

Volume 1
Final
General Management Plan
Environmental Impact Statement

**ROCK CREEK PARK
AND THE
ROCK CREEK AND
POTOMAC PARKWAY**

Washington, D.C.

AFFECTED ENVIRONMENT

This section describes the physical resources of Rock Creek Park and the Rock Creek and Potomac Parkway, including both natural and cultural resources. It also describes visitor and community conditions, such as visitor profile, visitation trends, automobile traffic and other transportation within and near the park, and the characteristics of the communities around the park and parkway.

NATURAL RESOURCES

AIR QUALITY

Regional Compliance with Air Quality Standards

Air quality is included as an impact topic based on the criteria presented in the “Impact Topics - Resources and Values at Stake in the Planning Process” section. The specific concerns related to this impact topic are summarized as part of the “Environmental Consequences” discussion.

National Ambient Air Quality Standards (NAAQS) were established in the 1970 Clean Air Act amendments. The standards are concentrations of contaminants in the air that will protect public health and prevent degradation or harm to the environment.

To measure compliance with the National Ambient Air Quality Standards, the District of Columbia operates an ambient air monitoring network. The Air Quality Division of the District of Columbia, Department of Health is the responsible agency for monitoring and enforcing the applicable standards. A complete table of the National Ambient Air Quality Standards is available on the Internet site of the District of Columbia, Air Quality Division at <http://dchealth.dc.gov/index.asp>. The web site also contains monitoring data, and a printed ambient air monitoring data report can be obtained.

The Metropolitan Washington Council of Governments is a partner in the program and analyzes the air quality data. The Metropolitan Washington Council of Governments provides an area air quality index and notifies the public of the region’s air quality status. Up-to-date information on the index can be obtained by calling 202-962-3299. In addition, this organization has information available about its environmental programs and publications at <http://www.mwcog.org/>.

Most air pollutants in the District of Columbia region are from vehicle emissions. Since the Clean Air Act was amended in 1990, the metropolitan Washington area has made significant strides in improving air quality, mostly by reducing the volumes of contaminants in automobile emissions (District of Columbia 2004c).

The region currently meets five of the six National Ambient Air Quality Standards. The area remains out of compliance only with the standard for ground-level ozone (Metropolitan Washington Council of Governments 2004).

In 2003, the U.S. Environmental Protection Agency began phasing in a more stringent standard for measuring ground-level ozone. The new standard involves measurements collected over an 8-hour period, instead of the 1-hour period previously used. When the U.S. Environmental Protection Agency announced its guidance for the new standard, the region was found to be moderately out of compliance for ozone (Day 2004).

In early 2004, the Metropolitan Washington Air Quality Committee approved a regional State Implementation Plan for submission to the U.S. Environmental Protection Agency. The State Implementation Plan focuses on improving air quality in the Washington region to meet the National Ambient Air Quality Standard for ozone. The plan consists of

- two rate-of-progress demonstrations, for the periods 1999-2002 and 2002-2005
- an attainment demonstration for 2005

The State Implementation Plan shows that progress is being made on improving air quality in the Washington non-attainment area. There were no 1-hour exceedences for ozone during 2004 (Day 2004). Despite these improvements, the entire Washington, D.C. metropolitan area, including Rock Creek Park and the adjacent counties in Virginia and Maryland, is still classified as being in non-attainment with the ozone standard by the U.S. Environmental Protection Agency.

The park and parkway are within a class II air quality area. As described above, the air quality is generally good with the exception of ozone. Ozone cannot be measured as a tailpipe emission. Instead, it is a secondary pollutant that is formed in the atmosphere by the combination of volatile organic hydrocarbons and nitrogen oxides with sunlight as a catalyst. Ozone exceedences generally occur in the summer and are region-wide, rather than localized. The occurrence of high levels of ozone is almost always associated with hot stagnant air masses over the region in combination with strong sunlight. Carbon monoxide is a tailpipe emission, and local monitoring can indicate problem areas. The region became an attainment area for carbon monoxide in 1988 and data indicate that the long-term trend for carbon monoxide is downward (Day 2004). The reduction in carbon monoxide concentrations has been attributed to the use of oxygenated fuels and the gradual replacement of older, more polluting motor vehicles with newer, more fuel-efficient models. Washington, D.C. and the surrounding region now implement a maintenance plan to prevent violations of the carbon monoxide standard.

Carbon Monoxide Monitoring Results in 2001 and 2002

The District of Columbia, Department of Health, Air Quality Division operates an ambient air monitoring network consisting of six permanent air monitoring stations. Two of these stations monitor for carbon monoxide. Air quality experts from the District of Columbia, Department of Health and U.S. Environmental Protection Agency have agreed that for regulatory purposes, the data from these two sites provide an adequate representation of carbon monoxide concentrations for the District. The carbon monoxide monitoring stations are located at the

Verizon Telephone building at 21st and K Street, N.W., which is 3.2 miles from the headquarters of Rock Creek Park at the Peirce-Klingbein Mansion

River Terrace Elementary School at 34th and Dix Streets, N.E., which is 6.1 miles from the headquarters of Rock Creek Park

Data from these monitoring sites are reported as 1-hour averages. As shown in table 8, the 1-hour standard for carbon monoxide is 35 parts per million. One-hour values are averaged over 8-hour periods to determine compliance with the 8-hour standard for carbon monoxide of 9 parts per million.

Data from throughout 2001 and 2002 indicated that carbon monoxide concentrations in the District of Columbia are well within the 1-hour and 8-hour standards for carbon monoxide. The combined data from both monitoring sites show only 20 1-hour readings over the 2-year period that exceeded 5 parts per million (compared to the standard of 35 parts per million). The highest concentration of carbon monoxide detected in the 2-year period was 7.6 parts per million. This sample was collected in the 9:00 A.M. hour on October 16, 2002 from the Verizon Telephone building site (District of Columbia 2004a and 2004b).

TABLE 8: CARBON MONOXIDE NATIONAL AMBIENT AIR QUALITY STANDARDS AND VALUES FOR WASHINGTON, D.C., 2001 – 2002

Standard or Parameter	Value
1-hour National Ambient Air Quality Standard for carbon monoxide	35 parts per million
8-hour National Ambient Air Quality Standard for carbon monoxide	9 parts per million
Total number of 1-hour readings from either monitoring station exceeding 5.0 parts per million over 2-year period	20
Maximum carbon monoxide level measured in 2001 and 2002	7.6 parts per million

Year 1996 Air Quality Evaluation for Rock Creek Park

The National Park Service conducted a short-term air pollution monitoring study in the park and along the parkway from December 7 to 20, 1996 (Robert Peccia and Associates *et al.* 1997). The goal was to assess carbon monoxide concentrations at three locations during peak morning and afternoon rush hours. Winter sampling was performed, because winter is the worst season for high carbon monoxide emissions. This occurs because vehicles emit more carbon monoxide during cold weather, especially during the cold-startup period, and temperature inversions can trap carbon monoxide emissions close to the ground.

Monitoring sites were located at the intersection of 16th Street and Colorado Avenue near Military Road; at the intersection of the Rock Creek and Potomac Parkway and Calvert Street; and at the golf course, away from roads. The golf course location was chosen in an effort to establish background (unaffected by local traffic) levels.

Considerable variations were seen in the data as a result of wind direction, precipitation, and atmospheric mixing. On three occasions, wind direction caused the “background” golf course concentrations to be higher than the other, heavily traveled sites.

The study did not indicate that there were any “valley effects” that would tend to concentrate pollutants within the narrow valley bottom. Elevated concentrations of carbon monoxide were detected at all of the sampling locations and, in general, showed agreement with measurements taken during the same period at other local air monitoring stations around the Washington, D.C. metropolitan area. The sampling results suggested that some of the carbon monoxide detected in the park drifts in from the city.

The highest concentration of carbon monoxide was 3.38 parts per million, measured over a 3-hour period at the intersection of 16th Street and Colorado Avenue. This and all other measured concentrations from the park and parkway were well below both the 1-hour (35 parts per million) and 8-hour (9 parts per million) National Ambient Air Quality Standards for carbon monoxide. Based on these limited sampling results, the carbon monoxide levels in the park and along the parkway met the National Ambient Air Quality Standards for carbon monoxide.

ROCK CREEK AND ITS TRIBUTARIES

Rock Creek and its tributaries are included as an impact topic based on the criteria presented in the “Impact Topics – Resources and Values at Stake in the Planning Process” section. The specific concerns related to this impact topic are summarized as part of the “Environmental Consequences” discussion.

Watershed Overview

The Rock Creek Watershed map was included previously in the “Servicewide Mandates and Policies” section. Rock Creek flows generally south for 33 miles from its headwaters near Laytonsville, Maryland, to its confluence with the Potomac River at Georgetown. Land uses within the 77-square-mile Rock Creek watershed include urban, suburban, residential, agricultural, and parkland.

An estimated 500,000 people reside in the watershed. Approximately 70 percent of the watershed, mostly upstream from Rock Creek Park, is developed. Much of the developed area consists of impervious surfaces, such as buildings, roads, and driveways. Problems within the park that have been produced by upstream development include increased flooding from rapid runoff, abnormal stream bed scouring in some places and sedimentation in others, bank erosion, organic and chemical pollution, and accumulation of litter and other solid waste.

Rock Creek is the primary water feature in the park, and within the area it has two major tributaries.

Broad Branch enters from the northwest, just opposite the intersection of Blagden Avenue and Beach Drive.

Piney Branch enters Rock Creek from the northeast at Piney Branch Parkway, approximately a half mile south of Broad Branch.

Sixteen smaller tributaries enter the creek in Rock Creek Park, primarily from the west. Most Rock Creek tributaries to the east were canalized, covered, and converted into storm drains during the early development of Washington, D.C. (Banta 1993). There also are numerous minor tributaries and many groundwater springs that drain to Rock Creek within the park.

Sewers and Outfalls

As shown in the Sewerlines and Outfalls map, numerous municipal storm sewers converge in the Rock Creek valley and discharge surface water from city streets and lots directly into park waters. The pollutants that surface waters transport from roadways and parking lots are a major source of contamination of Rock Creek and its tributaries during and after precipitation events.

The Sewerlines and Outfalls map also shows that numerous municipal sanitary sewers are located within the park, including pipelines that run under road beds and under the creek channel. Sanitary sewers carry raw sewage, and can pollute park waters when leaks develop. In upper Rock Creek, high bacterial concentrations are suspected to originate from sanitary sewer leaks, and from failed septic systems in the Maryland portion of the watershed.

A serious source of pollution exists in the southeastern portion of the park where there is an antiquated system of combined sanitary and storm sewers (see the Sewerlines and Outfalls map). Under normal conditions, the flow in these combined sewers is routed to the Blue Plains Wastewater Treatment Plant. However, during storms when rainfall exceeds 0.3 inches per hour, these sewers overflow and discharge untreated sewage directly into Piney Branch and Rock Creek. There are 29 combined sanitary/storm sewer overflow structures on Rock Creek (URS Greiner Woodward Clyde 1999). Together, they contribute 49 million gallons of combined storm water and sewage to the creek in an average year (District of Columbia 2003).

The District of Columbia Water and Sewer Authority estimated that 60 to 70 storm-related sewer overflow events occur each year (*Engineering News-Record* 2001). In 1998, the Water and Sewer Authority began planning a long-term, combined sewer system control plan that would reduce overflow discharges throughout its service area by more than 90 percent (District of Columbia 2004e). This project would construct three 20-foot-diameter, concrete-lined tunnels that together could hold approximately 115 million gallons of mixed storm runoff and sewage. The tunnels would collect and store all of the runoff from all but the largest 5 to 10 storm flows annually and then release it gradually for treatment at the Blue Plains Wastewater Treatment Plant. One of the tunnels, which would be a half-mile long and have a capacity of 5 million gallons, would be constructed along Rock Creek (the Piney Branch Storage Tunnel).

In August 2002, the Water and Sewer Authority prepared and submitted for approval a final plan to the U.S. Environmental Protection Agency and the District of Columbia Department of Health. The Water and Sewer Authority is currently negotiating with the regulatory agencies and is awaiting regulatory approval on this final plan. Under the plan, installation of the Piney Branch Storage Tunnel, which would be located within Rock Creek Park, is estimated to start in 2021 (District of Columbia 2002b and 2004e; Siddique 2004).

Also within the Rock Creek drainage, the Separate Luzon Valley project, which provides separation of combined sewers north of the park and city, was completed in 2002. Separation of combined sewer outfalls 031, 037, 053, and 058 was initiated in 2004. Monitoring at combined sewer outfalls 033, 036, 047, and 057 is ongoing (District of Columbia 2002b and 2004e; Siddique 2004).

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 District works to support the designations and meet the applicable standards by granting permits and reviewing permit applications and environmental impact statements. The standards and classification of the District's waters are published in the District of Columbia Register, Title 21, Chapter 11.

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 have been documented in District of Columbia 305(b) reports that are prepared every other year; the most recent was produced in 2002. For Rock Creek, the 2002 report (District of Columbia 2002a) indicates the following progress in achieving standards for each specified class.

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 generally not being met in Rock Creek and its tributaries except for one reach in the northern portion of the park in which the Class B designation is being partially supported.

Class C is for propagation of fish, shellfish, and wildlife. The water quality in Rock Creek and its tributaries partially supports the Class C designation.

Class D is for protection of human health related to consumption of fish and shellfish. The Class D standards are not being supported below the Peirce Mill dam. The creek above the dam was not assessed for support of the Class D standards, because the dam continues to be a barrier to the migration of fish. Installation of a bypass as part of the mitigation program for the Woodrow Wilson Bridge is planned to occur in 2005 (NPS, Cox 2004a).

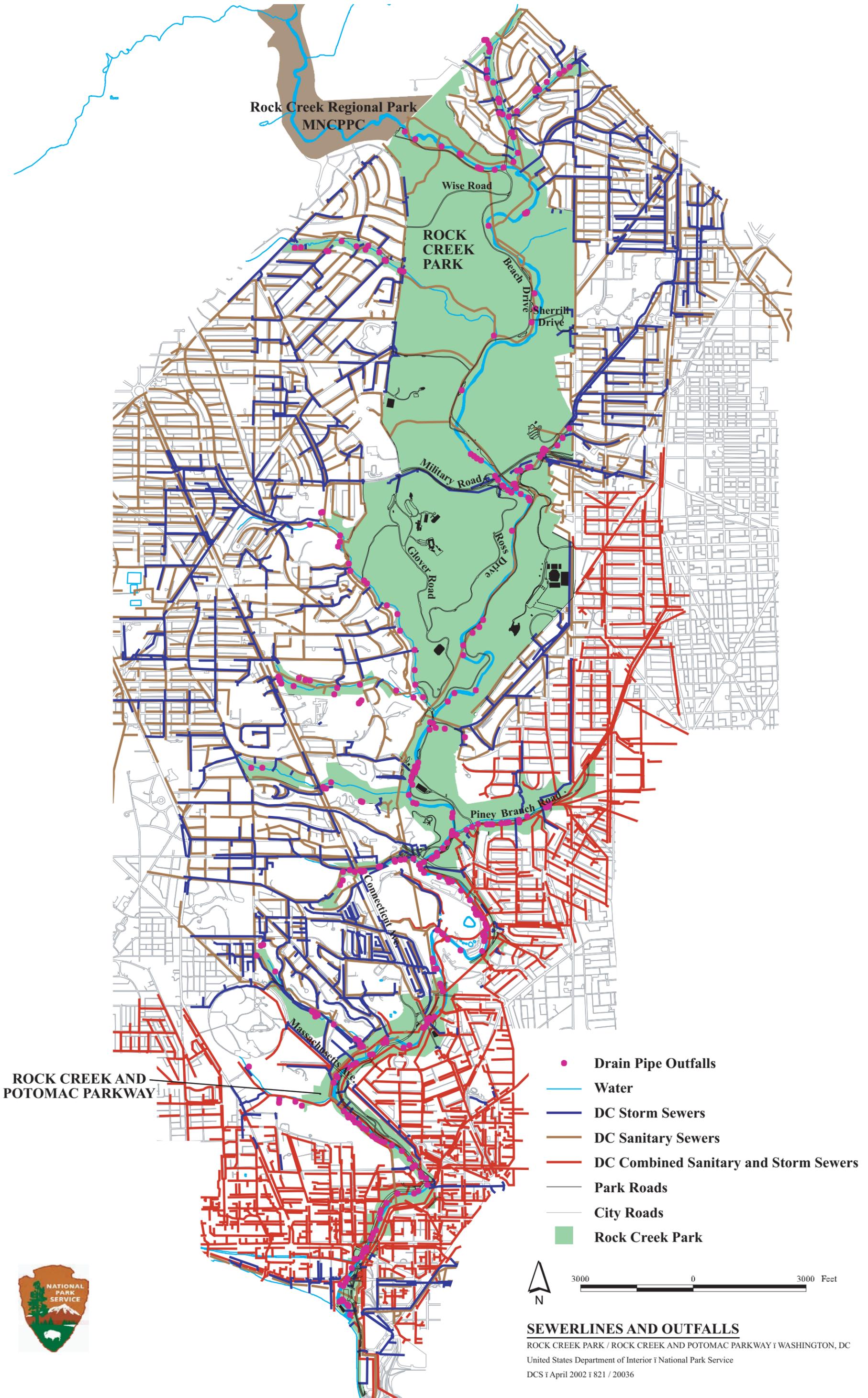
Class E is for navigation. The Class E designation is supported in Rock Creek.

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

Rock Creek Water Quality

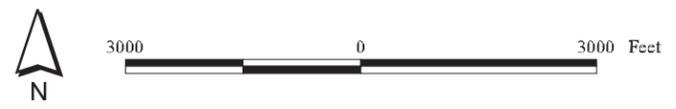
Point and non-point sources of water pollutants in Rock Creek were identified by Anderson *et al.* (2002) and the District of Columbia Department of Health (District of Columbia 2002a). The types of contaminants entering Rock Creek surface waters include the following:

Sediment is transported from unvegetated soils, such as construction sites and agricultural fields.



ROCK CREEK AND POTOMAC PARKWAY

- Drain Pipe Outfalls
- Water
- DC Storm Sewers
- DC Sanitary Sewers
- DC Combined Sanitary and Storm Sewers
- Park Roads
- City Roads
- Rock Creek Park



SEWERLINES AND OUTFALLS
 ROCK CREEK PARK / ROCK CREEK AND POTOMAC PARKWAY / WASHINGTON, DC
 United States Department of Interior / National Park Service
 DCS / April 2002 / 821 / 20036



Storm water runoff from transportation corridors and parking lots within the watershed carries sediments, oil and grease, and metals, such as cadmium, iron, lead, and zinc.

Runoff from lawns, stables, and leaking sewerlines are sources of nutrients, including nitrogen and phosphorus, and contributes to high coliform bacteria counts.

Pollution has adversely affected the ability of Rock Creek Park and its tributaries to support aquatic life. Banta (1993) determined that 58 percent of the tributaries of Rock Creek were classified as severely impaired for habitat quality and biological water quality using U.S. Environmental Protection Agency biological assessment standards, and that the remaining 42 percent of the creek's tributaries were moderately impaired. The 2002 District of Columbia 305(b) report (District of Columbia 2002a) indicated that the lower and upper reaches of Rock Creek continue to be partially supporting of its aquatic life.

The report entitled *Baseline Water Quality Data/Inventory and Analysis – Rock Creek Park* (NPS 1994) reported that criteria for nitrite, pH, dissolved oxygen, copper, zinc, total and fecal coliform bacteria, and turbidity were exceeded multiple times throughout the study area. The criteria included drinking water standards and U.S. Environmental Protection Agency freshwater acute toxicity standards. The report concluded that surface water quality in the park was typical of that encountered in streams in metropolitan areas.

A study entitled *Best Management Practices for Water Quality, Rock Creek Park* (URS Greiner Woodward Clyde 1999) identified several facilities as actual or potential sources of water pollution in Rock Creek Park. These include the maintenance yard, public stables, H-3 Park Police stables, Edgewater Park Police stables, golf course, roads, and parking lots. For each of these areas, the report provided best management practices to remediate or prevent pollution. The National Park Service has been implementing the recommended best management practices and will continue to do so, regardless of the alternative selected from this final general management plan.

Water quality assessment reports were prepared by the District of Columbia for the U.S. Environmental Protection Agency and U.S. Congress pursuant to Section 305(b) of the Clean Water Act (District of Columbia 1996a, 1998, 2000a, 2000b, and 2002a). The 1996 report documented violations of fecal coliform bacteria and pH standards. The 2002 edition indicated that dissolved oxygen and fecal coliform violations also were occurring. These indicate that nutrient enrichment and leakage from unidentified sewerlines and combined sewer outfall discharges are a continuing problem.

A report by the U.S. Geological Survey entitled *Water Quality, Sediment Quality, and Stream-Channel Classification of Rock Creek, Washington D.C., 1999-2000* documented the presence of pesticides in surface waters of Rock Creek. Bottom sediments contained a variety of contaminants, including heavy metals, polycyclic aromatic hydrocarbons (PAHs), pesticides, phthalates, and polychlorinated biphenyls (PCBs) (Anderson *et al.* 2002).

Water quality conditions in Rock Creek appear to have stabilized. A review of the District of Columbia 305(b) reports from 1998, 2000, and 2002 and the NPS' (1994) *Baseline Water Quality Data/Inventory and Analysis – Rock Creek Park* indicates that over the past decade the water quality in Rock Creek generally has exhibited little change. A contributing factor has been the efforts of government agencies in the District of Columbia and Maryland in controlling pollutant discharges and storm water runoff. This particularly includes requiring new development and

selected established sites to implement best management practices to control storm water runoff. In addition, there has been a decrease in upstream agriculture, and natural vegetation has been allowed to revegetate abandoned farmlands. This land use change reduces sediment, pesticides, and fertilizers entering the waterway.

Individuals, companies, and communities throughout the watershed continue to implement measures to control point and non-point source pollution in the Rock Creek drainage. For example, comments on the draft general management plan indicated concern about the potential for wastes to enter Rock Creek from a stable located adjacent to Rock Creek just north of the Maryland line. Follow-up found that the stables have implemented numerous actions to ensure that animal and other wastes are not entering Rock Creek. These include the installation of a manure management system with a bioretention facility to treat stable runoff.

Historically, the *Rock Creek Watershed Conservation Study* (CH2M Hill 1979) led to improvements to Rock Creek and its tributaries outside and within the park. Many of the actions developed in response to this report continue to be important contributors to improvements in the watershed's water quality.

Park resources management staff members monitor sanitary sewers and facilitate their repair to correct leaks.

The District of Columbia has been given assistance in tracing illegal pollutant discharges connected to storm drains.

Combined sanitary/storm sewer outlets have been identified for retrofitting to reduce discharges.

Dry-weather outfall surveys have led to the cleaning of blocked combined sanitary/storm sewers to halt continual overflowing.

The District of Columbia Water and Sewer Authority continues to monitor and investigate for illegal connections to storm sewers, retrofit combined sewer outlets to reduce discharges, and clean blocked combined sewer outfalls (Siddique 2004).

Because the majority of the Rock Creek watershed lies outside Rock Creek Park and the jurisdiction of the National Park Service, park personnel must work with other federal, local, state, district, and regional agencies and organizations to implement steps that would improve existing water quality in the park. The Chesapeake Bay Program is the most comprehensive interagency effort to improve water resource values in the region. A description of this program and the NPS' participation was described previously under the heading "Servicewide Mandates and Policies."

WETLANDS AND FLOODPLAINS

Wetlands and floodplains are included as an impact topic based on the criteria presented in the "Impact Topics - Resources and Values at Stake in the Planning Process" section. The specific concerns related to this impact topic are summarized as part of the "Environmental Consequences" discussion.

The Clean Water Act and Executive Orders 11990 and 11988 identify wetlands and floodplains as national natural assets. They direct all federal agencies to avoid the occupation, adverse modification, or degradation of wetlands and floodplains.

Wetlands

Four temporarily flooded, forested wetlands (National Wetland Inventory designation of palustrine forested 1 (PFO1)) are found along Rock Creek in the northern portion of the park (U.S. Fish and Wildlife Service 2004). Rock Creek is identified as an open water, tidally influenced riverine system (National Wetland Inventory designation of R1OWV) (U.S. Fish and Wildlife Service 1999).

An additional wetland inventory was performed in 1997 (District of Columbia 1997a). Its results differ from the National Wetland Inventory only by defining the northernmost forest wetland as being about twice the size of the wetland identified by the National Wetland Inventory.

The National Wetland Inventory-designated forested wetlands are located within the primary floodplain of Rock Creek where the creek is underlain by Codorus silt loam (Soil Conservation Service 1976). These wetlands are typically covered by sycamore-green ash forest. Other wetlands, not identified by the National Wetland Inventory, are in the narrow alluvial deposits of the Pinehurst Branch, Fenwick Branch, and Joyce Branch drainages.

Vernal pools, also not identified on the National Wetland Inventory, are widely scattered wetland features in the park. These are small, temporary puddles or ponds that appear during wet periods and are dry at other times. If they persist for 4 months or more, particularly in the spring, these limited habitats can be breeding places for frogs, toads, and salamanders. 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.

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. In a park-wide inventory conducted in 2004, a total of eight vernal pools were located (Jung 2004). Wood frogs and spotted salamander egg masses were identified in the vernal pools surveyed.

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 (Jung 2004).

Floodplains

Floodplains in the park were mapped as part of the *Rock Creek Watershed Conservation Study* (CH2M Hill 1979). 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 storm events are estimated to be more than double the predevelopment discharge (CH2M Hill 1979).

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 (CH2M 1979). Normally, the National Park Service would avoid the occupancy of 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: Floodplain Management* does not apply to these sites (NPS 2003a).

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. Under Section V.B. of the NPS floodplain management procedures, historic structures, such as the roads, and facilities that require little physical development and do not involve overnight occupation, such as picnic facilities, daytime parking facilities, and trails, specifically are excepted from floodplain management procedures (NPS 2003b).

A network of storm sewer, sanitary sewer, and combined sanitary/storm sewer lines underlies the park (see the Sewerlines and Outfalls map). Some of these pipelines are within the 100-year floodplain. The storm sewers discharge into drainages that may lead to riparian wetlands, and the combined sanitary/storm sewers experience overflows that may discharge raw sewage into floodplains and wetlands whenever rainfall exceeds 0.3 inches per hour. As mentioned previously under "Rock Creek and its Tributaries," the District of Columbia Water and Sewer Authority submitted a plan for managing such overflow events and currently is awaiting approval from the U.S. Environmental Protection Agency (District of Columbia 2002b and 2004e).

DECIDUOUS FORESTS

Deciduous forests are included as an impact topic based on the criteria presented in the "Impact Topics - Resources and Values at Stake in the Planning Process" section. The specific concerns related to this impact topic are summarized as part of the "Environmental Consequences" discussion.

The establishing legislation for the park identifies "timber" as an essential resource to the park. The National Park Service interprets this in an ecological context to mean not individual trees, but the interrelated plant and animal populations that form the forest community. The ecosystem processes provided by forests are a part of this essential resource. In addition, forest stands are an integral component of the scenic quality of the park cited in the establishing legislation. Therefore, regardless of the management alternative selected from this general management plan, the National Park Service will maintain the forests consistent with its charge in the 1916 Organic Act to preserve unimpaired the natural resources and values of the park for this and future generations.

Approximately 80 percent (1,662 acres) of the park land area is covered with second growth forest, much of which is more than 100 years old. Activities prior to the park's establishment in 1890, such as timber cutting, farming, and Civil War clearing, removed virtually all of the original forest. A few large oaks still living in the park are estimated to be more than 280 years

old and may be remnants of virgin growth. Today's forests are primarily a mixture of deciduous species typical of the eastern deciduous forest in the later stages of succession.

Rock Creek Park runs along the topographic break separating the Piedmont Plateau and the Atlantic Coastal Plain provinces. The vegetation reflects affinities to both of these provinces. The following five forest associations have been identified and mapped in Rock Creek Park using the National Vegetation Classification System developed by The Nature Conservancy (1998).

The beech-white oak/mayapple forest association occurs on moist to somewhat drier slopes. It is the most common of all associations found in the park. Two variants include the mixed oak/beechnut variant and the beech-tulip poplar variant.

The tulip poplar forest association is uncommon and occurs on moist, mid-slope to low-slope sites that were cleared in the past. The sites are dominated by tulip poplar.

The chestnut oak-black oak/huckleberry forest association is uncommon and occurs on ridge tops, convex upper slopes, and south-facing slopes on rocky, well-drained soils.

The sycamore-green ash forest association is uncommon and occurs along stream banks, floodplains, and other low-lying areas subject to temporary or irregular flooding.

The Virginia pine-oak forest association is rare because it is an early to mid-successional forest that is being replaced by hardwood forests. Remnants of this association occur on dry soils of hilltops in limited areas where forest succession has not yet replaced it.

Small natural areas such as the park and parkway have been shown to be very important contributors to regional biodiversity (Falkner and Stohlgren 1997). Rock Creek Park serves as a major reservoir of native flora for the region and is important in protecting the natural heritage of this area.

An inventory of park vegetation, conducted by park and volunteer staff between 1986 and 1994, documented 656 species of vascular plants in Rock Creek Park between the National Zoo and the Maryland boundary (NPS 1995a). Approximately 150 plant species that had been found in the park during a 1919 vegetation inventory were not found during the 1986 – 1994 inventory (NPS, Cox 2004a). Among the more notable species that appear to have disappeared from the park are the swamp shadbush (*Amelanchier canadensis*), shooting star (*Dodecatheon meadia*), dwarf chinkapin oak (*Quercus prinoides*), Allegheny chinkapin (*Castanea pumila*), and a wild rose species (*Rosa setigera*). The reasons for their absence in the second inventory are unknown.

The recent inventory of park vegetation also determined that 238 of the plant species were introduced species, not native to the area. Of this number, 42 species have been judged to be invasive exotic plants that, unless controlled, are likely to spread and adversely affect native plant populations. Control of these invasive exotic plants is a serious problem in the park. A program now underway is selectively applying approved herbicides to invasive species in a limited portion of the park. However, control efforts are not able to keep pace with the rate of invasive plant introduction and spread. Management of invasive species will be a continuous need in the park and operational plans will be updated as control strategies and funding evolve.

Soil properties are integral components of determining the species diversity, productivity, and regenerative potential of the deciduous forest system. Therefore, soil characteristics important to these processes are included in this impact topic characterization.

The park's soil resources are 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 improperly designed and maintained trails. Accelerated erosion caused by increased runoff from the upstream watershed is occurring along the Rock Creek channel 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. The National Park Service will implement measures to protect soils from erosion, compaction, and deposition caused by human activities and to restore areas of soils degradation, as required in *Management Policies 2001* (NPS 2000a).

Woodland fires in the park were described in the section entitled "Servicewide Mandates and Policies." An average of two fires occur in the park each year. All wildfires are suppressed promptly by the District of Columbia Fire Department or park firefighters.

PROTECTED AND RARE SPECIES

Protected and rare species are included as an impact topic based on the criteria presented in the "Impact Topics - Resources and Values at Stake in the Planning Process" section. The specific concerns related to this impact topic are summarized as part of the "Environmental Consequences" discussion.

The National Park Service is required under the Endangered Species Act to ensure that federally listed species and their designated critical habitats are protected on lands within the agency's jurisdiction. Only one federally listed species, the endangered Hays spring amphipod (*Stygobromus hayi*), is known to inhabit the park.

Lists of the rare and protected species that are documented as occurring in Rock Creek Park are provided in appendix E. Complete lists of federally listed species and the species identified as protected or rare by the states of Maryland and Virginia can be found on the Internet. Internet addresses for the lists are presented in the "Bibliography" of this general management plan under the following citations:

U.S. Fish and Wildlife Service 2004

Maryland Department of Natural Resources 2003a and 2003b

Virginia Department of Conservation and Recreation, Division of Natural Heritage 2004

Federal- and State-Listed Amphipods

The Hays spring amphipod was discovered in Rock Creek Park in 1998. Earlier, another rare species, Kenk's amphipod, also known as the Rock Creek groundwater amphipod, (*Stygobromus kenki*), was identified in park springs (NPS 1997a). Kenk's amphipod is not currently listed under

the Endangered Species Act, but it is under consideration by the U.S. Fish and Wildlife Service for future listing. 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 2003b).

Groundwater amphipods are sensitive to environmental pollution, making the present concentration of these species an extremely rare occurrence in the Piedmont region. The relative abundance of rare amphipods in the park has been attributed to the long-term protection of groundwater quality afforded by the park.

The Hays spring amphipod ranges from one-half to one inch long. It is colorless, eyeless, and has adaptive hairs for sensing currents and food. They have life spans of 8 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.

Researchers from the U.S. Geological Survey Northeast Amphibian Research and Monitoring Initiative identified 35 springs and seeps in the park (Jung 2004). All of these potentially provide habitat for groundwater amphipods.

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.

OTHER STATE-LISTED SPECIES

Washington, D.C. does not currently provide special protection status for rare plant or animal species. As shown in appendix E, the District of Columbia (NPS, Cox 2004a) and the adjoining states of Maryland and Virginia (Maryland Department of Natural Resources 2003a and 2003b; Virginia Department of Conservation and Recreation, Division of Natural Heritage 2004) identify

five plant species that are documented as occurring in Rock Creek Park as “highly state rare – critically imperiled” (E, S1, or S2)

twelve plant species that are documented as occurring in Rock Creek Park as “watch list – rare or uncommon” (S3, SU)

Although three of these species are trees, most are non-woody, herbaceous species that typically occur in a single population within the park.

Several animal species with known occurrences in Rock Creek Park are listed as rare or uncommon by Maryland (Maryland Department of Natural Resources 2003b). They include the Appalachian spring snail, gray petaltail dragonfly, and five bird species. The birds are discussed in the next section, “Other Native Wildlife.” Wetlands, including freshwater springs and outflow channels, provide habitat for the invertebrate species.

The National Park Service is not under any legal obligation to protect these plant or animal species. However, NPS policy and management actions include maintaining these uncommon native species as part of the park's natural heritage (NPS 2000a).

OTHER NATIVE WILDLIFE

Terrestrial Wildlife

Native wildlife species are included as an impact topic based on the criteria presented in the "Impact Topics - Resources and Values at Stake in the Planning Process" section. The specific concerns related to this impact topic are summarized as part of the "Environmental Consequences" discussion.

Mammals - The woodlands in Rock Creek Park provide suitable habitat for a variety of wildlife mammal species, despite their location within the city limits of the District of Columbia. Approximately 30 species of mammals have been inventoried in the park. Species of particular interest because of their size or their public attention include the raccoon (*Procyon lotor*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), opossum (*Didelphis virginiana*), beaver (*Castor canadensis*), gray squirrel (*Sciurus carolinensis*), eastern chipmunk (*Tamias striatus*), and white-tailed deer (*Odocoileus virginianus*).

White-tailed deer have been recorded for many years, but since the late 1980s their numbers have substantially increased in the park. The deer population is monitored to avoid adverse impacts on park resources, particularly vegetation.

Aerial infrared photography taken in March 1997 indicated a population of 87 deer, and a repeat survey in March 1998 estimated the number had increased to 155. Nighttime spotlight counts for deer were conducted to estimate autumn deer populations in the park from 2000 to 2003. The 2000, 2001, and 2002 results ranged from 162 to 166 deer, but year 2003 data indicated an estimated population of 270 deer. Deer populations are capable of increasing very quickly, and the increases in 1998 and 2003 are consistent with a rapidly expanding deer population (NPS, Cox 2004a). The National Park Service will be preparing an environmental assessment or environmental impact statement on the impacts of managing the park's deer population.

Birds - Approximately 180 species of breeding or migrating birds have been documented in Rock Creek Park (MacKiernan 2003). Most are migrants or seasonal visitors. Rock Creek Park is recognized by the National Audubon Society and the American Bird Conservancy as an Important Birding Area for its exceptional diversity of bird species during migration (Maryland/District of Columbia Audubon 2004).

From 10 years of migratory bird censuses conducted by the Audubon Naturalist Society, 33 of 34 warblers found in the northeastern United States have been detected in Rock Creek Park. As a group, warblers are of concern because their numbers have been dropping, with sharp declines for some species, throughout the past two decades. Warblers seen in the park include the cerulean warbler, which has been proposed for listing as endangered or threatened by the U.S. Fish and Wildlife Service. Bicknell's thrush, another species that has been proposed for listing, also has been detected in spring migratory censuses (Cooper 2003).

A number of Maryland state-designated threatened, endangered, or other concern species have been documented in Rock Creek Park during migration. These include the olive-sided flycatcher (Maryland endangered), Blackburnian warbler (Maryland threatened), mourning warbler (Maryland endangered), and the Nashville warbler (Maryland species of concern) (Cooper 2003). The yellow-crowned night-heron, considered rare by the state of Maryland, is also known to occur in the park. However, the only bird species that is listed as threatened or endangered by the U.S. Fish and Wildlife Service that potentially occurs in the park is the bald eagle (see appendix E, table E.1).

The breeding bird census area is an important bird-related resource within Rock Creek Park. The 65-acre census area is roughly triangular in shape. 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.

Data on breeding birds have been collected in the spring from the census area in most years since 1948. The longevity of the 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. Information from this long-running study is an important contribution to the nationwide breeding bird census run by the National Audubon Society (NPS, Cox 2004a). Typically, 22 to 24 species nest in the breeding bird census area in Rock Creek Park (unpublished data from the Rock Creek Park breeding bird census, 1997 through 1999).

A number of sites that provide good viewing of birds have been identified in Rock Creek Park. These include, but are not limited to, the areas around the nature center, stables, maintenance yard, picnic groves 17 and 18, and, in general, the western ridge of the park. The maintenance yard area, where the Audubon Naturalist Society conducts their migration censuses, is an especially notable area for large congregations of migrating birds (MacKiernan 2003). The Maryland Ornithological Society (2004), which maintains a web page of birding areas in the District of Columbia, also mentions less visited, but still productive areas, including “the area around Peirce Mill, Melvin Hazen Park, and the stream valley along Broad Branch west of the ridge.” Rock Creek Park recognizes the importance of these bird habitats within the park and is committed to ensuring their conservation and enhancement, regardless of the alternative selected in the final general management plan.

Reptiles and Amphibians - The variety and numbers of amphibians and reptiles found in the park are markedly reduced compared to inventories from the early and middle parts of the 20th century. Of species historically recorded for Rock Creek Park, only 9 of 17 amphibians and 11 of 24 reptiles have been recorded in recent years. The amphibian observations are consistent with the recent world-wide decline in amphibian numbers and diversity.

Some amphibians such as the gray treefrog (*Hyla versicolor*) and chorus frog (*Pseudacris triseriata*) have disappeared altogether from Rock Creek Park.

Others 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 do not depend on wetlands, are relatively common in moist uplands where they inhabit moist niches under logs and leaf litter.

The U.S. Geological Survey Northeast Amphibian Research and Monitoring Initiative has been monitoring stream salamanders in Rock Creek Park since 2001 (Jung 2004). Some of the species identified include the northern dusky salamander, northern two-lined salamander, and northern red salamander.

Factors responsible for the declines that have been noted in reptile diversity in Rock Creek Park are unknown. Relatively protected and abundant moist upland sites provide habitat for small snakes, such as the northern ringneck snake (*Diadophis punctatus*), which is common. Eastern box turtles (*Terrapene carolina*) and larger snakes such as the black rat snake (*Elaphe obsoleta*) are much less common.

Aquatic Wildlife

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*).

At least two native species, the blueback herring (*Alosa aestivalis*) and the alewife (*Alosa pseudoharengus*), migrate from salt water up Rock Creek to spawn each spring (anadromous). An abandoned sewerline and an abandoned gauging station near Q Street that interrupted their migrations were removed from Rock Creek in 2001 (Madaras 2001). The 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 (Madaras 2001). These activities are expected to be completed in 2005.

The American eel (*Anguilla rostrata*) is the only species found locally that lives in either fresh or brackish water. Eels migrate to the Sargasso Sea to spawn (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.

The urban pollution and storm water runoff problems that were described previously in the section entitled "Rock Creek and Its Tributaries" 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. Flooding and scouring during storms, pollution from runoff, and periodic low flows are likely contributing factors.

Non-Native Terrestrial Animals

Several non-native species of wildlife that occur in Rock Creek Park are adversely affecting the park's natural resources.

Free-roaming domestic cats (*Felis catus*) are particularly found near the park borders. Mitchell and Beck (1992) demonstrated that cats in such settings prey on local populations of songbirds, squirrels, and other small mammals and may reduce their numbers.

Starlings (*Sturnus vulgaris*) compete with some cavity-nesting birds for nest sites.

The gypsy moth (*Lymantria dispar*) has been present in the park for many years and, at times, has become sufficiently abundant to require aerial spraying to prevent forest defoliation and related impacts.

The effects of these and other exotic animals on native species are not fully known. They could be substantial, considering the small size of the natural areas of Rock Creek Park and the park's location within an urban setting. However, except for treatments of insect pests, no control efforts are presently contemplated for these species.

Roadkill

Collisions with vehicles kill or injure terrestrial and semi-aquatic animals on roads in Rock Creek Park, along the Rock Creek and Potomac Parkway, and on adjoining city streets. From 1980 to 2000, the park staff kept informal counts of carcasses along roads and streets within and adjacent to the park and parkway. The data included species, date, and location where each carcass was found. The counts were non-systematic and were collected incidental to other activities. Because of the informal nature of the data collection and the frequent removal of roadkill carcasses by scavengers such as crows and raccoons, the park roadkill counts probably were lower than actual animal deaths. Larger, more conspicuous animals, particularly mammals, tend to be more represented in the count, as opposed to smaller animals such as songbirds, amphibians, and reptiles that are more easily overlooked or scavenged.

For the 10 years between 1991 and 2000, park staff recorded 1,223 roadkilled carcasses. Table 9 summarizes these data by class and by selected species.

TABLE 9: RECORDED ROADKILLS IN AND ADJACENT TO ROCK CREEK PARK AND THE ROCK CREEK AND POTOMAC PARKWAY, 1991 THROUGH 2000

Type	Number	Percent of Total Roadkills Recorded
Total recorded roadkills, 1991 through 2000	1,223	100
Mammals	1,088	89
Squirrel	455	37
Raccoon	303	25
Deer	135	11
Opossum	96	8
Other	96	8
Gray fox	3	0.25
Birds	90	7
Reptiles	45	4
Box turtle	22	2
Black rat snake	15	1

Between 25 and 33 percent of the annual recorded roadkill in the park and vicinity occurred on Beach Drive. For example, in the year 2000, 104 carcasses were recorded, including 28 from Beach Drive. Table 10 shows all roadkilled species recorded from Beach Drive in 2000 and sub-totals for sections of the road under different traffic management strategies.

TABLE 10: ROADKILLS RECORDED ON BEACH DRIVE IN 2000

Species	Total for Beach Drive	South of Broad Branch Road	Sections Closed to Traffic on Weekends and Holidays	Sections Open to Traffic North of Broad Branch
Raccoon	8	5	3	0
Squirrel	7	3	3	1
Deer	4	1	0	3
Water snake	2	0	1	1
Unidentified bird	2	2	0	0
Red-eyed vireo	1	0	0	1
Snapping turtle	1	0	1	0
Box turtle	1	0	0	1
Opossum	1	1	0	0
Domestic cat	1	0	1	0
Total	28 (100%)	12 (43%)	9 (32%)	7 (25%)
Percent of road length	100%	13%	46%	41%
Average annual road-kill per mile	28/5.8 = 4.8	12/0.70 = 17.1	9/2.7 = 3.3	7/2.4 = 2.9

As shown in the table, the highest incidence of roadkill on Beach Drive occurred south of Broad Branch Road. The roadkill rate on this stretch was five times higher than on more northern portions of Beach Drive, indicating that this area might be an appropriate site for the installation of mitigating measures such as traffic controls or protected wildlife crossings such as culverts.

As shown in table 11, 16 animal carcasses were recorded from the 2-mile-long Rock Creek and Potomac Parkway in the year 2000. This produces an average annual roadkill of eight animals per mile. Contributing factors to this relatively high value probably include the higher traffic speeds on the parkway and a heavier traffic level than on most park roads.

TABLE 11: ROADKILLS RECORDED ON THE ROCK CREEK AND POTOMAC PARKWAY IN 2000

Species	Number
Squirrel	5
Raccoon	5
Mallard duck	2
Unidentified bird	2
Crow	1
Deer	1
Total	16

The importance of roadkill to populations of wildlife is difficult to determine. Squirrels, raccoons, and deer sustain the heaviest toll from vehicle collisions. However, these species are common in the region and have high reproduction potentials. Their populations do not appear to be substantially influenced by roadkill. For less common species with more limited reproduction potential,

roadkill could be a contributing factor to population reductions or local extirpation (Foreman and Alexander 1998).

Based on casual, undocumented sightings, four species of wildlife may have declined in the park over the past decade or more. These species are the opossum, gray fox, eastern box turtle, and black rat snake. Concern has been expressed that roadkill could be a contributing factor. Recorded roadkill numbers and locations for these species between 1991 and 2000 are shown in table 12. For all four species, approximately a third of the roadkills were recorded *outside* the park and parkway.

TABLE 12: LOCATIONS OF RECORDED ROADKILLS FOR FOUR SPECIES, 1991 THROUGH 2000

Location	Opossum	Grey Fox	Box Turtle	Black Rat Snake
Park roads				
Rock Creek and Potomac Parkway	18	1		
Beach Drive south of Broad Branch Road	14	1		1
Beach Drive north of Broad Branch Road	8		2	3
Wise Road	4		1	1
Glover Road	3		3	2
Ross Drive	1		1	
Bingham Drive			4	
Joyce Road				1
Nature center/maintenance area	1		1	1
Other park roads	7			
Adjacent non-park roads				
Military Road (though park and nearby)	17	1	2	
Oregon Avenue	14		8	5
Broad Branch Road	4			1
Other non-park roads	5			
Total roadkills recorded 1991-2000	96	3	22	15

Opossum. The number of roadkilled opossum carcasses recorded in and around Rock Creek Park and the parkway declined over the 10-year period of data analysis. Numbers dropped from a high of 16 animals in 1992 to one specimen in 2000.

Although the reason for the decrease is unknown, it is unlikely that roadkill caused a population decline. Opossums are common in the region and much of the United States. They have a high reproduction potential (2 litters per year with 5 to 13 young per litter) and are highly adapted to living in close proximity to humans, even in densely developed metropolitan areas (Hossler *et al.* 1994; Pennsylvania Game Commission 2001). The decline in roadkill in Rock Creek Park probably reflects population reductions caused by another factor such as a disease outbreak. It is unlikely that roadkill would seriously threaten or cause the extirpation of opossums in the park.

Gray Fox. Between 1991 and 2000, three gray foxes were found dead on roads in and around the park, including one each in 1991, 1994, and 1999. Gray foxes are relatively common in the eastern United States. They have been described as habitat generalists that prefer wooded areas with dense cover for daytime dens and mixed fields and forests for nighttime hunting (Greenburg and Pelton 1994).

A study in Tennessee found that gray foxes had overlapping home ranges of about 1,000 acres, and that a 5,000-acre area supported 12 adult and young foxes (Greenburg and Pelton 1994). New Mexico studies showed that gray foxes were tolerant of low to moderate residential development, but avoided high-density development (Harrison 1993 and 1997). At 1,700 acres, Rock Creek Park may provide sufficient habitat for only a few individuals. Additional habitat on adjoining lands would be necessary to support a larger, more sustainable gray fox population.

Gray foxes, such as young animals dispersing from the den, will travel distances of 50 miles or more (Trippensee 1953). The Rock Creek corridor probably served as a travel route between foxes in the park and populations in woodlands to the north. However, as more of the forested areas in the upper drainage have been developed, the interactions of animals in the park with those in other areas probably were reduced. This would include the recruitment of foxes into the park population.

Gray foxes are very susceptible to canine diseases such as distemper and hepatitis (Nicholson and Hill 1984). The potential for these diseases to be introduced into the gray fox population from the large number of dogs using the park is high.

Gray fox populations in and around the park are probably small and are likely stressed by habitat destruction, habitat fragmentation, low recruitment, and periodic disease outbreaks. Roadkills, even infrequent ones, could contribute to an overall reduction of a resident population or even local extirpation.

Box Turtle. There is no clear trend in recorded roadkills of box turtles in and around the park and parkway. Between 1991 and 2000, 22 box turtle roadkills were recorded, for an average rate between two and three turtles per year.

Prime habitat for box turtles includes wooded uplands and bottomlands. In the wild, box turtles are known to live at least 40 years and there are claims of some turtles living more than 100 years. They do not reach sexual maturity until 4 or 5 years of age. The average clutch size is only four or five eggs, although a female may lay several clutches per year. The female does not protect the nest or hatchlings, and mortality of hatchlings is high, primarily because of predation (Dawson 1999).

Populations of box turtles have declined throughout their range in the eastern United States because of a variety of human-induced factors. Roadkill is believed to be a contributing factor to the declining numbers, along with habitat loss and fragmentation, commercial and personal collecting, predation by animals such as dogs and raccoons that are associated with human development, and disease (Hutchinson 2000; Mitchel 2000). Because box turtles are long-lived and have a low reproduction potential, losses of individuals can have long-lasting effects on local populations.

A study in the 1950s of mixed forests and agricultural lands in Maryland reported turtle densities at 10 per acre (Hall *et al.* 2000). Other studies in Missouri summarized by Dawson (1999) indicated a lower density, identifying home range size as varying from about 5 acres to about 13 acres and stating that “the home ranges of several individuals will often overlap.”

There is little information on box turtle populations in Rock Creek Park. The riparian wetlands along Rock Creek and its tributaries provide excellent habitat, and sightings of box turtles by park visitors and park staff are relatively common. However, studies of box turtle numbers or densities have never been conducted. Removing box turtles from the park for any purpose, including use as

pets, is illegal, but anecdotal evidence suggests that such illegal collecting occurs at a rate far greater than the annual roadkill rate of two or three box turtles. However, the additive effect of roadkill may be a contributing factor in an apparent decline in box turtles in and near the park.

Black Rat Snake. There is no clear trend in the pattern of roadkills of black rat snakes in Rock Creek Park between 1991 and 2000. Fifteen roadkills were recorded, including five on Oregon Avenue outside the park.

Black rat snakes are fairly common in the region. They are active during daylight hours and hibernate during the winter months. They prefer dense cover along forest edges, meadows, and hedgerows and tend to avoid open areas such as closely mowed roadsides, road surfaces, and open fields. Black rat snakes use the interior of forests and often enter structures for periodic refuges (Durner 1991; Durner and Gates 1993).

Habitat for the black rat snake has declined in the Washington D.C. metropolitan area over the decades as land has been converted from woodlots and agriculture to high-density development. Within Rock Creek Park, black rat snake populations also may have declined because of continued maturation of forest, as opposed to the mix of woodlands and meadows that existed historically. Roadkill may be a contributing factor affecting local populations, but the degree of effect is unknown.

CULTURAL RESOURCES

ARCHEOLOGICAL RESOURCES

Several studies provide information on Rock Creek Park's archeological resources, previous archeological work in the park, and the status of archeological research. These studies include

Ancient Washington: American Indian Cultures of the Potomac Valley (Humphrey and Chambers 1985)

Archeological Survey Report: An Archeological Investigation of Thirty-One Erosion Control and Bank Stabilization Sites along Rock Creek and Its Tributaries, Rock Creek Park and Rock Creek and Potomac Parkway (NPS, Inashima 1985a)

National Capital Area Archeological Overview and Survey Plan for the Systemwide Archeological Inventory Program, National Park Service, National Capital Area (NPS, Little 1995c)

Rediscovering Archeological Resources at Rock Creek Park (Moran 1997)

Some of the prehistoric and historic objects recovered from Rock Creek Park have been cataloged and are kept in storage at the NPS' Museum Resource Center in Landover, Maryland.

There are at least 10 archeological sites in the Rock Creek valley with known prehistoric occupations. Three are quartzite quarries, three are soapstone quarries, three are short-term campsites, and one is a cremation burial. The latter was excavated prior to construction of a pier for one of the Whitehurst Freeway ramps.

Historic archeological sites in the park are largely associated with historic agricultural and industrial uses during the 18th and 19th centuries, Civil War-era operations, and development of the park under the administration of the U.S. Army Corps of Engineers (1890 to 1933) and the National Park Service (1933 to present).

There is a high probability that there are additional undisturbed prehistoric and historic archeological resources in Rock Creek Park. Archeological sites in the park have not been systematically surveyed or inventoried, and precise information about locations, characteristics, and the significance of the majority of known archeological resources in the park is incomplete. Because the condition of archeological resources, especially those underground, is generally unknown, the impacts of development projects on archeological sites in the park are uncertain.

As described in the "Servicewide Mandates and Policies" section, an archeological identification and evaluation study of the park is required by law. A 4-year study to meet this requirement began in 2004. Year two is currently underway (NPS, Cox 2004a). In addition, individual surveys will be needed prior to the initiation of ground-disturbing activities. Areas identified as having a high potential for archeological resources must be treated with special sensitivity.

NPS policy at Rock Creek Park is to work with the District of Columbia State Historic Preservation Officer to nominate all archeological and historical resources within the park and parkway that appear to meet the National Register of Historic Places criteria. Although Rock Creek Park is

listed in the National Register of Historic Places, its archeological resources have yet to be individually listed. As a result of the 4-year archeological study that currently is underway, new National Register of Historic Places listings for archeological resources might be generated. Currently, 23 archeological sites associated with the earliest occupation of the region and one site associated with an early 19th century industrial complex (Blagden Mill) have been investigated.

HISTORIC RESOURCES AND CULTURAL LANDSCAPES

Several NPS documentary studies provide an understanding of the historic development of the Rock Creek Park area and the Rock Creek and Potomac Parkway. These include

Rock Creek Park: An Administrative History (NPS, Mackintosh 1985b)

Historic Resource Study: Rock Creek and Potomac Parkway, George Washington Memorial Parkway, Suitland Parkway, Baltimore-Washington Parkway (NPS, Krakow 1990a)

Historic Resource Study: Rock Creek Park, District of Columbia (NPS, Bushong 1990b)

Rock Creek and Potomac Parkway (Historic American Buildings Survey, HABS No. D.C.-697, 1991-2) (NPS, Davis 1992)

Linnaean Hill Cultural Landscape Inventory (NPS, Wheelock *et al.* 1998b)

Peirce Mill Cultural Landscape Inventory (NPS Wheelock *et al.* 1998d)

Europeans began to acquire private rights to land in the Rock Creek valley during the 17th century. However, the Rock Creek valley remained largely untouched by settlement until a trading post was established in 1703 at what was then the navigable mouth of Rock Creek.

Commercial and industrial use of Rock Creek increased steadily in the early decades of the 19th century. The gradient of the streambed and the water flow were sufficient to support a number of mills above and below the District line. The milling industry flourished along the creek in the first half of the 19th century, growing in direct proportion to the development of Georgetown and Washington City. More than a half-dozen water mills operated along its course within the District.

Today only the Peirce Mill stands on the creek near Tilden Street as a reminder of this once-common building type. Peirce Mill functioned as an integral part of a diversified farm complex. After 1890, stone grinding became obsolete and few water-powered flour millers operated in the eastern United States. However, Peirce Mill continued grinding corn, rye, and wheat into flour and meal until 1897 when its main shaft broke.

The Peirce family erected two substantial enclaves of buildings, several of which remain today. They represent the only examples of 19th century structures erected in the park prior to its establishment. The original Peirce family dwelling and its immediate dependencies were located about a quarter mile west of Peirce Mill, just south of present-day Tilden Street. The Peirce estate eventually numbered 11 buildings, many of which were built of solid granite. The Peirce-Klingling Mansion, which houses the park headquarters, was the core of the second major complex of buildings erected by the Peirce family in what would become Rock Creek Park.

Joshua Peirce became a prosperous nurseryman and landscape gardener who specialized in the cultivation of camellias and other exotic plants. His arboretum at Linnaean Hill provided botanical specimens for the grounds of the White House, U.S. Capitol, and many of the national capital's other federal reservations. The expansive landscape surrounding his mansion also included fruit trees and ornamental plants. Today, the Peirce structures stand as rare examples of early 19th century vernacular stone construction in the District of Columbia.

The mills and estates in the Rock Creek valley were served by a network of roads. The courses of five of these pre-Civil War roads exist roughly today in the form of

Tilden Street and Park Road (formerly Peirce's Mill Road)

Klinge Road (formerly Joshua Peirce's Road, laid out in 1831)

Broad Branch Road (surveyed and built in 1839)

Blagden's Mill Road (1847), a road trace on the landscape and a portion of Colorado Avenue

Milkhouse Ford Road, now Rock Creek Ford Road

Most of these early, narrow, unpaved roads were privately built, but they later evolved into public thoroughfares and were eventually acquired by the local government. Further road development was stimulated by the Civil War.

In 1862, army engineers constructed Fort DeRussy as part of a circle of fortifications around the city. They also established Military Road to connect the defenses of the city. Located northeast of the intersection of Military Road and Oregon Avenue, Fort DeRussy was strategically placed to provide formidable resistance to enemy advancement down the valley. The fort saw action during the only Confederate assault on the city in July 1864. Although the fort's structures were removed after the war, Fort DeRussy remains the most pronounced Civil War earthworks site in the national capital area.

Operation of the Godey Lime Kilns began in 1864. The manufacture and sale of lime at this site continued until 1907. The kilns represent an important aspect of the thriving late 19th century commercial activities in Georgetown. The kilns were partially restored by the National Park Service in 1967.

Urban development in the area surrounding the valley began with a building boom in the 1880s. By the late 1880s, tracts north of the old Washington city limits and near the future park had been subdivided into suburban lots, with development potential reaching to the banks of Rock Creek.

The rapid pace of suburban development threatened to destroy the rural character and natural scenery of the Rock Creek valley. In response, a bill establishing Rock Creek Park (Public Reservation 339) was approved by both houses of Congress and signed into law (26 Stat. 492) by President Benjamin Harrison on September 27, 1890. A copy of this legislation is provided in appendix A.

The first park improvements included a road system. The new park drive along the creek, named for Capt. Lansing Beach, incorporated existing road segments and a dirt road created by the construction of a sewerline below Piney Branch in 1896. Walking trails and bridle paths also provided public access.

Boulder Bridge was constructed in 1902. It has become a quintessential symbol of the rustic character and picturesque design of the first park structures. It is Washington's finest example of rustic bridge architecture, and one of the earliest Melan reinforced concrete arch structures of its type built in the District.

In 1901-02, a Senate Park Commission comprehensive plan for the nation's capital included a proposal for a regional park system that extended beyond the boundaries of the District to include such scenic areas as Great Falls. One aspect of their proposal was the development of a parkway, in the wording of the 1913 legislation establishing the Rock Creek and Potomac Parkway, "for the purpose of preventing pollution and obstruction of Rock Creek and of connecting Potomac Park with the Zoological Park and Rock Creek Park."

On June 2, 1912, the reconstructed Joaquin Miller cabin (named for the California author of *Song of the Sierras*) was dedicated at a site just off Beach Drive, approximately a half-mile north of Military Road. The cabin, which had been disassembled and moved from its location across from Meridian Hill Park by the California State Association, soon became an "adopted" historic attraction in the park and a meeting point for picnic groups, hikers, and equestrian riders. Placement of the Miller cabin in the landscape was part of the picturesque improvement of the early 20th century Rock Creek Park, which was also evident in the design of Boulder Bridge, the dam at Peirce Mill, and the rustic stone improvements to Milkhouse Ford.

To accommodate the growing popularity of golf, two nine-hole golf courses were opened in 1923 and 1926 in the east side of the park north of Military Road at the site of a former arboretum, which had been removed in 1920. A remodeled farmhouse served as a clubhouse.

During the 1930s, numerous physical improvements in Rock Creek Park were made by the National Park Service and Depression-era work relief laborers. The National Park Service made an effort to blend new construction with the picturesque park landscape, designing new structures in a rustic style popularly known today as "parkitecture."

In 1935-36, the stone-lodge-style Lodge House was constructed as a U.S. Park Police substation near the intersection of Military Road and Beach Drive. The National Park Service continued to preserve historic buildings, including the Peirce-Klingling Mansion, the other structures at the Linnaean Hill complex, and the Peirce Mill with its adjacent springhouse and barn.

The 1930s marked the beginning of Rock Creek Park's use as a commuter route. The completion of a motor drive from the park's north end to East-West Highway in Maryland in 1932 and the opening of the Rock Creek and Potomac Parkway in 1936 created a continuous automobile route from Maryland to central Washington, D.C. However, it was not until 1966 that a truly continuous automobile route was created with completion of the zoo tunnel. Previously, evening zoo closure and flooding of fords hampered full use.

Historic National Register Properties. Historic properties within the park and parkway that are listed in the National Register of Historic Places include the

Peirce-Klingling Mansion

Peirce Mill

Peirce Springhouse and Peirce Mill Barn

Godey Lime Kilns

Boulder Bridge and Ross Drive Bridge

Fort DeRussy, which is listed as a contributing feature to the “Civil War Fort Sites” National Register nomination

In addition to the listing of individual properties, the area of Rock Creek Park covered by this general management plan was listed in the National Register of Historic Places as Rock Creek Park Historic District (No. 91001524) on October 23, 1991. The historic district boundaries encompass Public Reservation 339 established as Rock Creek Park on September 27, 1890. The historic district included 31 resources classified as contributing to its significance. These resources are listed in appendix F.

In 1997-98, the National Park Service, in consultation with the District of Columbia State Historic Preservation Officer, completed a comprehensive survey of structures in Rock Creek Park and the Rock Creek and Potomac Parkway that are eligible for listing in the National Register of Historic Places. The Rock Creek and Potomac Parkway was found to be eligible for listing, and the National Park Service coordinated with the District of Columbia State Historic Preservation Officer to finalize a nomination. A National Register nomination for the parkway has been sent to the Keeper of the National Register for review (NPS, Cox 2004a).

Cultural Landscapes. Cultural landscapes reflect the relationship between what is natural and what is man-made. According to *The Secretary of the Interior’s Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes* (Secretary of the Interior 1995b), a cultural landscape is “a geographic area (including both cultural and natural resources and the wildlife or domestic animals therein) associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values.”

A cultural landscape inventory documents the qualities and attributes of a cultural landscape that make it significant and worthy of preservation. The goal of the National Park Service is to locate and evaluate cultural landscapes and provide information on their location, historical development, characteristics and features, and management to assist park managers in planning, programming, and recording treatment and management decisions.

In 1997, the National Park Service initiated a cultural landscape inventory of the area covered by this general management plan. As part of the cultural landscape inventory process, inventories for two component landscapes, Peirce Mill and Linnaean Hill, were completed. Field work and research for the remainder of Rock Creek Park and Rock Creek and Potomac Parkway has been completed, but has not been entered into the NPS Cultural Landscape Inventory database.

VISITOR AND COMMUNITY VALUES

TRADITIONAL PARK CHARACTER AND VISITOR EXPERIENCE

Rock Creek Park was intended in the establishing legislation to be a “pleasure ground.” Visitors come for the scenery and the other sensory experiences that accompany a forested creek valley. They enjoy such features as the changing seasonal colors; life cycles and scents of the forest; sounds of water, wind, and small animals, including birds; and the quiet. The open spaces offer more active recreation and the sounds of people at play.

Recreation Opportunities

Nonmotorized Recreation. Rock Creek Park provides a visual respite from the urban surroundings. The park offers a variety of views, from rugged expanses of mature, second-growth forest with little recent human disturbance to landscapes from the rural past. The engineered bridges are reminders of the monumental city to the south.

Rock Creek Park offers visitors a variety of recreation options, including

- paved multi-use trails and weekend closures of Beach Drive for jogging, bicycling, in-line skating, and other nonmotorized uses

- an extensive system of hiking and horseback riding trails

- Rock Creek Horse Center for public horseback riding and horse boarding (concession operated)

- an 18-hole public golf course (concession operated)

- tennis courts, including 21 soft-surface courts and 10 hard-surface courts (concession operated)

- picnic areas, including 20 unrestricted picnic areas and 10 picnic areas requiring a permit

- sports fields suitable for soccer, football, volleyball, field hockey, lacrosse, and rugby

- canoeing and kayaking on Rock Creek

- interpretive programs and other visitor contact at the Rock Creek Nature Center and Planetarium, Peirce Mill complex, and Old Stone House

- the Carter Barron Amphitheater, which is a 4,000-seat outdoor theater offering summer musical and theatrical performances

- two community gardens with a total of about 200 garden plots

One of the favorite ways to experience Rock Creek Park is from Beach Drive. This roadway, which is within the narrow creek valley for much of the length of the park, is a popular site for such activities as walking, in-line skating, and bicycling. During weekends and holidays when

three segments of Beach Drive are closed to automobile traffic, thousands of people recreate along its length.

During weekdays, participation in nonmotorized recreation activities along Beach Drive is limited. Based on comments received on the draft general management plan and environmental impact statement, many potential users perceive this area as “hazardous” and either choose to recreate in other areas of the park or avoid the park altogether.

Motorized Recreation. A popular visitor experience on weekdays is motorized travel on Beach Drive and other park roads. 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 traffic studied conducted in 2004, approximately 2.5 to 3 million visitors per year drive on Beach Drive on the 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 and 2001b).

The 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. For some routes involving Beach Drive, the driver could have selected another route, most of which were outside the park, that would have reduced the trip duration (Parsons 2004). This suggests that some of the drivers who use Beach Drive do so 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 Department of Transportation (District of Columbia 2001a and 2001b) and the 2004 traffic study (Parsons 2004), use includes an estimated

1.3 million vehicles per year on Wise Road

285,000 vehicles per year on Bingham Drive

125,000 vehicles per year on Ross Drive north of the intersection with Glover Road and 290,000 vehicles per year south of this intersection

Wise Road and Bingham Drive can provide cross-park connections, but selection of these routes may also be based on the quality of the experience of driving through the park. Many routes are more efficient than the north/south trending Glover Road and Ross Drive, so motorized vehicle use on these roads primarily relates to enjoyment of the drive.

The Rock Creek and Potomac Parkway is a heavily used municipal thoroughfare that, in the vicinity of Massachusetts Avenue, carries average traffic of 55,000 vehicles per day or about 20 million vehicle trips per year (District of Columbia 2001a and 2001b). Because many national parks experience large differences in seasonal use, the NPS' Public Use Statistics Office assists park planners by providing recreation-related seasonal traffic factors as well as average daily traffic factors. On the Rock Creek and Potomac Parkway, these factors are virtually identical, indicating that throughout the year, travelers on the parkway are seeking an efficient travel route and are little affected by season or weather.

Visitor Profile

Visitors to Rock Creek Park are primarily local residents of the Washington, D.C. metropolitan area. However, because it is a national park, it also is visited by people from all over the country and the world who are visiting the area. The park's recreational visitors come from a wide variety of demographic backgrounds representing many ethnic, racial, and economic groups reflective of the adjacent neighborhoods and society at large. A survey of Rock Creek Park visitors by the University of Idaho in 1999 characterized visitors and their experiences. Many of the values exceed 100 percent because, for example, visitors may have driven to the edge of the park and then walked in and identified both modes as how they arrived.

The majority of visitors during the survey were white (74 percent). Blacks or African Americans comprised 24 percent of those surveyed. Asians made up 3 percent; Hispanics or Latinos 2 percent; and American Indian/Alaska Natives and Native Hawaiian/Pacific Islander groups were each 1 percent or less (Littlejohn 1999).

Visitors from the United States predominantly were from Washington, D.C. (64 percent), Maryland (18 percent), and Virginia (7 percent). Not enough international visitors were surveyed to provide information that was reliable (Littlejohn 1999). However, comments of the draft general management plan were received from visitors from Canada, England, Israel, Japan, and Singapore.

Most visitors to interpretive centers, concessioner-operated sites, and picnic areas drive to the park in private automobiles. Many users of trails and the closed segments of Beach Drive arrive on foot, bicycle, or in-line skates. Park-wide, 58 percent of visitors said they arrived by private vehicle, 32 percent walked, 14 percent biked, 2 percent took public transportation, 1 percent arrived on in-line skates, 1 percent used a rental car, 1 percent came on a school bus, and 5 percent used other forms of transportation (Littlejohn 1999).

Visitors come to the park for a wide variety of reasons. In the University of Idaho survey (Littlejohn 1999), respondents mentioned participating in the following activities:

walking/hiking/jogging:	44 percent
bicycling:	18 percent
walking the dog:	17 percent
communing with or studying nature:	13 percent
picnicking and family reunions:	11 percent
golfing:	10 percent
in-line skating:	6 percent
tennis:	4 percent
studying history:	3 percent
creating art:	3 percent
horseback riding:	1 percent
other activities:	16 percent

The most common reasons given for visiting the park were exercise (61 percent), escaping the city environment (47 percent), time with family and/or friends (37 percent), and solitude (30 percent) (Littlejohn 1999).

Rock Creek Park is a popular site in the Washington metropolitan area for birding (birdwatching). 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. Rare bird sightings can bring larger than normal numbers of birders to the park.

The length of a visitor's stay depends on the purpose of the visit. A jogger may only stay an hour while a picnicker may stay all day. Overall, the majority of visitors (59 percent) stay 2 hours or less (Littlejohn 1999). Many visitors come to Rock Creek Park on a regular basis, and 52 percent of those surveyed visited weekly (Littlejohn 1999).

Most visitors do not participate in the park's education or interpretive programs. Visitor contacts at the three interpretive sites (the Rock Creek Nature Center and Planetarium, Peirce Barn, and Old Stone House) totaled 82,000 in 2002 and 75,000 in 2003. Visitor contacts at formal interpretive programs totaled 33,000 in 2002 and 14,000 in 2003. Fewer than 20,000 visitors in either year participated in other activities, such as the Junior Ranger Program, slide shows, and special events (NPS, Cox 2004a).

Visitation Trends and Visitor Services

In the 1980s, 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. Since then, based on traffic counts, visitation has been relatively stable (NPS, Street 2004d).

At the same time, the park's visitor services have been severely reduced, resulting in a substantial decline in visitation to the park's interpretive centers. Visitor services such as publications and wayside exhibits also are inadequate. The result is that many visitors to Rock Creek Park never know they are in a national park. Most never have contact with park rangers or receive any basic orientation.

Recreational visits to Rock Creek Park occur fairly evenly over the warmer months of spring, summer, and early fall, and drop slightly in the late fall and winter. This pattern has been recorded at a number of sites throughout the park, where from 2001 to 2003, an average of 26 percent of annual visits occurred during spring, 28 percent occurred during summer, 27 percent occurred during fall, and 19 percent occur during winter (NPS, Street 2004). These findings are supported by data from traffic counting devices along Morrow Drive and Beach Drive (NPS, Street 2004) and the University of Idaho Visitor Survey (Littlejohn 1999).

Nonrecreational visits, including those from commuters, are distributed evenly throughout the year, with an average of 25 percent 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, Street 2004). During scoping, many commenters identified themselves as commuters (by both automobile and bicycle) and emphasized that they consider their commute through the park to be recreational because it is an enjoyable ride through a scenic landscape and provides mental decompression from the workday.

Noise

In early December 1996, noise levels were measured at 21 sites in and around Rock Creek Park and the Rock Creek and Potomac Parkway (Robert Peccia and Associates *et al.* 1997). Results included the following:

Peak traffic noise levels within the park and parkway ranged from a low of 57 decibels (dB) equivalent sound level (L_{eq}) at the 4th hole of the golf course to 79 dB L_{eq} on the jogging trail south of Calvert, about 10 feet from the Rock Creek and Potomac Parkway.

Peak and off-peak noise levels were quite similar. Readings between these two periods varied by 4 dB or less at all 17 sites at which both peak and off-peak measurements were made.

Peak noise levels at seven sites met or exceeded the Federal Highway Administration's noise abatement criterion of 67 dB L_{eq} . All of these sites were within 100 feet of Beach Drive or the Rock Creek and Potomac Parkway and four of the seven were within 25 feet of the roads. Noise levels at four of these sites also met or exceeded the noise abatement criterion during off-peak periods.

Generally, the study found the following:

Picnic areas along Beach Drive north of Military Road are not adversely affected by traffic noise.

South of Military Road, traffic noise exceeds Federal Highway Administration standards at picnic areas that are within 60 feet of Beach Drive.

Visitor facilities within 110 feet to 125 feet of the Rock Creek and Potomac Parkway typically experience noise levels above the Federal Highway Administration standard.

The noise standard is frequently exceeded along segments of recreation trails within 100 feet of Beach Drive and the parkway.

Noise samples near residences along Oregon Avenue, 16th Street, and Broad Branch Road, at Kalorama Circle and at the National Zoo were all within the Federal Highway Administration standard.

Access

Rock Creek Park provides access to all visitors, in accordance with governing laws, regulations, and policies (see the “Servicewide Mandates and Policies” section). Mobility-impaired visitors can currently access all facilities within the park by automobile. From the University of Idaho Visitor Survey (Littlejohn 1999), 72 percent of those surveyed rated the quality of handicapped accessibility as “Good” or “Very Good.”

None of the road segments currently closed on weekends limit access to park facilities. Picnic groves 3 and 4 are within the southernmost closed road segment, but visitors are allowed to access them by driving very slowly along the road segments (NPS, Cox 2004a).

Perceptions regarding access were provided in comments on the draft general management plan. On weekends when the three segments of Beach Drive are closed to automobiles, some mobility-impaired visitors feel their access to those particular road stretches is eliminated. Others expressed appreciation at the ability to move slowly with a walker or wheelchair on the road’s broad, smooth, level surface without worrying about traffic and to be able to experience the sights, sounds, smells, and touch of roadside features that were inaccessible to them from a car.

PUBLIC HEALTH AND SAFETY

Traffic Safety

An analysis of accidents occurring on park roads and the Rock Creek and Potomac Parkway between January 1, 1993 and December 31, 1995 was included in the *Transportation Study, Rock Creek Park, Washington, D.C.* (Robert Peccia & Associates 1997). More recent traffic accident data (January 1, 2001 to December 31, 2003) for Rock Creek Park and the Rock Creek and Potomac Parkway were provided by the U.S. Park Police (NPS, Pettiford 2004c). This section is based on information from these source.

Accidents by Type and Location. Table 13 summarizes traffic accident data by outcome (fatal, survivable injury, or property damage only) and collision type for three areas (Beach Drive, other park roads, and the Rock Creek and Potomac Parkway) for the 1993-1995 and 2001-2003 periods. The table also includes a comparison between the two data sets. Table 13 indicated the following:

Property-damage-only accidents consistently accounted for approximately three-quarters of all accidents, regardless of location or time period. Fatal accidents (four in 1993-1995 and three in 2001-2003) represented 0.3 percent of all accidents in both time periods. The remaining accidents resulted in survivable injuries.

During both time periods, the highest number of collisions between motorized vehicles and pedestrians or bicyclists occurred on Beach Drive. However, the number of these collisions on Beach Drive dropped more than 75 percent, from 13 in 1993-1995 to 3 in 2001-2003. Similar drops occurred along other park roads and the parkway so that throughout the area, this class of accidents dropped from 2.4 percent of all accidents in 1993-1995 to 0.6 percent in 2001-2003.

TABLE 13: SUMMARY OF TRAFFIC ACCIDENTS IN ROCK CREEK PARK AND THE ROCK CREEK AND POTOMAC PARKWAY, 1993 THROUGH 1995 AND 2001 THROUGH 2003^a

Accident Type	Beach Drive			Other Park Roads			Rock Creek and Potomac Parkway			Total		
	1993-1995	2001-2003	Percent change	1993-1995	2001-2003	Percent change	1993-1995	2001-2003	Percent change	1993-1995	2001-2003	Percent change
Total accidents	294 (25%)	247 (26.2%)	-16.0	224 (19.1%)	45 (4.8%)	-79.9	657 (55.9%)	651 (69.0%)	-0.9	1,175 (100%)	943 (100%)	-19.7
Fatal accidents	1 (0.3%)	0 (0%)	-100.0	1 (0.4%)	1 (2.2%)	0	2 (0.3%)	2 (0.3%)	0	4 (0.3%)	3 (0.3%)	-25.0
Injury accidents	75 (25.5%)	60 (24.3%)	-20.0	45 (20.1%)	11 (24.4%)	-75.6	155 (23.6%)	140 (21.5%)	-9.7	275 (23.4%)	211 (22.4%)	-23.3
Property damage only	218 (74.2%)	187 (75.7%)	-14.2	178 (79.5%)	33 (73.3%)	-81.5	500 (76.1%)	509 (78.2%)	+1.8	896 (76.3%)	729 (77.3%)	-18.6
Collision with motor vehicle or fixed object	273 (92.9%)	237 (96.0%)	-13.2	210 (93.8%)	45 (100%)	-78.6	621 (94.5%)	635 (97.5%)	+2.3	1,104 (94.0%)	917 (97.2%)	-16.9
Collision involved pedestrian or bicyclist	13 (4.4%)	3 (1.2%)	-76.9	4 (1.8%)	0 (0%)	-100.0	11 (1.7%)	3 (0.4%)	-72.7	28 (2.4%)	6 (0.6%)	-78.6
Non-collision accidents	8 (2.7%)	7 (2.8%)	-12.5	10 (4.5%)	0 (0%)	-100.0	25 (3.8%)	13 (2.0%)	-48.0	43 (3.6%)	20 (2.1%)	-53.5

a/Data are from Robert Peccia & Associates 1997 and NPS, Pettiford 2004c.

In the earlier period, 94 percent of accidents involved a collision of an automobile with another motor vehicle or a fixed object. This value increased to more than 97 percent during the latter period.

During both periods, accidents on Beach Drive represented about a quarter of all accidents in the park and on the parkway. Accidents on other park roads dropped from about 20 percent in 1993-1995 to less than 5 percent of all accidents in 2001-2003.

The total number of accidents on the parkway dropped by about 1 percent between 1993-1995 and 2001-2003. However, the proportion of all park and parkway accidents that occurred on the parkway increased from 56 percent to 69 percent.

The total number of accidents on the park and parkway dropped by almost 20 percent, from 1,175 accidents in 1993-1995 to 943 accidents in 2001-2003. This included a 25 percent decrease in fatal accidents, a 23 percent decrease in injury accidents, and a 19 percent decrease in accidents that resulted in property damage only.

The decreases were most notable on other park roads, where injury and property accidents both declined by more than 75 percent.

The least change occurred on the parkway, where injury accidents decreased by 10 percent and property-damage accidents increased by 2 percent.

The U.S. Park Police office in Rock Creek Park was contacted to identify what caused the 20 percent decrease in accidents in the 8 years between the two data sets. The consensus was that the decrease in accidents reflected the incremental benefits of many actions, including those listed below, that had occurred over the period (NPS, Davis 2004b).

Several engineered actions have been implemented to improve safety. Some of these include raised reflectors along the center of the Rock Creek and Potomac Parkway, stop signs at the intersection of Beach Drive and Piney Branch, and improved signage to manage rush-hour lane reversals on the Rock Creek and Potomac Parkway.

Region-wide traffic enforcement actions have improved driving habits. For example, the U.S. Park Police participate in the "Click It or Ticket" campaign to encourage seatbelt use that could have contributed in the decreases in fatal and injury accidents that were greater than the decrease in property-damage-only accidents. Other efforts have included the "Smooth Operator" program that intensively targets all forms of aggressive driving and a campaign to ticket drivers who run red lights.

An important contributor probably has been increased traffic volumes that have forced motorists to reduce vehicle speed along the parkway and, particularly, in the park. As a result, drivers get into fewer situations that could lead to accidents, and have time to react successfully even when those situations occur.

Robert Peccia & Associates (1997) stated that the frequency and severity of accidents in the 1993-1995 period were relatively low for an urban area. However, they attributed the relatively low number of serious accidents in the park at least in part to a perceived risk to personal safety, which caused some potential visitors to avoid using the park during periods of high traffic speeds and/or heavy volumes.

Robert Peccia & Associates (1997) attributed the greatest traffic safety problems in the park and along the parkway to excessive vehicle speeds and aggressive driving tendencies. They found that conflicts between automobiles and recreational visitors were common, even when accidents were avoided.

Temporal Distribution of Accidents. If traffic conditions were identical throughout the week, each day would have about 14 percent of the traffic accidents. However, the analysis of the 943 accidents for the 2001-2003 period shows that accidents were most common on Fridays (17.1 percent) and Saturdays (16.4 percent) and least common on Mondays (11.0 percent) and Sundays (11.8 percent). For the Rock Creek and Potomac Parkway, accidents were slightly more common on Saturdays than on any other day, possibly because drivers could travel at higher speeds in the lighter weekend traffic.

In the 2001-2003 period, the three geographic areas showed different accident patterns based on time of day.

For the Rock Creek and Potomac Parkway, the 6 hours between midnight and 6:00 A.M. each had fewer than 2 percent of the total accidents. The rush hours between 6:00 A.M. and 9:00 A.M. each had fewer than 4 percent of accidents. Accident numbers generally increased throughout the remainder of the morning and early afternoon, peaking at more than 9 percent of the daily total between 3:00 P.M. and 4:00 P.M., and then declining through the afternoon rush hour and evening.

For Beach Drive, the 13 hours between 10:00 P.M. until 11:00 A.M. each had fewer than 3 percent of the total accidents. From 11:00 A.M. until 8:00 P.M., most hours accounted for about 8 percent of daily accidents, with the peak of 10.5 percent occurring between 3:00 P.M. and 4:00 P.M.

Other park roads had a more even distribution of traffic accidents. The highest rates of 5 percent to 7 percent of daily traffic accidents each hour occurred between noon and 6:00 P.M. Almost all other hours accounted for 2 to 4 percent of daily accidents.

Beach Drive and Ross Drive. The locations of the 247 accidents that were recorded on Beach Drive during the 2001-2003 period were mapped. Of these, only 16 (6.7 percent) occurred on the segments between the Maryland border and the intersection with Broad Branch Road that currently are closed on weekends. Table 14 shows the distribution of accidents in these segments, plus accident data for Ross Drive, which could be used as an alternate north-south route through the park.

**TABLE 14: SUMMARY OF TRAFFIC ACCIDENTS ON BEACH DRIVE SEGMENTS
NORTH OF BROAD BRANCH ROAD, 2001 TO 2003 ^{a/}**

Accident Type	Broad Branch to Joyce Road	Picnic Grove 10 to Wise Road	West Beach Drive to Mary- land border	Ross Drive	Total
Total accidents	6	6	4	0	16
Fatal accidents	0	0	0	0	0
Injury accidents	1	3	0	0	4
Property damage only	5	3	4	0	12
Collision with motor vehicle or other object	3	4	3	0	10
Collision involved pedestrian or bicyclist	0	0	0	0	0
Non-collision accidents	1	1	0	0	2

a/ Data are from NPS, Pettiford 2004c.

Concern was expressed during scoping and in comments on the draft environmental impact statement that many accidents occur along the narrow portion of Beach Drive where there is no trail and where pedestrians and cyclists enter the traffic flow. However, for the 2001-2003 period, only six accidents, including one with injuries, occurred in the three-quarter-mile stretch extending from the intersection with Broad Branch Road north to Joyce Road. None of these accidents involved a pedestrian or bicyclist. Factors that could contribute to the low incidence of traffic accidents along this stretch include its closure to motorized traffic on weekends and holidays and the extra caution taken by motorists who recognize the gorge area as potentially dangerous.

The portion of Beach Drive between the Wise Road intersection and picnic grove 10, which also is closed on weekends, had a similarly low number of accidents. However, this area appears to have had an unusually high ratio of injury accidents for the years 2001-2003 of 50 percent, compared to less than 25 percent throughout the remainder of the park and parkway (see table 13). During the 1993-1995 period, an even higher 60 percent of accidents on this road segment resulted in injuries. These findings over both periods suggest that public safety could benefit from an investigation to determine the causes of the high injury ratio in this road segment and the implementation of corrective measures.

The segment of Beach Drive from West Beach Drive to the Maryland border was the site of four accidents in the 2001-2003 period. These accidents resulted in property damage only, and none involved pedestrians or bicyclists.

As shown in table 14, no traffic accidents were recorded on Ross Drive during the 2001-2003 period. However, this road is very lightly traveled, and the 340 vehicles that use it on a daily basis represent only about 5 percent of the traffic levels on the parallel segment of Beach Drive.

Fatalities. Three traffic fatalities in the 2001-2003 period occurred in the park or along the parkway (table 13). This was one fewer (25 percent decrease) than the 1993-1995 period. None of the 2001-2003 fatalities involved a bicyclist or pedestrian and none occurred on Beach Drive.

Two of the fatalities occurred along the Rock Creek and Potomac Parkway.

One involved a driver traveling the wrong way on the ramp from P Street to the southbound parkway near midnight.

The other was an afternoon rush-hour rear-end accident in the intersection of the parkway and Beach Drive.

The third fatality occurred on the Piney Branch Parkway between Beach Drive and 17th Street. A driver traveling too fast for conditions on a rainy afternoon lost control and hit a tree head-on.

Traffic Accidents involving Pedestrians and Bicyclists. As shown in table 13, there were six traffic accidents involving motorized vehicles and pedestrians or bicyclists during the 2001-2003 period. This represented a decrease of more than 75 percent from the 28 traffic accidents involving motorized vehicles and pedestrians or bicyclists that occurred during the 1993-1995 period. Three of these accidents occurred on Beach Drive and three occurred along the Rock Creek and Potomac Parkway. Because of the low accident numbers, it was not possible to establish patterns relating to locations or causative factors.

Accident Rates. The accident rate for a road segment is calculated as the number of accidents per 100 million vehicle-miles traveled. Accident rates also can be determined for fatal and injury accidents.

Robert Peccia & Associates (1997) calculated accident, injury, and fatality rates for the park and parkway for the 3-year period, 1993-1995. The results are presented in table 15. The area evaluated for the Rock Creek and Potomac Parkway extended from Calvert Street to Ohio Drive. The Beach Drive analysis extended from the Maryland line to the intersection with the parkway south of the National Zoo.

A similar analysis was not conducted for the 2001-2003 data. However, park and parkway rates would be expected to be about 20 to 25 percent lower, based on the lower accident rates shown in table 13.

For comparison, table 15 also includes

average accident and injury rates in Washington, D.C. for 1993 through 1995 (calculated from District of Columbia 1995)

average fatality rates for Washington, D.C. and average accident, injury, and fatality rates nationwide in 2002 (National Highway Traffic Safety Administration 2002; Bureau of Transportation Statistics 2003)

The parkway had an overall accident rate that was about 20 percent higher than that occurring throughout Washington, D.C. and more than 2.4 times higher than the national accident rate. The fatality rate also was about 20 percent higher than the Washington, D.C. rate, but only 6 percent higher than the national rate. The parkway's injury rate also was higher, by 25 percent, than the national average, but was 13 percent lower than the injury rate for Washington, D.C.

The accident rate on Beach Drive exceeded the national rate by a factor of 1.8, but was about 10 percent lower than the accident rate of Washington, D.C. Probably because of the relatively slow speed limit on Beach Drive (25 miles per hour), the injury and fatality rates on this road equaled or were lower than the national rates.

TABLE 15: ACCIDENT RATES FOR THE ROCK CREEK AND POTOMAC PARKWAY, BEACH DRIVE, AND WASHINGTON, D.C.

Location	Accident Rate (per 100 million vehicle-miles traveled)	Injury Rate (per 100 million vehicle-miles traveled)	Fatality Rate (per 100 million vehicle-miles traveled)
Rock Creek and Potomac Parkway ^{a/}	540	127	1.6
Beach Drive ^{a/}	387	99	1.3
Washington, D.C. area	425 ^{b/}	147 ^{b/}	1.3 ^{c/}
Nationwide ^{c/}	221	102	1.5

a/ Data from Robert Peccia & Associates 1997.

b/ Data from District of Columbia 1995.

c/ Data from National Highway Safety Transportation Administration 2002; Bureau of Transportation Statistics 2003.

Crime

A number of commenters on the draft general management plan mentioned feeling unsafe sometimes in the park, and some stated that safety concerns were a factor influencing their decisions on when and where to recreate. With regard to the management of Beach Drive, some commenters on the draft plan felt that it is unsafe to recreate along a busy road because no one could hear a cry for help over the traffic. Others felt that having lots of people in cars in the vicinity would help prevent personal crimes, such as assault.

Table 16 includes statistics for crimes against persons for the period 1999-2003 for the three police districts that include the park. The 2nd District is west of Beach Drive and the Rock Creek and Potomac Parkway. The 3rd and 4th Districts are east of Beach Drive and the parkway, with the 3rd District on the north. Although these districts include NPS properties, crimes occurring in the park are not reported separately.

Numbers of offenses within the 2nd District are substantially lower than numbers in the 3rd and 4th Districts. The only notable trends for these 5 years are a decrease in homicides for the 3rd District and a decrease in aggravated assaults in the 4th District. However, 10-year trends show substantial decreases in homicides and aggravated assaults for both the 3rd and 4th Districts (District of Columbia 2004d, 2004g, 2004h, 2004i, and 2004j).

Evacuation of the City during a Major Emergency

Concerns about evacuating portions or all of Washington, D.C. during an emergency situation were raised by the public following the terrorist attacks of September 11, 2001. Comments focused on the possibility of using Beach Drive as an evacuation route to reach areas to the north.

Beach Drive is not formally designated as an emergency evacuation route. The National Park Service does not take any actions such as closing Beach Drive or any other park roads during emergency situations.

**TABLE 16: PERSONAL CRIME TOTALS FOR
POLICE DISTRICTS 2, 3, AND 4 IN WASHINGTON, D.C., 1999-2003**

Crime Type	Year	2nd District Total	3rd District Total	4th District Total
Homicide	1999	3	31	39
	2000	3	30	40
	2001	0	30	29
	2002	3	17	41
	2003	2	16	31
Sexual Assault	1999	14	33	39
	2000	16	37	53
	2001	19	28	24
	2002	22	37	43
	2003	8	22	50
Aggravated Assault	1999	143	633	806
	2000	157	596	831
	2001	159	721	773
	2002	168	721	798
	2003	139	559	776

REGIONAL AND LOCAL TRANSPORTATION

A detailed description of traffic conditions in the vicinity of the Rock Creek Park and the Rock Creek and Potomac Parkway was included in *Transportation Study, Rock Creek Park, Washington, D.C.* (Robert Peccia & Associates 1997). That study was prepared to support this general management plan and used year 1990 data, which were the most current available. A similarly comprehensive traffic study has not been performed since then.

Information in this section is based on the Robert Peccia & Associates (1997) report, average daily traffic counts for 2001 provided by the District of Columbia, Department of Transportation (District of Columbia 2001a and 2001b), and a traffic analysis of the southern portion of Beach Drive and surrounding roads that was conducted in June 2004 (Parsons 2004). The most recent information available for each road segment was used in this analysis. Levels of service have not been recalculated since the work by Robert Peccia & Associates (1997) and their data are included in this evaluation.

Regional Traffic Flows

Traffic congestion in the Washington, D.C. metropolitan area is the third worst in the nation (Shaver 2003). The roads in the vicinity of Rock Creek Park are an important component of the urban road network of Washington, D.C.

Principal arterial routes radiate out from the center of the District and include Massachusetts, Wisconsin, Connecticut, Nebraska, Georgia, and Virginia Avenues as well as 16th Street. Many of the arterial streets extend into Maryland and are primary commuter and delivery routes into the District.

Military Road, the Whitehurst Freeway, and Porter, Harvard, Calvert, and M Streets traverse the park and provide for cross-town traffic.

The Average Weekday Traffic Volumes map presents traffic counts on major roads in the vicinity of Rock Creek Park from 1990, 2001, and 2004. The most recent data are reported for each road segment.

As shown on the map, the major arterials each had an average daily traffic (ADT) count of 20,000 to 40,000 vehicles.

On weekdays, the peak-hour morning count and peak-hour evening count were nearly identical (difference of 10 percent or less) for almost every major roadway.

On almost all of these roads, the peak-hour morning count and peak-hour evening count each accounted for approximately 8 percent to 9 percent of the ADT.

During the morning and evening commuting periods, traffic levels on these arterial roadways typically meet or exceed their capacities. Table G.1 in appendix G shows the average daily traffic volumes for the major roadways in the area (the most recent data from 1990, 2001, or 2004 are provided). The roadways usually can accommodate these high traffic volumes through aggressive traffic management measures such as reversing lanes during commuting periods.

Some morning and evening traffic counts in the mapped area have increased while others have decreased between 1990 and 2004. (Table G.2 in appendix G shows 1990 and 2004 peak hour volume data where available.) However, the patterns described above are still occurring.

In Maryland, Maryland 410 (East-West Highway) intersects Beach Drive and is the closest state road to the affected area. The average daily traffic for Maryland 410 near Beach Drive is 31,600 vehicles per day. The average daily traffic on Beach Drive at the state line (one mile south of Maryland 410) is approximately 5,400 (Simpson 2003).

Excellent public transportation opportunities occur in the area. The Washington Area Metropolitan Transit Authority provides Metro Bus service throughout the area. The Metro Rail's red line runs to the west of the park and the green line runs to the east of the park. Several Metro Rail stops are within 1 mile of the central portion of the park.

Recent counts of vehicular and passenger volumes show that throughout the metropolitan Washington area, single-occupancy vehicle use increased slightly from 1999 to 2002 (from 40 percent to 41 percent of all 5 A.M. to 10 A.M. inbound trips), while multiple-occupancy vehicle use decreased slightly (from 23 percent to 20 percent) (Metropolitan Washington Council of Governments 2003a). At the same time, transit trips increased from 36 percent to 38 percent, offsetting the decrease in multiple-occupancy vehicles.

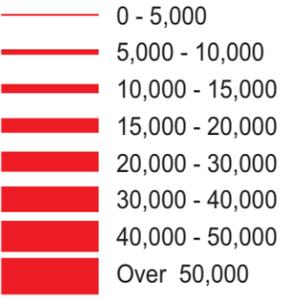
Local Traffic Flows

The Rock Creek and Potomac Parkway and Beach Drive are the principal roads within Rock Creek Park.



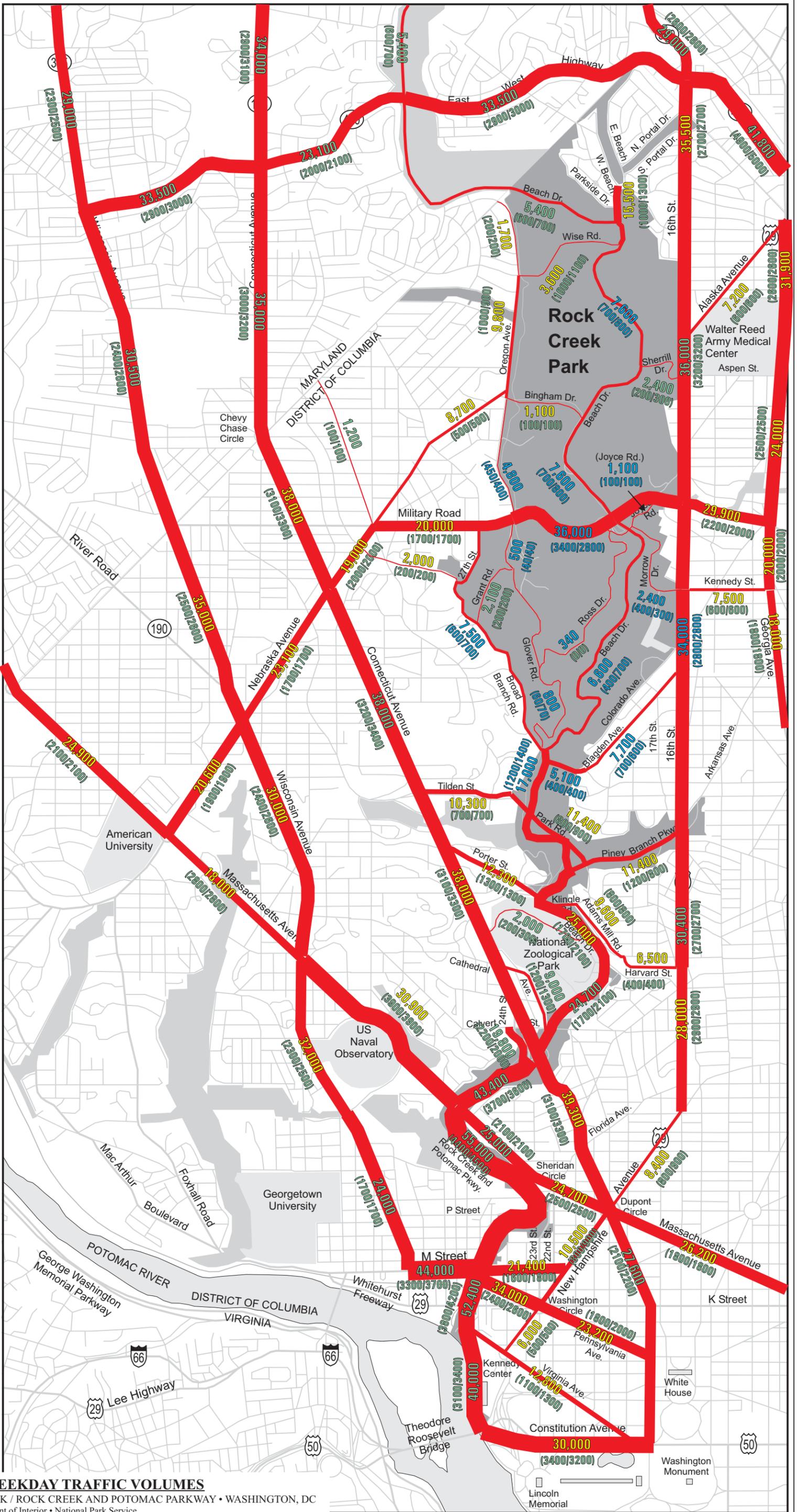
Map Scale: 1" = 0.5 Miles

Rock Creek Park



900 = Average daily traffic volume (ADT)
(100/100) = (AM Peak Hour/PM Peak Hour)

20,000 1990 data
20,000 2001 data
20,000 2004 data



The Rock Creek and Potomac Parkway extends approximately 2.5 miles from the Theodore Roosevelt Bridge in the core of the District north to Calvert Street. The parkway is a four-lane, paved, limited-access facility with a posted speed limit of 35 miles per hour.

As shown on the Average Weekday Traffic Volumes map, this roadway carried more traffic than any other in the vicinity, with average daily traffic counts of 40,000 to 55,000 vehicles.

Traffic patterns were very similar to those described above for other arterials, with similar morning and evening traffic volumes and peak-hour counts during the morning and evening each accounting for approximately 8 percent to 9 percent of the average daily traffic.

It is assumed that, as with the other arterials, traffic has increased since 1990 on the Rock Creek and Potomac Parkway. However, accurate estimates of current traffic levels on this roadway are not available.

From Calvert Street, Beach Drive extends approximately 6.5 miles north to the Maryland state line. Beach Drive is a two-lane, paved road with a posted speed limit of 25 miles per hour. Traffic exhibited the following characteristics:

Overall, there was slightly more evening traffic than morning traffic. At all sites shown on the map, peak-hour evening traffic represented 5 percent to 13 percent of the average daily traffic, while morning peak-hour traffic accounted for 5 percent to 17 percent of the daily total.

Between Wise Road and Blagden Avenue, average daily traffic counts were 8,000 to 9,000 vehicles in 1990. More recent data were not available for this portion of the road.

Beach Drive between Joyce Road and Broad Branch Road has an average daily traffic volume on weekdays of about 6,600 vehicles. The highest 1-hour volume occurs during the afternoon rush hour and includes about 670 vehicles. During the 5-hour mid-day period on a weekday from 10:00 A.M. to 3:00 P.M., approximately 1,660 vehicle trips occur, for an average of about 330 vehicle trips per hour (Parsons 2004).

From Blagden Avenue south to the Rock Creek and Potomac Parkway, counts ranged from 18,000 to 24,700 vehicles per day in 1990; 12,500 to 25,100 in 2001; and 6,600 to 17,000 (from Blagden Avenue south to Tilden Road/Park Road only) in 2004. These data show a small decrease in traffic volumes over time for this section of Beach Road.

Twenty-four entry routes provide access to Rock Creek Park (see Existing Conditions map). Although the park is closed at dark, park roads and entry points remain open.

Major entry points north of Military Road include Beach Drive at the Maryland state line, West Beach Drive, and Wise Road.

South of Military Road, major entry points include Joyce Road, Morrow Drive, Broad Branch Road, Blagden Avenue, Park Road, Tilden Street, and Piney Branch Parkway.

Visitors can also enter the park from 16th Street NW, the Kennedy Street area, and from the National Zoological Park.

Commuting has the greatest effect on traffic flows through Rock Creek Park. Traffic volumes show little seasonal variation (NPS, Street 2004d) and the highest traffic levels correspond to the peak morning and evening commuting times. To accommodate these peaks in commuter traffic, all lanes of the Rock Creek and Potomac Parkway are designated as one-way southbound during the morning commute period (6:30 to 9:00 A.M.) and one-way northbound during the evening commute (3:30 to 6:00 P.M.) (NPS, Cox 2004a).

To provide recreational opportunities for pedestrians, bicyclists, and in-line skaters, the park closes portions of Beach Drive to motorized vehicle traffic during the day on weekends and holidays. During these times, Beach Drive is closed from Broad Branch Road to Joyce Road, picnic grove 10 to Wise Road, and West Beach Drive to the Maryland state line. Bingham Drive and Sherrill Drive also are closed.

During the week when all park roads are open to automobile traffic, interactions are common between automobiles and visitors on foot or using bicycles. These particularly occur in areas where a trail does not parallel Beach Drive, because those are places where pedestrians and bicyclists often enter the traffic flow.

To understand automobile traffic patterns, the National Park Service commissioned a license plate survey in 1996 (Robert Peccia & Associates 1997). The results indicated the following:

During weekday rush hours, more than 99 percent of all vehicles using the Rock Creek and Potomac Parkway and more than 95 percent of vehicles entering Rock Creek Park pass through without stopping.

Commuting patterns through Rock Creek Park do not simply flow north and south. Instead, many rush-hour drivers use segments of park roads to traverse the park and reenter the city street grid.

Only 3 percent of the vehicles that enter the park at the Maryland state line exit onto the parkway.

In the morning, the greatest number of vehicles that exit onto the parkway enter the park at Broad Branch Road (17 percent), Blagden Avenue (20 percent), and Piney Branch Parkway (34 percent).

In the evening, the patterns are very similar. Only 1 percent of the vehicles that enter from the parkway exit the park at the Maryland state line. The majority of vehicles exit onto Broad Branch Road (18 percent), Blagden Avenue (19 percent), and Piney Branch Parkway (33 percent).

The study also determined vehicle occupancy in August 1996. During commuting periods, the average vehicle occupancy on park roads ranged from a low of 1.09 people per vehicle on Morrow Drive to a high of 1.38 people per vehicle on Tilden Street. On nearby streets in the District,

the results ranged from 1.22 people per vehicle on Oregon Avenue to 1.34 people per vehicle on 16th Street. These averages indicate that much of the rush-hour use is by vehicles with a single occupant (Robert Peccia & Associates 1997).

More recently, vehicle occupancies were measured by the Metropolitan Washington Council of Governments in the final draft version of the *2002 Metro Employment Core Cordon Count of Vehicular and Passenger Volumes* (2003a). For the Rock Creek and Potomac Parkway just south of P Street N.W., the 5-hour inbound average vehicle occupancy was 1.18. Nearby major roads in northwest Washington ranged from 1.16 to 1.24 occupants per vehicle. These updated vehicle occupancy statistics indicate that the majority of rush-hour use is still by single-occupancy vehicles.

Higher traffic volumes during peak hours cause delays at certain intersections during the commuting periods (Robert Peccia & Associates 1997).

In the morning, the following intersections failed or functioned very poorly: Beach Drive and Blagden Avenue, Beach Drive and Piney Branch Parkway, Beach Drive and Tilden Street/Park Road, and 16th Street and Kennedy Drive/Morrow Road.

In the evening, failures or poor operations occurred at Beach Drive and Joyce Road, Beach Drive and Porter Road, and Beach Drive and Tilden Street/Park Road.

Most vehicles travel at or above the posted speed limit through the park. Spot speed checks revealed that the average speed was 15 miles per hour over the posted speed limit. Commuters in Rock Creek Park also tend to have more aggressive driving habits than do visitors unfamiliar with the park. A detailed speed analysis can be found in *Transportation Study, Rock Creek Park, Washington, D.C.* (Robert Peccia & Associates 1997).

Residents in neighborhoods to the north of the park perceive that with the current management of weekend closures, there is substantial cut-through traffic in their neighborhoods once drivers realize that Beach Drive is closed (Mikulski 2003). They are concerned that the same would happen if permanent or mid-day weekday road closures on Beach Drive occurred. Observations included in comments on the draft general management plan were that the non-local traffic in their neighborhoods on weekends consists of drivers who are not familiar with the area or the weekend closures and intended to enter Rock Creek Park via Beach Drive. When they find Beach Drive is closed, they turn onto the nearby neighborhood streets in an attempt to get back to a local arterial.

The Maryland-National Capital Park and Planning Commission responded to residents' concerns by conducting a limited traffic count study in summer 2003 for three roads (Beach Drive north of the park, Daniel Road., and Pinehurst Parkway) in Montgomery County, Maryland, just to the north of the park (Maryland-National Capital Park and Planning Commission, Hawthorne 2004). Results are summarized in table 17.

The traffic counts demonstrated that weekend traffic is higher for the neighborhood roads than during the week. Some of this is related to neighborhood residents running errands or conducting other local activities on weekends. However, Richard Hawthorne, the Chief of Transportation Planning for the Maryland-National Capital Park and Planning Commission, believes that it also is attributable to the weekend closure of Beach Drive in Rock Creek Park. Mid-day weekday volumes for Beach Drive measured in this count may indicate the maximum number of vehicles that could potentially travel through these neighborhoods if Beach Drive were closed during the mid-day period on weekdays.

TABLE 17: AVERAGE MID-DAY AND DAILY TRAFFIC VOLUMES FOR NEIGHBORHOOD ROADS NORTH OF ROCK CREEK PARK IN 2003 ^{a/}

Road Segment	Weekday		Saturday	
	Average Daily Traffic	9:00 A.M. – 3:00 P.M. Volumes	Average Daily Traffic	9:00 A.M. – 3:00 P.M. Volumes
Beach Drive (north of Rock Creek Park)	5,700	1,500	650	275
Pinehurst Parkway	970	320	960	460
Daniel Road	1,980	670	2,180	930

a/ Data are from Maryland-National Capital Park and Planning Commission, Hawthorne 2004.

Mass Transportation

There are 14 Metrorail stations within a mile of the park and parkway (see the Existing Conditions map) and numerous bus stops. The Washington Metropolitan Area Transit Authority provides bus and rail service in the region, which includes the District of Columbia, two counties in Maryland, and three counties in Virginia. Average weekday ridership in fiscal year 2004 was 650,000, a sizable portion of the 3.2 million residents in the service area (Washington Metropolitan Area Transit Authority 2004a and 2004b). Transportation trends show that transit use increased, while automobile transportation decreased in the last 10 years (Metropolitan Washington Council of Governments 2003a).

Transit buses and commercial vehicles are not permitted on park roads or the parkway. The number of visitors entering the park and parkway by foot or bicycle from the mass transit network is unknown, but is believed to be relatively small.

Nonmotorized Transportation Flows

Nonmotorized transportation in this document includes walking, bicycling, and other means of personal transport for the purpose of getting from one location to another. This contrasts with nonmotorized recreation, defined here as walking or riding for pleasure, fitness, or some other recreational purpose.

Bicycles are used by 1.16 percent of the population for all District of Columbia-based work trips, a higher percentage than most major cities in the United States (District of Columbia 2004f). Studies prepared for the National Capital Region Transportation Planning Board (NCRTPB) of the Metropolitan Washington Council of Governments (MWCOC) reported that cyclists represent a wide range of ages, and more than half have an annual income of \$75,000 or greater (Bairstow 1995a and 1995b).

There are several hundred miles of paved trails and designated bicycle routes in the region. The report entitled *Priorities 2000 Metropolitan Washington Greenway* (Metropolitan Washington Council of Governments 2001) highlights Rock Creek Park as an existing greenway and designates Fort Circle Greenway and the Metropolitan Branch Trail as regional priority projects that would connect directly to Rock Creek Park. Other major trails that currently connect to the paved trails through Rock Creek Park and the parkway include the Rock Creek Trail (in Rock Creek

Regional Park, Maryland), the Capital Crescent Trail, the Mount Vernon Trail, and the C and O Canal Trail.

A 1990s survey (Sacks 1994) found that 67 percent of all users on the paved recreation trails in Rock Creek Park and along the parkway during weekday peak hours were engaged in transportation rather than strictly recreation. Average distance traveled by such users was 5.3 miles. Typical nonmotorized transportation participants in the park and parkway lived within 2 miles of the paved trail system and were going to destinations within 1 mile of the trail.

Bicycling is the most popular form of nonmotorized transportation along the park and parkway, accounting for 54 percent to 86 percent of average weekday nonmotorized transit during a 1-day August 1996 survey (Robert Peccia & Associates 1997). Surveys (Bairstow 1995a and 1995b) of morning peak-hour bicyclists along the Rock Creek and Potomac Parkway trail determined the following characteristics:

Eighty-five percent of the trail users were going to destinations in the District and 16 percent were headed through the park to locations in Arlington, Virginia.

Bicyclists averaged 9.9 miles per trip on paved trails.

Sixty-eight percent of cyclists preferred off-street trails while 20 percent preferred bike lanes on streets or sharing streets with automobiles.

Bad weather was the greatest deterrent to cycling (72 percent). The threat to safety from traffic was the second most frequently mentioned deterrent (35 percent).

The same survey of bicyclists on radial routes into the city documented that paved trails have a 5-fold or greater increased bicycle use compared to designated street routes or low-traffic roads (Bairstow 1995a and 1995b). This survey, combined with 1993 counts, indicated about 60 bicycles per hour during the evening peak period on the Rock Creek and Potomac Parkway paved trail at P Street. The studies considered 12 to 80 bikes per hour to be in the high range for the region.

A 1-day, 8-hour sample of nonmotorized transportation in the park and parkway was collected on Thursday, August 22, 1996 (Robert Peccia & Associates 1997). Similarly to the NCRTPB survey (Bairstow 1995a and 1995b), the Peccia survey found preferential use of trails, with an average weekday hourly volume of 34 users per hour on the bike/foot trail south of the Beach Road/Broad Branch Road intersection and 14 users per hour on Beach Drive north of this intersection. Beach Drive in the vicinity of Joyce Road averaged 22 users per hour, and 112 users per hour were recorded on the bike/foot path along the Rock Creek and Potomac Parkway south of P Street.

Little information is available on pedestrian nonmotorized transportation. However, the 2000 Census reports that 11.8 percent of the District of Columbia's population walked to work. Results from zip code tabulation areas close to or within the downtown area indicate that up to 50 percent of commuters walk to work (U.S. Census Bureau 2000).

COMMUNITY CHARACTERISTICS

Community characteristics are included as an impact topic based on the criteria presented in the "Impact Topics - Resources and Values at Stake in the Planning Process" section.

Metropolitan Washington, D.C.

The Washington, D.C. metropolitan area is generally illustrated in the Region map shown at the beginning of this general management plan. More than 4 million people reside in the U.S. Census Bureau's Washington metropolitan statistical area, including about 570,000 people who live within the boundaries of the District (U.S. Census Bureau 2000). The remainder of the statistical area consists of five Maryland counties, six Virginia counties, and four Virginia cities (District of Columbia 1996c).

Washington, D.C.'s population is approximately 60 percent African American, 31 percent white, and 9 percent other races. Approximately 8 percent of Washington, D.C.'s citizens also identify themselves as Latino. Compared to statistics from the 50 states, the District's per capita income is 33 percent higher than the national average (U.S. Census Bureau 2000).

Generalizations cannot be made about ethnic composition of the nearby areas in Maryland and Virginia. For example, populations in some of these communities are 90 percent or more white, while the Takoma Park area (zip code tabulation area 20912) just north of the Maryland state line is 36 percent black, 43 percent white, and 22 percent other races, with 21 percent of the residents identifying a Latino heritage.

Surrounding Neighborhoods and Zip Code Tabulation Areas

The Existing Conditions map shows the locations of the U.S. Census Bureau zip code tabulation areas for Washington, D.C. in the vicinity of the park. It also shows the zip code tabulation areas for the Maryland cities of Chevy Chase, Silver Springs, and Takoma Park that are just north of Rock Creek Park.

Table 18 provides statistics from the 2000 census for areas around the park, organized by zip code tabulation area. Zip code tabulation areas are generalized area representations of U.S. Postal Service ZIP Code service areas that are aggregations of census blocks. More information on how zip code tabulation areas were designated can be found at:

<http://www.census.gov/geo/ZCTA/zcta.html>.

The neighborhoods surrounding Rock Creek Park are some of the most racially, ethnically, and economically diverse in the Washington, D.C. metropolitan area. Many residential and mixed-use areas, including Adams Morgan, DuPont Circle, and Georgetown, as well as office buildings and foreign embassies, are located near the park and parkway. During scoping, citizens living in the adjoining neighborhoods both east and west of Rock Creek Park expressed concerns about local increases in traffic that might be associated with changes in park management.

To the north of the park in Montgomery County, Maryland, are communities that are primarily residential, with commercial development extending along the major thoroughfares. These include Connecticut Avenue, Wisconsin Avenue, and 16th Street. Table 19 summarizes selected census characteristics of the people living in these communities, organized by zip code tabulation area.

In addition to Rock Creek Park, many recreational and educational opportunities exist in the area. Some of these are identified below. However, Rock Creek Park is unique because it is the only major natural area in this urban environment.

More than 40 recreation centers, 25 swimming pools, and 75 tennis courts provide active recreational opportunities in the areas neighboring the park.

More than 100 public and private schools are located in the surrounding area, along with major universities such as American University, University of the District of Columbia, George Washington University, Georgetown University, and Howard University.

Many other public parks occur in the area, including the C&O Canal National Historical Park, the sites of the Civil War Defenses of Washington, Meridian Hill Park, Dumbarton Oaks Park, Glover-Archbold Park, Montrose Park, and the National Zoological Park.

Montgomery County's Rock Creek Regional Park borders Rock Creek Park to the north. The regional park follows Rock Creek through southern Montgomery County and provides many recreational opportunities such as fishing, boating, canoeing, picnic shelters, a golf course, and trails.

**TABLE 18: GENERAL CHARACTERISTICS OF THE POPULATIONS OF WASHINGTON, D.C.
SURROUNDING ROCK CREEK PARK BY ZIP CODE TABULATION AREA ^{a/}**

Feature	Zip Code Tabulation Area ^{b/}									Total Dis- trict
	2007	2008	2009	2010	2011	2012	2015	20036	20037	
Population	28,818	26,195	46,561	28,772	57,444	13,604	15,824	3,808	12,642	572,059
Land area (acres) ^{c/}	2,145	1,895	865	996	3,110	1,630	2,151	201	470	39,303
Population density (residents per acre)	13	14	54	29	18	8	7	19	27	15
Average household size	1.86	1.61	1.81	2.59	2.50	2.32	2.29	1.31	1.37	2.16
Median household income	\$70,815	\$66,339	\$42,106	\$33,408	\$39,757	\$59,040	\$97,091	\$51,847	\$42,487	\$40,127
Age distribution										
Under 18 years	8%	9%	14%	22%	21%	18%	19%	2%	2%	20%
18-64 years	84%	78%	80%	70%	62%	65%	59%	91%	86%	68%
65+ years	8%	13%	7%	9%	17%	18%	22%	7%	13%	12%
Racial composition										
White	87%	84%	49%	23%	8%	16%	82%	82%	75%	31%
Black or African-American	4%	5%	32%	47%	80%	75%	10%	5%	12%	60%
Other	10%	10%	19%	30%	12%	9%	8%	13%	13%	9%
Also identified Latino heritage	5%	7%	20%	32%	14%	8%	5%	7%	13%	8%
Educational attainment										
Less than high school diploma	2%	4%	20%	41%	26%	14%	7%	2%	6%	22%
High school graduate (only)	5%	5%	11%	17%	27%	15%	10%	5%	5%	21%
College, 1-3 years	10%	10%	14%	16%	25%	22%	15%	9%	13%	18%
College, 4 or more years	83%	82%	56%	26%	22%	49%	69%	84%	76%	39%

TABLE 18: GENERAL CHARACTERISTICS OF THE POPULATIONS OF WASHINGTON, D.C. SURROUNDING ROCK CREEK PARK BY ZIP CODE TABULATION AREA (CONTINUED)

Feature	Zip Code Tabulation Area ^{b/}									Total District
	2007	2008	2009	2010	2011	2012	2015	20036	20037	
Housing unit occupancy										
Owner occupied (percent of occupied)	48%	38%	28%	32%	54%	67%	73%	35%	31%	41%
Renter occupied (percent of occupied)	52%	62%	72%	68%	46%	33%	27%	65%	70%	60%
Vacant (percent of total units)	5%	5%	7%	9%	7%	5%	2%	7%	11%	10%
Median gross rent	\$896	\$943	\$699	\$559	\$554	\$625	\$794	\$851	\$866	618
Median value of owner-occupied units	\$497,500	\$560,200	\$290,000	\$156,300	\$139,400	\$220,600	\$399,500	\$530,300	\$380,900	\$157,200
Unemployment rate	4%	1%	4%	6%	5%	4%	1%	2%	11%	7%
Families below poverty line in 1999	4%	3%	18%	19%	10%	5%	1%	2%	5%	17%
Individuals below poverty line in 1999	14%	6%	18%	22%	14%	9%	4%	10%	23%	20%
Commuting to work										
Car, truck, or van: drove alone	47%	34%	26%	30%	49%	51%	53%	16%	13%	38%
Car, truck, or van: carpooled	9%	6%	8%	14%	15%	12%	13%	2%	3%	11%
Public transportation (including taxi)	17%	44%	38%	47%	32%	26%	21%	30%	27%	33%
Walked	17%	8%	22%	6%	2%	6%	4%	43%	51%	12%
Other means	3%	1%	4%	3%	1%	1%	2%	3%	1%	2%

a/ All data are from the 2000 U.S. Census and are available at www.census.gov.

b/ Zip code tabulation areas aggregate census block data to the zip code level, and may not correspond exactly with postal zip codes.

c/ Land area data were obtained from the U.S. 2000 Gazetteer, available at www.census.gov.

TABLE 19: GENERAL CHARACTERISTICS OF THE POPULATIONS OF MARYLAND COMMUNITIES NEAR ROCK CREEK PARK BY ZIP CODE TABULATION AREA ^{a/}

Feature	Zip Code Tabulation Area ^{b/}			Montgomery County, MD
	20815	20910	20912	
Population	27,916	35,588	24,498	873,341
Land area (acres) ^{c/}	3,558	2,989	1,637	317,025
Population density (residents per acre)	8	12	15	3
Average household size	2.20	2.15	2.52	2.66
Median household income	\$ 95,511	\$50,552	\$44,572	\$ 71,551
Age distribution				
18 years and older (percent)	79%	81%	76%	75%
Under 18 years	21%	19%	24%	25%
18-64 years	58%	70%	68%	63%
65+ years	21%	11%	8%	11%
Racial composition				
White	89%	52%	43%	65%
Black or African-American	3%	32%	36%	15%
Other	8%	17%	22%	20%
Also identified Latino heritage	5%	14%	21%	12%
Educational attainment				
Less than high school diploma	3%	12%	18%	10%
High school graduate (only)	7%	13%	16%	15%
College, 1-3 years	12%	20%	21%	21%
College, 4 or more years	79%	56%	45%	55%
Housing unit occupancy				
Owner occupied (percent of occupied)	66%	36%	38%	69%
Renter occupied (percent of occupied)	34%	64%	62%	31%
Vacant (percent of total units)	4%	3%	4%	3%
Median gross rent	\$1,233	\$844	\$658	\$914
Median value of owner-occupied units	\$469,400	\$208,300	\$178,800	\$221,800
Unemployment rate	1%	2%	5%	2%
Families below the poverty line in 1999	2%	4%	10%	4%
Individuals below the poverty line in 1999	3%	7%	12%	5%
Commuting to work				
Car, truck, or van: drove alone	58%	54%	52%	69%
Car, truck, or van: carpooled	9%	9%	14%	11%
Public transportation (including taxi)	18%	29%	26%	13%
Walked	4%	3%	4%	2%
Other means	1%	1%	1%	1%

a/ All data are from the 2000 U.S. Census and are available at www.census.gov.

b/ Zip code tabulation areas were defined specifically for aggregating census block data to the zip code level.

c/ Land area data were obtained from the U.S. 2000 Gazetteer, available at www.census.gov.