIONS

Deer management actions, even the dissemination of information about deer and their effects on the environment, require time and money, and all alternatives considered would have effects on staffing and operating budgets. The staff of Rock Creek Park is currently organized into three operating divisions: Administration, Resource Management and Visitor Services, and Maintenance. There are 48 full-time employees.

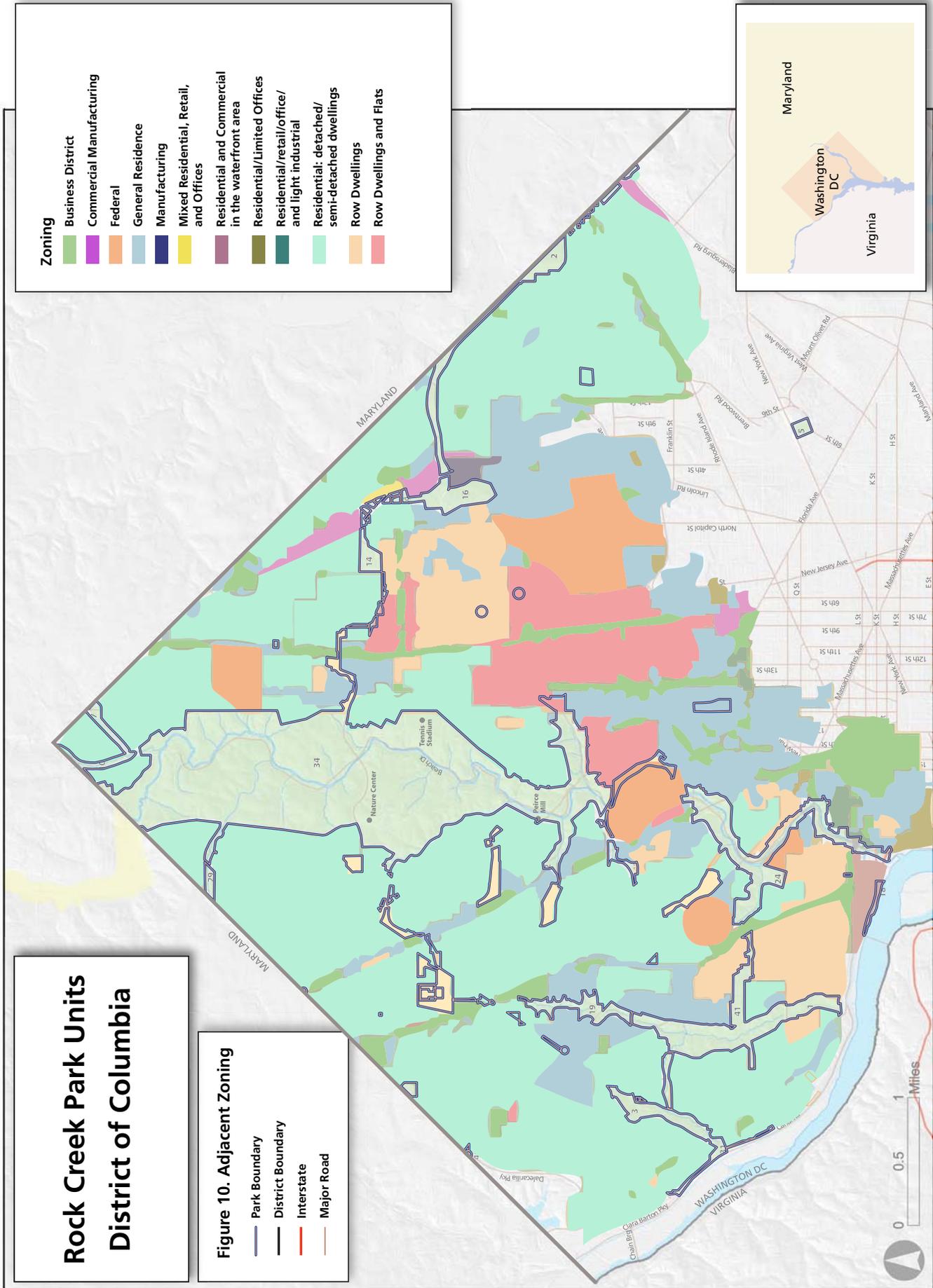
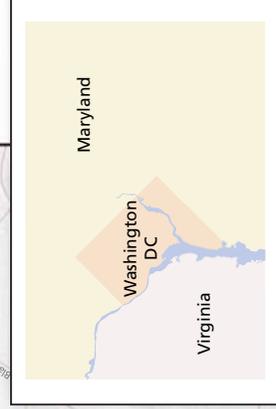
Rock Creek Park Units District of Columbia

Figure 10. Adjacent Zoning

-  Park Boundary
-  District Boundary
-  Interstate
-  Major Road

Zoning

-  Business District
-  Commercial Manufacturing
-  Federal
-  General Residence
-  Manufacturing
-  Mixed Residential, Retail, and Offices
-  Residential and Commercial in the waterfront area
-  Residential/Limited Offices
-  Residential/retail/office/and light industrial
-  Residential, detached/semi-detached dwellings
-  Row Dwellings
-  Row Dwellings and Flats



The permanent staff is augmented by a seasonal or temporary workforce, which changes from year to year due to funding variations. Typically, this seasonal workforce has included 1 to 2 park rangers, 1 biological technician, and 8 to 10 laborers and maintenance workers. Three to four volunteers from the Student Conservation Association augment park staff (K. Ferebee, pers. comm. 2007d). In 2007 there were 19 seasonal or temporary employees at the park, for a total of 64 employees. Seasonal employees are common from the spring through the fall and are allowed to work a total of 1039 hours annually (K. Ferebee, pers. comm. 2008g).

The 2005–2007 operating budget for Rock Creek Park is detailed in table 23. The budget for the Resource Management and Visitor Services portion of the total budget is also given. Operating budgets may vary annually (Champagne, pers. comm. 2007).

TABLE 23. ROCK CREEK PARK OPERATING BUDGET

Year/Division	Operating Budget
2005	
Total Operating Budget	\$6,639,300
Resource Management and Visitor Services	\$1,067,697
2006	
Total Operating Budget	\$6,782,700
Resource Management and Visitor Services	\$1,031,232
2007	
Total Operating Budget	\$7,172,100
Resource Management and Visitor Services	\$1,139,139

Source: Champagne, pers. comm. 2007

RESOURCE MANAGEMENT AND VISITOR SERVICES

Natural Resource Management

Rock Creek Park currently has two full-time employees with duties solely in natural resource management. The natural resource management staff devotes about 10% to 15% of their time to deer management activities, which include erecting and maintaining small exclosures, conducting annual fall spotlight surveys to determine population trends and densities, moving carcasses killed by vehicle collisions, assisting D.C. Animal Control with injured animals, and responding to questions from visitors and neighbors (K. Ferebee, pers. comm. 2007d).

Other duties of the natural resource management staff include water quality monitoring and mitigation of problems affecting these resources, park wildlife population monitoring and management, vegetation management including control of invasive plants, wildland fire management, integrated pest management, and trails management.

The NPS Center for Urban Ecology assists the park resource management staff by providing services related to Distance Sampling and deer management statistics. The center staff also provides technical assistance on other park programs including water quality monitoring, vegetation monitoring, air quality monitoring, invasive plant control, and integrated pest management.

Compliance and Boundary Management

One permanent full-time park ranger is responsible for project compliance in the park to include preparing environmental assessments, writing right-of-way and special-use permits, and monitoring permit compliance by contractors. This ranger is also responsible for the park boundary management program (K. Ferebee, pers. comm. 2007d).

Cultural Resources Management

One full-time employee at the park has duties solely devoted to managing the park's cultural resources. The park manages many properties that are listed in the National Register of Historic Places, as well as several sites that are eligible for listing. The park manages several Civil War sites and many other sites of historical significance.

Education and Interpretation

Education and interpretation are a large part of the visitor services offered by this division. The staff provide many educational and interpretive programs focused on the park's natural and cultural history for school groups, families, and adults. Several programs are presented on the wildlife found in the park, including white-tailed deer and the role they play in the park's ecosystem. Three urban wildlife kits (deer, turtle, owl), designed for pre-kindergarten through grade 3, are available for loan from the Rock Creek Park Nature Center. Each kit contains a teacher's guide, materials, books, and objects for hands-on lessons focusing on adaptations and habitats. The wildlife kits are borrowed an average of four times each year (based on receipts from 1998–2005). Teachers keep the kit for three to five weeks. The deer kit has 16 suggested lessons and teachers often create additional activities. Checking the kits in and out requires minimal staff time. Each teacher may teach as many as 10 to 12 lessons for different classes using the kits (Illige, pers. comm. 2005).

In addition, park staff and the superintendent have spoken at community association meetings and town hall meetings regarding deer issues in the park. Six "Oh Deer" interpretive programs are given during the year. Other deer management activities currently undertaken by Rock Creek Park include assisting D.C. Animal Control with injured animals (e.g., darting animals, euthanizing injured animals), responding to neighbors' questions about the deer population (e.g., how to keep deer out of yards, preventing browse of landscaping vegetation), and disseminating information about the deer population.

The park manages three main visitor contact points: Nature Center and Planetarium, Peirce Mill complex, and Old Stone House. The Nature Center functions as the park's main visitor center where the majority of the public programs are presented; however, programs and visitor assistance are available at the other sites. The park is an integral part of the Bridging the Watershed Program, which educates local school groups on the importance and function of the watersheds in the Washington, D.C. metro area.

MAINTENANCE

Of Rock Creek Park's 29 full-time maintenance employees, few perform general maintenance tasks specifically related to deer management, and no maintenance staff employees are currently assigned to perform deer management tasks, such as applying repellents or erecting small exclosures. As described previously, the natural resource management staff conduct these activities. Maintenance staff will occasionally remove a deer carcass from a park road.

The primary responsibility of the Maintenance Division is to provide for the general upkeep and maintenance of all park buildings and infrastructure, including the visitor center, tennis stadium, large amphitheater, 30 picnic groves, approximately 50 miles of foot, horse, and bike trails, 20 miles of park roadways, and numerous buildings, some of which are historic. Park maintenance staff are also responsible for maintaining all utilities that service park buildings and other park facilities (K. Ferebee, pers. comm. 2007d).

ADMINISTRATION AND PARK MANAGEMENT

This division consists of the Park Superintendent and Assistant Superintendent, as well as the Administrative Officer and other support staff. The primary responsibility of the Superintendents is the day-to-day management of overall park operations. The Administrative Officer oversees personnel, purchasing, budget, and contracting activities.

Currently there is one park ranger who manages the park's community gardens and prepares permits for special park uses. Many of the community gardens are experiencing pressure from deer browse, which has required the erection of fencing to protect plots. The park administration staff is consulted on deer and pest issues related to the community gardens (K. Ferebee, pers. comm. 2007f).

The Park Police provide law enforcement on all lands administered by Rock Creek Park. They also provide for visitor safety, respond to emergencies, enforce traffic laws, enforce the Code of Federal Regulations, and preserve the natural and cultural resources entrusted to the NPS. The Park Police will respond to traffic accidents involving wildlife and will humanely dispatch injured animals when required.

