



## Environmental Consequences

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## Chapter 4: Environmental Consequences

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### 4.1 Introduction

This Environmental Consequences chapter analyzes both beneficial and adverse impacts that would result from implementing any of the alternatives considered in this plan/EIS. This chapter also includes a summary of laws and policies relevant to each impact topic, definitions of impact thresholds (negligible, minor, moderate, and major), methods used to analyze impacts, and the analysis methods used for determining cumulative impacts. As required by the CEQ regulations implementing NEPA, a summary of the environmental consequences for each alternative is provided in Table 7, which can be found in Chapter 2: Alternatives. The resource topics presented in this chapter, and the organization of the topics, correspond to the resource discussions contained in Chapter 3: Affected Environment.

#### 4.1.1 Summary of Laws and Policies

There are four overarching environmental protection laws and implementing policies that guide the actions of the NPS in the management of the parks and their resources — the Organic Act of 1916, NEPA and its implementing regulations, the National Park Omnibus Management Act, and *NPS Management Policies 2006* (NPS 2005a). For a complete discussion of these and other guiding authorities, refer to the section titled “Related Laws, Policies, Plans, and Constraints” in Chapter 1: Purpose and Need for Action. These guiding authorities are briefly described below.

The Organic Act of 1916 (16 U.S.C. 1), as amended or supplemented, commits the NPS to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations.

The National Environmental Policy Act of 1969 is implemented through regulations of the Council on Environmental Quality (40 CFR Parts 1500–1508). The NPS has, in turn, adopted procedures to comply with these requirements, as found in DO #12 (NPS 2001) and its accompanying handbook.

The National Park Omnibus Management Act (16 U.S.C. 5901 et seq.) underscores the NEPA provisions in that both acts are fundamental to park management decisions. Both acts provide direction for connecting resource management decisions to the analysis of impacts and communicating the impacts of those decisions to the public, using appropriate technical and scientific information. Both acts also recognize that such data may not be readily available, and they provide options for resource impact analysis should this be the case. Section 4.5 of DO #12 adds to this guidance by stating, “when it is not possible to modify alternatives to eliminate an activity with unknown or uncertain potential impacts, and such information is essential to making a well-reasoned decision, the NPS will follow the provisions of the CEQ regulations (40 CFR 1502.22).” In summary, the NPS must state in an environmental assessment or impact statement (1) whether such information is incomplete or unavailable; (2) the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific adverse impacts that is relevant to evaluating the reasonably foreseeable significant

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*The analysis of impacts follows CEQ guidelines and Director's Order 12 procedures. It is based on the underlying goal of supporting forest regeneration and providing for long-term protection, conservation, and restoration of native species and cultural landscapes at Valley Forge NHP.*

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adverse impacts; and (4) an evaluation of such impacts based on theoretical approaches or research methods generally accepted in the scientific community. Collectively, these guiding regulations provide a framework and process for evaluating the impacts of the alternatives considered in this draft environmental impact statement.

## 4.2 Methodology for Assessing Impacts

The following elements are used in the general approach for establishing impact thresholds and measuring the effects of the alternatives on each resource category:

- general analysis methods as described in guiding regulations, including the context and duration of environmental effects
- basic assumptions used to formulate the specific methods used in this analysis
- thresholds used to define the level of impact resulting from each alternative
- methods used to evaluate the cumulative impacts of each alternative in combination with unrelated factors or actions affecting park resources
- methods and thresholds used to determine if impairment of specific resources would occur under any alternative

These elements are described in the following sections.

### 4.2.1 General Analysis Methods

The analysis of impacts follows CEQ guidelines and DO #12 procedures (NPS 2001) and is based on the underlying goal of supporting forest regeneration and providing for long-term protection, conservation, and restoration of native species and cultural landscapes at Valley Forge NHP. This analysis incorporates the best available scientific literature applicable to the region and setting, the species being evaluated, and the actions being considered in the alternatives.

As described in Chapter 1: Purpose and Need for Action, the NPS created an interdisciplinary science team to provide important input to the impact analysis. For each resource topic addressed in this chapter, the applicable analysis methods are discussed, including assumptions and impact intensity thresholds.

### 4.2.2 Assumptions

Several guiding assumptions were made to provide context for this analysis. These assumptions are described below.

#### Analysis Period

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Goals, objectives, and specific implementation actions needed to manage deer at Valley Forge NHP are established for the next 15 years; therefore, the analysis period used for assessing impacts is up to 15 years. The impact analysis for each alternative is based on the principles of adaptive management, which would allow the NPS to change management actions as new information emerges from monitoring the results of management actions and ongoing research throughout the life of this plan.

## Geographic Area Evaluated for Impacts (Area of Analysis)

The geographic study area (or area of analysis) for this plan includes all of Valley Forge NHP. The area of analysis for Socioeconomic Resources and Adjacent Lands was extended to include the estimated 1,325-foot area that was determined to contain portions of the deer population's home range. The specific area of analysis for each impact topic is defined at the beginning of each topic discussion.

## Duration and Type of Impacts

The following assumptions are used for all impact topics (the terms “impact” and “effect” are used interchangeably throughout this document):

- Short-term impacts — Impacts would last from a few days up to three years following an action.
- Long-term impacts — Impacts would last longer than three years, up to the life of the plan (approximately 15 years).
- Direct impacts — Impacts would occur as a direct result of deer management actions.
- Indirect impacts — Impacts would occur from deer management actions and would occur in the future or farther in distance from the action.

## Impact Thresholds

Determining impact thresholds is a key component in applying NPS *Management Policies 2006* and DO #12. These thresholds provide the reader with an idea of the intensity of a given impact on a specific topic. The impact threshold is determined primarily by comparing the effect to a relevant standard based on regulations, scientific literature and research, or best professional judgment. Because definitions of intensity vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this document. Intensity definitions are provided throughout the analysis for negligible, minor, moderate, and major impacts. In all cases the impact thresholds are defined for adverse impacts. Beneficial impacts are addressed qualitatively.

## Impact Analysis Related to CWD

Impacts are evaluated based on risk related to amplification and spread of CWD if it should occur within the park. The park is already at risk of high exposure to CWD. See Appendix C for a summary of the risk analysis.

### 4.2.3 Cumulative Impact Analysis Methodology

The CEQ regulations to implement NEPA require the assessment of cumulative impacts in the decision-making process for federal actions. Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions” (40 CFR 1508.7). As stated in the CEQ handbook, “Considering Cumulative Effects” (CEQ 1997), cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on effects that are truly meaningful. Cumulative impacts are considered for all alternatives, including Alternative A.

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects and plans at Valley Forge NHP and, if applicable, the surrounding area. Table 14 (located at the end of this chapter) summarizes these actions that could affect the various resources at the park, and those requiring additional explanation are discussed in the following narrative.

The analysis of cumulative impacts was accomplished using four steps:

Step 1 — Identify Resources Affected: fully identify resources affected by any of the alternatives.

Step 2 — Set Boundaries: identify an appropriate spatial and temporal boundary for each resource.

Step 3 — Identify Cumulative Action Scenario: determine which past, present, and reasonably foreseeable future actions to include with each resource.

Step 4 — Cumulative Impact Analysis: summarize impacts of these other actions (x) plus impacts of the proposed action (y), to arrive at the total cumulative impact (z).

### **Cumulative Impact Scenario**

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The following projects were determined to be potential contributors to cumulative impacts on the affected resources in conjunction with the potential impacts of the alternatives presented in this document.

#### ***Transportation Corridor Development, Redevelopment, and Maintenance***

- Traffic calming
- Close Gulph Road to public traffic
- Improvements to PA Route 23
- Metro transit improvements
- Pennsylvania Turnpike widening
- River Crossing Complex
- Transportation corridor maintenance
- New trail connections

As the suburban community that surrounds the park continues to grow, so will the volumes of vehicular traffic. A number of state roads running through the park are used by commuter traffic. To address the increasing traffic and minimize its impacts to the park, the NPS established plans in the park's GMP/EIS to work with local governments to develop *traffic calming* measures in the immediate area. Traffic calming includes reduced speed limits, signage and road surfaces that encourage slower speeds, and increased signage and signals to control traffic movements. Through-traffic on public roads (PA 23 and PA 252) would be calmed, in partnership with state and local government. Commuters would continue to be able to use PA 23 and PA 252. However, *Gulph Road would be closed* to private vehicles.

Efforts to control traffic outside of the park include **improvements to PA Route 23**. Improving the PA 23 corridor in Upper Merion Township has been a long-standing transportation objective for the township. The purpose is to improve access to river crossings; improve safety and level of service; minimize traffic impacts through residential neighborhoods on PA Route 23 and adjacent streets; support local and regional planning and economic development objectives; and integrate/improve access to nonvehicular modes of transportation, including bus and transit services, and pedestrian and bicycle networks.

Another transportation corridor development being considered is **improvements to the metro transit system**. The R-6 Extension public transportation project is proposed for the Schuylkill Valley corridor, extending between Reading and Norristown. The region within the corridor is one of the fastest growing areas in southeastern Pennsylvania. Its two principal highways, the Schuylkill Expressway (I-76) and the US 422 Expressway, as well as many arterial and secondary roads, are plagued by congestion. With the tremendous growth of jobs and population taking place in the corridor, land development is occurring rapidly, with commensurate loss of farmland and open space. Meanwhile, many of the older, formerly industrial towns in the corridor desire economic development. Existing public transportation consists of limited bus service, concentrated primarily toward the Reading and Philadelphia ends of the corridor, and commuter rail service between Philadelphia and Norristown and Philadelphia and Paoli that do not directly serve the newer centers of growth in the corridor.

The Pennsylvania Turnpike Commission proposes to **widen the Pennsylvania Turnpike**. The section of the turnpike adjacent to the park was built in the 1950s. Widening of the turnpike to six lanes between the Valley Forge and Downingtown interchanges would be accomplished in stages that would impact motorists and the turnpike's neighbors in different ways. Along with the expansion, the PA 29 "slip ramp" exit is a new Pennsylvania Turnpike interchange planned for construction in Chester County. Located midway between the Downingtown exit and the Valley Forge exit, the new facility would serve corporate centers and business parks along the Route 29 corridor – especially in the Great Valley area.

Four independent projects comprise the **River Crossing Complex**, to be developed in the vicinity of the US 422 crossing of the Schuylkill River, along the eastern edge of the park. The projects are the Betzwood Bridge replacement project, the US 422/PA 23 interchange with the North Gulph Road relocation (SR0422 SEC 2NG), the US 422/PA 363 interchange and US 422 widening from Trooper Road to US 202 (SR0422 SEC 4TR), including a new Schuylkill River bridge.

All the proposed improvements and developments would require regular **corridor maintenance**. Maintenance activities could include cleaning, repaving, mowing, and other actions to manage vegetation alongside or within the transportation corridor.

Within the park, the GMP/EIS laid out plans for a number of **new trail connections**. These connections would create a more fluid trail system within the park. They would also connect to regional trail systems, such as the future Chester Valley Trail. These actions were analyzed in greater detail in the Valley Forge NHP GMP/EIS (NPS 2007j).

These projects could potentially impact the following resources: vegetation and special status plant species; white-tailed deer population; other wildlife, wildlife habitat, and special status animal species; cultural landscapes; visitor use and experience;

socioeconomic resources and adjacent lands; and public safety. These actions were analyzed in greater detail in the Valley Forge NHP GMP/EIS (NPS 2007j).

### ***Changes in Air Quality***

Located within Chester and Montgomery counties, Valley Forge NHP sits within the EPA's Philadelphia-Wilmington-Trenton Severe Ozone Nonattainment Area. Air quality in the region has been affected by years of industrial pollution and commercial/residential development. Degraded air quality has adversely affected vegetation, wildlife, and human populations. In recent years, technological improvements have minimized further impacts to air quality. Although development inside and outside the park will continue, it is anticipated that air quality conditions will improve. These projections do not take into account climate change, which is discussed under Issues and Impact Topics Considered but Dismissed from Further Analysis in Chapter 1: Purpose and Need for Action. These changes have the potential to impact vegetation and special status plant species, cultural landscapes, and visitor use and experience.

### ***Natural Resource Management Activities***

- Fencing of rare plant species
- Fencing of riparian buffer areas
- Monitoring of forest plant communities
- Integrated Pest Management
- Reforestation of Waggoner and Fuller Fields
- Valley Creek Restoration Plan
- Agricultural leasing
- Field Management Plan

As noted in earlier chapters, the park's natural resource management has included the ***fencing of rare plant species*** and ***fencing of riparian buffer areas***. The park contains eight plant species that are considered special status species. These species are listed by the commonwealth of Pennsylvania as endangered, threatened, or rare or are proposed for listing in one of these categories. At least one state-listed endangered plant species, possumhaw viburnum (*Viburnum nudum*), has been fenced to prevent extirpation from the park. Other special status plant species may be fenced in the future based on the results of efforts to inventory and document the location of these species. To promote establishment of a healthy forested riparian buffer approximately three acres along Valley Creek was fenced between 2003 and 2004. Fencing is monitored and maintained on a regular basis.

Park staff has also conducted ***monitoring of forest plant communities***. Under Alternative A, vegetation monitoring, described in Appendix A of this document, would continue. This monitoring comprises 30 paired plots on Mount Misery and Mount Joy. Vegetation monitoring would continue to detect changes in the abundance and species composition of the forest understory plant community over time. As noted in Chapter 1, the NPS Mid-Atlantic I&M Network established an additional seven long-term forest monitoring plots in 2007, as part of its Vital Signs Monitoring Program. An additional 21 plots are scheduled to be evaluated in 2008-2011. Monitoring of the original 30 paired plots would continue at least until new plots have been established for a period of time that allows for some meaningful comparison of data between existing and new plots.



Park staff regularly implement *integrated pest management* activities to achieve park management goals and objectives. Integrated pest management is a resource management approach, which seeks to maximize the use of natural controls on vertebrate, arthropod, and vegetative pests while minimizing the use of short-term chemical treatments. Pests are living organisms that interfere with the purposes or management objectives of a specific site within a park, or that jeopardize human health or safety. At Valley Forge NHP, these species include both plants (e.g. nonnative invasive plant species) and animals (e.g. aggressive nonnative animals, stinging insects, mice in buildings). Integrated pest management is an approach to pest Management that employs physical, mechanical, cultural, biological, and educational tactics to keep pest numbers low enough to prevent intolerable damage or annoyance. Currently, 32 high priority invasive plant species and one high priority animal species are targeted through integrated pest management. The majority of integrated pest management activities targeting invasive nonnative plants are conducted in cooperation with the NPS Mid-Atlantic Exotic Pest Management Team who visits the park three to four times per year. Areas where these species have been treated (chemical and/or non-chemical treatment) has been limited in area (57 acres in 2008) and distribution due to lack of staff. An overall strategy for implementation of integrated pest management activities will be developed in 2009.

To support natural and cultural resource management objectives, the park's new GMP proposes the *reforestation of Waggonseiler and Fuller Fields* south of Route 422 (NPS 2007j). These former agricultural fields are currently transitioning into old growth forests. As funding becomes available, additional plantings would help improve available habitat on the north side of the park.

Along with natural resource management activities in the park, the NPS is also partnering with local groups on the *Valley Creek Restoration Plan*. Following the discovery of major PCB contamination of Valley Creek, the Valley Creek Trustee Council was formed to develop a plan for recovery of the creek's natural and recreational values. The plan calls for projects to promote infiltration of stormwater, stabilize stream channels, maintain greenways along the creeks in the watershed, increase access by anglers and other users of the watershed, and restore a population of brook trout in Crabby Creek. Grant money is available for projects in the watershed that meet these goals.

Agriculture has been a historic component of the Valley Forge landscape. This activity has been managed since 1976, through the NPS *Agricultural Leasing Program*. Agricultural activities occurred primarily in fields north of the Schuylkill River after the late-1980s. Due to high deer density within the park, the only crops grown for the last several years the leasing program was active were wheat and hay. During revision of the park *Field Management Plan* in 2009-10, the agricultural leasing program as a tool for field management will be re-evaluated.

These actions have the potential to impact vegetation and special status plant species; white-tailed deer population; other wildlife, wildlife habitat, and special status animal species; cultural landscapes; archeological resources; visitor use and experience; and socioeconomic resources and adjacent lands.

### **Cultural Resource Management Activities**

- Rehabilitate the cultural landscape
- Landscape plantings
- Preserve encampment-period earthworks
- Re-establish important viewsheds

The GMP/EIS preferred alternative included a number of actions to be taken to ***rehabilitate the cultural landscape*** within the park. In this alternative, two areas of great interpretive value, the interpretive focus zones of Muhlenberg's Brigade and the Grand Parade, are to be rehabilitated to their 18th century conditions as interpretive vignettes. Rehabilitation of the Grand Parade would include filling of the quarries that mar this essential cultural landscape at the heart of the park to their historic contour. Cave Quarry would not be filled, because it lies beyond the eastern edge of the Grand Parade and because it exhibits rare geologic features that are of educational interest. The rest of the park's historic landscape would be preserved as it is, and the park would be respected as a memorial landscape that has been commemorated in many ways over generations. The park would reflect and interpret the "layers" from all periods, including the encampment period, the 19th century agricultural and industrial period, and the 20th century state park commemorative period. A number of ***landscape plantings*** would be included as restoration of earlier commemorative groves or as vegetative screens. These actions were analyzed in greater detail in the Valley Forge NHP GMP/EIS (NPS 2007j).

The GMP/EIS also includes plans to ***preserve encampment-period earthworks*** and fortifications. Earthworks would be preserved from damage from tree roots and also from trampling by people and animals. Work along the earthworks and fortifications would also ***re-establish important viewsheds***. Historic views among Redoubts 1, 2, 3, 4, the Star Fort, and Stony Battery would be re-established so that visitors could better understand the strategic use of the terrain during the encampment. These actions were analyzed in greater detail in the Valley Forge NHP GMP/EIS (NPS 2007a).

These actions have the potential to impact vegetation and special status plant species; white-tailed deer population; other wildlife, wildlife habitat, and special status animal species; cultural landscapes; historic structures; archeological resources; and visitor use and experience.

### ***New Construction within the Park Boundary***

The GMP/EIS, and other park documents, have laid out plans for a number of new construction projects within the park. These projects included the removal of old parking lots and roads, the construction of new park roads, and the future renovation of existing buildings.

The GMP/EIS recommended the removal of six parking lots and their associated access roads. These removals were recommended based on the limited use of these parking lots. Once the parking lots are removed, the area that they occupied would be regraded and planted with native vegetation to allow the area to blend in to the surrounding landscape. The GMP/EIS also recommended the construction of three new parking lots that could better serve the public without adversely impacting the park resources or visitor experience.

The GMP/EIS also recommended the construction of a new connector road to link Inner Line Drive and Outer Line Drive. Like the new parking lots, this road was planned to provide better service to the public without adversely impacting park resources or the visitor experience.

Finally, the GMP/EIS and other park plans have called for the renovation of several buildings and structures throughout Valley Forge NHP. One project that is currently underway is at the Washington's Headquarters area. Renovations include changes to existing parking lots and pedestrian circulation, enhancing the cultural landscape through new plantings, rehabilitation of the train station and its platform; improving

utilities and amenities at the site, and the addition of interpretive elements. Other proposals call for similar improvements to be made at other sites. These actions were analyzed in greater detail in the Valley Forge NHP GMP/EIS (NPS 2007j) and individual Environmental Assessments.

A private developer has proposed to construct a museum, conference center, hotel, and other uses, on an inholding within the park's boundary.

These projects have the potential to impact vegetation and special status plant species, cultural landscapes, archeological resources, visitor use and experience, and park operations.

### ***Land Acquisition***

As funding and properties becomes available, the park would acquire remaining lands within the authorized boundary. These projects have the potential to impact vegetation and special status plant species; other wildlife, wildlife habitat, and special status animal species; cultural landscapes; archeological resources; visitor use and experience; socioeconomic resources and adjacent lands; and park operations. These actions were analyzed in greater detail in the Valley Forge NHP GMP/EIS (NPS 2007j).

### ***Utility Improvements***

Valley Forge NHP's location in a developed suburban environment provides it with access to modern utilities and other services. Many utility corridors run through the park and continued to be monitored and maintained by utility companies. Monitoring and maintenance include routine visits to the corridor for inspection and maintaining vegetation that grows over the utilities. These actions have the potential to impact special status species, and socioeconomic resources and adjacent lands.

### ***Hazardous Material Response***

- Asbestos Release Site (ARS)
- Hazardous waste site investigation/remediation

In January 1997, during the installation of a fiber optic cable in the Amphitheater Quarry of Valley Forge NHP, park staff discovered a suspicious substance in the soil, later confirmed to contain asbestos. At the request of the NPS, the EPA initiated an emergency response action in 1997 to abate the immediate risks to public health, welfare, and the environment posed by contaminated soils. The impacted area is referred to as the ***Valley Forge Asbestos Release Site***. Remediation of the site is expected to begin in 2009. This project could potentially impact the following resources: cultural landscapes, public safety, and park operations. These actions were analyzed in greater detail in the Valley Forge NHP GMP/EIS (NPS 2007j).

### ***Activity Outside of the Park Boundary***

- Development outside of the park boundary
- Legal hunting on adjacent properties

***Development outside the park boundary*** has included a great deal of residential and commercial development. In 1983, the area around the park still retained a rural character. Over the last 25 years, however, the region has rapidly grown into a developed suburban environment. Along with new homes, this growth has brought more roads, utilities, jobs, and other services to the region. This high level of growth has left the park as an island of undeveloped land in the region. This has forced many of the wildlife species that inhabit the region into the park. Species that are

able to adapt to and thrive in this environment, including the white-tailed deer, have flourished. As these species have grown in numbers, they have moved beyond the park boundary and reestablished themselves throughout the suburban environment.

**Legal hunting** is a common activity in Pennsylvania. To an extent, legal hunting has been used to keep the deer population in check. However, it has also pushed the deer into developed communities and the park, where hunting is not allowed. As the deer population has flourished in the developing suburban environment, local land owners have experienced increasing levels of property damage as a result of deer browsing. In an effort to reduce these impacts, many property owners have hired private firms who specialize in the lethal removal of deer. These firms are only able to operate on the given land owner's property and do not pursue deer onto adjoining properties, including the park. These constraints still allow several deer to be taken on any given property.

These developments have had and continue to have the potential to impact vegetation and special status plant species; white-tailed deer population; other wildlife, wildlife habitat, and special status animal species; cultural landscapes; visitor use and experience; and socioeconomic resources and adjacent lands.

#### ***Inappropriate Visitor Use***

- Accidental fires
- Illegal harvesting
- Social trails

Despite the wide range of opportunities the NPS offers visitors to Valley Forge NHP, some inappropriate visitor uses have occurred throughout the years. These inappropriate uses often result in damage to park resources. Unapproved camp fires or use of fireworks have resulted in a number of **accidental fires** over the years. In some cases, these fires are quickly contained and do not cause any damage. In other cases, the fires were not immediately reported and spread through minor portions of the park's meadows.

Other inappropriate uses have included the **illegal harvest** of rare plant and animal species. Although the park has not identified anyone who has illegally harvested species from the park, this is becoming a growing issue throughout the national park system. Resources that exist within the park have been known to be targeted by illegal harvest. Therefore, it is possible that these actions are already occurring or could occur in the near future.

A more noticeable and widespread inappropriate use is the development of **social trails** throughout the park. Social trails are unofficial paths that are created by continued foot or bicycle traffic. This traffic exists when visitors seek a shortcut or attempt to travel through portions of the park that are not meant to be accessible to the general public. This was analyzed in greater detail in the Valley Forge NHP GMP/EIS (NPS 2007j).

These actions have the potential to impact vegetation and special status plant species, cultural landscapes, historic structures, archeological resources, visitor use and experience, public safety, and park operations.

## Climate Change

While climate change is a global phenomenon, it manifests differently depending on regional and local factors. Pennsylvania's climate has already begun changing in noticeable ways. Over the past 100 years, annual average temperatures have increased by around 0.5°F and annual average rainfall has been steadily increasing in all regions but the central southern. Winters have warmed the most, and in many Pennsylvania cities the number of extremely hot (over 90°F) summer days has increased since the 1970s. Decreasing snow cover—a statewide trend—has accelerated its decline in the past few decades. These trends are expected to accelerate over the next several decades (2010–39) and it is considered unlikely that these changes will be significantly curbed by any reductions in emissions of heat-trapping gases undertaken in Pennsylvania and the rest of the world during that period, as these near-term changes have already been set in motion by emissions over the past few decades. Climate change is expected to affect vegetation and wildlife in Valley Forge NHP during the life of this plan and beyond; however, many of the specific effects, the rate of changes, and the severity of impacts are not known.

In the U.S. Northeast, climate change is not expected to cause a net loss of forested land, but it is projected to alter the character of the region's forests over the coming century (UCS and Ecological Society of America 2005). Some current forest types would give way to new forest types that will have combinations of species different from those we know today. In Pennsylvania, suitable forest habitat for maple, black cherry, hemlock, and others is expected to shift northward by as much as 500 miles by late century under a higher-emissions scenario. (UCS 2008). The extent to which each species can persist or migrate to more suitable locations will depend on a combination of factors, including competition from other species, rates of seed dispersal (trees rely on animals, wind, or water to disperse their seeds), suitability of soils, and the degree of stress caused by drought, warmer temperatures, invasive species, overgrazing, human development and changes in land use. Alternatively, the rising atmospheric carbon dioxide levels that drive global warming have the potential to benefit trees and other plants directly, possibly spurring greater growth and more efficient water use while also increasing plant demands for soil nutrients. In addition, global warming may indirectly add to the pressures and uncertainties facing the region's forests by changing the distribution of forest pests, pathogens, and invasive plant species, and potentially the frequency or intensity of ice storms, droughts, wildfires, and other major disturbances. Attempting to predict how such complex forests, affected by multiple forces, will respond to a changing climate is a challenging task. While trees can persist in areas where the climate is no longer well suited to their requirements, they may become less productive and more vulnerable to competition and other stresses, ultimately risking displacement by better-suited species.

Climate change would likely affect the park's wildlife populations, although as noted previously it is difficult to predict the rate and magnitude of change to specific wildlife populations. Resident mammal species such as white-tailed deer may benefit from climate change. Other species, such as wood tick (*Dermacentor variabilis*), wild turkey (*Meleagris gallopavo*), and flying squirrel (*Glaucomys* sp.), may extend their ranges and/or increase in numbers in the park. Longer mosquito and black fly seasons will also likely occur (NPS 2007b, 2007c; UCS and the Ecological Society of America 2005). Warming climate and shifting distributions and quality of forest habitat is expected to cause substantial changes in bird life. As many as half of the 120 bird species modeled in Pennsylvania could see at least 25-percent reductions in their suitable habitat. Species at greatest risk include the ruffed grouse, white-throated sparrow, magnolia warbler, and yellow-rumped warbler. For bird species that migrate to the Northeast from neotropical and temperate climate

zones, it is known that migration timing and ranges are changing due to climate change and that changes in climate are having significant effects on breeding and winter distribution of birds in North America. Some northern birds that are on the edge of their range in the park may disappear, while other birds may expand northward into the park. Food sources may be reduced for long-distance migratory birds such as warblers, thrushes, and flycatchers.

These actions have the potential to impact vegetation and special status plant species and other wildlife, wildlife habitat, and special status animal species.

### Cumulative Impact Contribution

In defining the contribution (i.e., incremental effect contributed) of each alternative to cumulative impacts, the following terminology is used.

**Negligible:** The incremental effect contributed by the alternative to the overall cumulative impact is such a small increment that it is impossible or extremely difficult to discern.

**Noticeable:** The incremental effect contributed by the alternative, while evident and observable, is still relatively small in proportion to the overall cumulative impact.

**Appreciable:** The incremental effect contributed by the alternative constitutes a large portion of the overall cumulative impact.

Because some of the actions described above are in the early planning stages, the evaluation of the cumulative impact is based on a general description of the project. The cumulative impact is considered for all alternatives and is presented at the end of each impact topic discussion.

#### 4.2.4 Impairment Analysis Methodology

NPS *Management Policies* 2006 requires analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system, established by the Organic Act (16 USC 1-4) and reaffirmed by the General Authorities Act of 1970, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. However, the laws do give the NPS the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values.

Although Congress has given the NPS the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the NPS must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values. An impact to any park resource or value may constitute an impairment, but an impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

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*The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values.*

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1. necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
2. key to the natural or cultural integrity of the park; or
3. identified as a goal in the park's GMP or other relevant NPS planning documents.

Impairment may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessionaires, contractors, and others operating in the park.

In this “Environmental Consequences” section, a determination of impairment is made in the Conclusion section of the impact analysis for each impact topic related to natural and cultural resources. The following process was used to determine whether the various deer management alternatives had the potential to impair park resources and values:

Step 1 — The enabling legislation, the park's GMP/EIS (NPS 2007j), its Strategic Plan (NPS 2000), and other relevant background information for Valley Forge NHP were reviewed to ascertain its purpose and significance, resource values, and resource management goals or desired conditions.

Step 2 — Resource management goals were identified.

Step 3 — Thresholds were established for each resource of concern to determine the context, intensity, and duration of impacts, as defined earlier in this chapter under “Impact Thresholds.”

Step 4 — An analysis was conducted to determine if the magnitude of impact would constitute an “impairment,” as defined by *NPS Management Policies 2006* (NPS 2005a).

Impairment determinations are not made for socioeconomic resources and adjacent lands, visitor use and experience, public safety, or park operations. The reason for this is that impairment findings relate back to park resources and values, and these impact topics are not generally considered to be park resources or values and according to the NPS Organic Act, cannot be impaired in the same way that an action can impair park resources and values.

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## 4.3 Impacts on Natural Resources

### 4.3.1 Impacts on Vegetation and Special Status Plant Species

Maps showing vegetation cover within Valley Forge NHP, communications with NPS staff, and past monitoring data were used to identify baseline conditions within the study area. Available information on the condition and composition of the vegetation in the park was compiled. The primary component of the forest that provides the best indicator of successful forest regeneration is the number of tree seedlings observed and their ability to reach heights above the average deer browsing height (60 inches). Thresholds identified for taking management action were based on recent research conducted at the park and in areas with similar habitat

conditions, as well as discussions with the science team. These thresholds are based on a certain number of seedlings per monitored plot to indicate the degree of regeneration. Therefore, the intensity level of impacts to vegetation was based on a similar scale, assuming that the moderate impact intensity would be aligned with the point where management action should be implemented to maintain or achieve good forest regeneration. Impact intensities for herbaceous vegetation were developed as a more qualitative definition, since quantitative herbaceous vegetation thresholds have yet to be determined.

The Endangered Species Act (16 U.S.C. 1531 et seq.) mandates that all federal agencies consider the potential effects of their actions on species listed as threatened or endangered. If the NPS determines that an action may adversely affect a federally listed species, consultation with the USFWS is required to ensure that the action will not jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat. No federally listed plant species occur in Valley Forge NHP, therefore, no consultation under Section 7 of the Endangered Species Act is required.

The NPS *Management Policies 2006* state that potential effects of agency actions will also be considered on state- or locally-listed species (NPS 2005a). The NPS is required to control access to important habitat for such species and to perpetuate the natural distribution and abundance of these species and the ecosystems upon which they depend. State-listed species of special concern occur in Valley Forge NHP and one of objectives of this plan/EIS is to protect and promote special status plant and animal species and their habitat. Therefore, an analysis of the potential impacts to state-listed plant species is included in this section.

Based on correspondence with the Pennsylvania Natural Heritage Program, inventory of field and forest plant communities, and input from park staff, eight state-listed (endangered, threatened, or rare) plant species of special concern are known to occur in the park (see Table 8). Based on reviews of park information on the effects of deer on these species and additional available local information on plant resistance or palatability, five of the listed plants have been identified as being highly susceptible to deer browse — broadleaf ironweed, possumhaw viburnum, sundial lupine, toothcup, and netted chainfern. Listed plants with low susceptibility to deer browsing include bushy bluestem, Elliott's broomsedge, and sand blackberry.

Available information on the condition and composition of the vegetation in the park and state-listed plant species was compiled and analyzed in relation to the management actions. The thresholds for the intensity of an impact are defined as follows:

### ***Impact Thresholds***

***Negligible*** A reduction in the abundance and diversity of native vegetation may occur, but any change would be so small that it would not be measurable.

Less than 10% of the unfenced forest monitoring plots would have fewer than 24 tree seedlings per plot. This tree seedling density would indicate that excellent regeneration was occurring.

Impacts to special status plants would result in no measurable or perceptible changes to a population or individuals of a special status species or its habitat.



**Minor**

A reduction in the abundance and diversity of native vegetation would occur and would be measurable, but would be limited and of little consequence to the viability of the native plant community.

From 10-30% of the unfenced forest monitoring plots would have fewer than 24 tree seedlings per plot. This seedling density would indicate that good regeneration was occurring.

Impacts to special status plants would result in measurable or perceptible changes to individuals of a species, a population, or its habitat, but would be localized within a relatively small area. The overall viability of the species would not be affected. Mitigation measures, if needed to offset adverse impacts, would be simple and very likely successful.

**Moderate**

Some reduction in the abundance and diversity of native vegetation would occur, and it would be measurable, but would result in a small-scale consequence to the viability of the native plant community.

From 31% to 69% of the unfenced forest monitoring plots would have fewer than 24 tree seedlings per plot. This seedling density would indicate that fair to poor seedling generation was occurring.

Impacts to special status plant species would result in measurable and or consequential changes to individuals of a species, a population, or its habitat; however, the impact would remain relatively localized. The viability of the species could be affected, but the species would not be permanently lost. Mitigation measures, if needed to offset adverse impacts, would be extensive and likely successful.

**Major**

A noticeable reduction in the abundance and diversity of native vegetation would occur. The change would be measurable and of widespread consequence to the viability of the native plant community.

70% or more of the unfenced forest monitoring plots would have fewer than 24 tree seedlings per plot. This seedling density would indicate that little to no regeneration was occurring.

Impacts to special status plant species would result in measurable and/or consequential changes to a large number of individuals of a species or a population or a large area of its habitat. These changes would be substantial, highly noticeable, and permanent, resulting in a loss of species viability and potential extirpation from the park. Extensive mitigation measures would be needed to offset any adverse impacts, and their success would not be guaranteed.

## Area of Analysis

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The area of analysis for assessing impacts on vegetation (including special status plant species) encompasses all of Valley Forge NHP. The area of analysis for cumulative impacts is contained within the park boundary as well.

## Impacts of Alternative A

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### *Impact Analysis*

Under Alternative A, park staff would continue monitoring the deer population and vegetation. In addition, park staff would also continue to fence special status species and other sensitive areas. Coordination with the PGC and limited CWD surveillance would continue. Fencing of vegetation would occur in association with vegetation monitoring (e.g. fenced monitoring plots) and protection of special status species and other sensitive vegetation. As described in Chapter 3: Affected Environment, the park has been monitoring forest plant communities in fenced and unfenced plots within the park for over 15 years. Under Alternative A, this monitoring would continue with additional monitoring being performed by the NPS I&M Program within forest areas parkwide.

Within fenced areas, the typical native woody and herbaceous species expected for each forest association would be present, however the area currently encompassed by fencing (3.1 acres parkwide) is not considered sufficient to contribute appreciably to forest regeneration. Additionally, it is not expected that the area fenced for the purposes of vegetation monitoring or protection of special status plant species will increase significantly over time. Protected special status plant species would continue to exist within the park but many would continue to be limited in distribution to fenced areas only. Particularly for special status plant species, a severely limited distribution (in some cases only one location) places these plants at high risk of extirpation due to catastrophic events, pests and disease, and other factors such as climate change. However, because these species would continue to be present, fencing would have an overall long-term beneficial impact on the plants within areas that were fenced, although this impact would be highly localized.

Long-term monitoring of forest plant communities indicates that outside the fenced plots, the majority of native woody species expected for each forest association would be absent. No tree seedlings above 50 centimeters in height (except for nonnative species) would be present and the forest shrub layer would be largely absent or sparse (Diefenbach, Vreeland, and Heister 2008; Heister, Fairchild, and Faulds 2002). Based on the past history of monitoring, and the lack of any action taken to control the deer population, it is expected that under Alternative A, no forest regeneration would occur within the life of this plan. Across Pennsylvania, abundant deer populations have impeded the establishment and growth of sufficient tree seedlings to regenerate forests and researchers describe the regeneration problem as “ubiquitous rather than specific to a particular region, owner, or forest type.” In 2004, it was estimated that only 50-65% of plots sampled across the state exhibited adequate tree-seedling and sapling regeneration under high and moderate deer population pressure (McWilliams et al. 2004; Marquis 1992; Horsely and Marquis 1983; Tilghman 1989). Ultimately, as trees die they would not be replaced leading to a shift in the total forested area of the park or they would be replaced by nonnative or less preferred browse species leading to a potentially undesirable shift in species composition within the forest canopy and subcanopy.

The impacts to herbaceous vegetation outside fenced areas would be similar to those described for woody vegetation because no action would be taken to control deer numbers and reduce browsing pressure. Unfenced monitoring plots in the park’s forests have shown that deer browsing has already caused noticeable changes to herbaceous vegetation, including the elimination of certain plant species, decreased native plant species abundance and diversity, and increased nonnative plant cover (Heister, Fairchild, and Faulds 2002). In many areas of Pennsylvania, selective browsing by deer has shifted ground-flora composition toward grasses and sedges and caused a decline in the number

of species present (Marquis 1992; Horsely and Marquis 1983; Tilghman 1989). For example, between 1929 and 1995, the number of shrub and herbaceous species in monitoring plots within a heavily browsed forest in northwestern Pennsylvania declined 59-80% (Rooney and Dress 1997). Within the majority of park forests, the herbaceous understory would continue to be largely absent and/or dominated by nonnative plants. Although formal studies on the park's grasslands have yet to be completed, deer are not known to have a significant impact on grasses (native or nonnative). However, native meadow flowers and other nectar plants, that represent a critical habitat component for wildlife such as insects (e.g., butterflies), would be expected to be present at low densities and with relatively low diversity due to selective browsing by deer.

Vegetative resources contained within the forest understory (trees, shrubs, ground cover, native versus nonnative species) represent key a component in determining habitat quality for deer and other wildlife species. The absence of regeneration, removal of the shrub and herbaceous layers, and shift from native to nonnative plant species within the majority of park forests would continue to reduce the quality and quantity of habitat available to wildlife. Vegetation outside fenced areas would provide low quality (less nutritious) forage, a reduced amount of forage, few nesting sites for ground and shrub nesting species, reduced availability of wildlife cover, and increased competition for those resources that are available (e.g., acorns and other mast and fruits) (Latham et al. 2005). Based on these results, Alternative A would have a long-term, major, adverse impact on woody and herbaceous vegetation and vegetative components of deer and wildlife habitat.

The majority of the park vegetation, which is unfenced, would continue to experience high browsing pressure. As a result, forests would fail to regenerate, the abundance and diversity of native herbaceous vegetation would continue to decline, cover of nonnative plant species would continue to increase, and the quality and quantity of available vegetative resources (forage) for deer and other wildlife would remain degraded (Latham et al. 2005; Heister, Fairchild, and Faulds 2002). These impacts may be particularly significant relative to special status plant species in unfenced areas. Browsing impacts to those sensitive species palatable or preferred by deer could result in extirpation of the species from the park, reduction in abundance (# of individuals in a population), and/or loss of plant vigor. Based on these impacts and because no measures would be taken to limit or control deer population size or growth, Alternative A would have a long-term, major, adverse impact on woody and herbaceous vegetation and vegetative components of wildlife habitat.

No impacts to vegetation would be expected to result from continuation of opportunistic CWD surveillance or initiation of targeted and/or enhanced targeted surveillance. Targeted and enhanced targeted surveillance would require that deer exhibiting clinical signs of CWD be removed from the population. It is unknown how many deer would be removed but there is the potential for population level impacts from this disease (see Appendix C). Due to the potential for reduced browsing pressure associated with removal of CWD-positive deer, these actions would have a long-term, beneficial impact on park vegetation. These actions were categorically excluded through a separate NEPA process in 2007.

No impacts to vegetation would be expected to result from other actions described under Alternative A.

The overall impact of Alternative A on vegetation would be long-term, major, and adverse.

### ***Cumulative Impacts***

Several past, present, and reasonably foreseeable future actions would contribute to the cumulative impact on vegetation at Valley Forge NHP, including transportation corridor development, changes in air quality, natural resource management activities, new construction in the park, land acquisition, hazardous material response, development activity outside the park boundary, and inappropriate visitor use.

Previous transportation corridor development has altered the composition of vegetation in and around Valley Forge NHP. These developments resulted in the removal of a number of different woody and herbaceous species from various sites. The development of these transportation corridors also enhanced the probability of invasive species introduction and spread through the region. Currently, vegetation is impacted through routine maintenance, which includes mowing, pruning, and removal of dead species. Management actions also include the removal of invasive species that take root or extend into the transportation corridor right-of-way. Most of the future developments would occur within the right-of-way of the existing transportation corridors. This would avoid impacts to undisturbed sites but could continue the spread of invasive species. These invasive species would continue to be managed through maintenance activities. These developments would result in a long-term, minor, adverse impact.

Over the last twenty years, the entire Philadelphia region, including Valley Forge NHP, has experienced changes in air quality. Both Chester and Montgomery counties have been identified by the EPA as non-attainment areas for one-hour and eight-hour concentrations of ozone. These counties are within attainment for other criteria pollutants. Valley Forge NHP was determined to be at high risk for foliar injury to vegetation from high ozone levels. An estimated 17 plant species sensitive to ozone have been identified at the park. High ozone levels can result in a 1-2% reduction in growth. Ambient concentrations of ozone within the park have far exceeded this threshold for at least 10 years (Comiskey 2005). Improvements in air quality standards and pollution prevention technology have recently been improving the trend in air quality and, over time, this should improve air quality throughout the region. The result of these actions would be a long-term beneficial impact.

Natural resource management activities within the park also have had and should continue to impact vegetation. Past and present actions include fencing of rare plant species and riparian areas, monitoring forest plant communities, and implementing field management plan and integrated pest management. These actions preserve naturally occurring native species and promote healthy plant and animal communities, and improve the NPS's knowledge of the natural communities. In the future, the park plans to continue these actions with an increased focus on invasive plant species management. The park also plans to reforest Waggoners and Fuller Fields and participate in the Valley Creek Restoration Plan. These actions would all have long-term beneficial impacts on vegetation. However, as long as the deer population density remained high it would be difficult for native plants to become reestablished. This would seriously impact the potential effectiveness of many of the natural resource management actions.

Along with these natural resource management activities, the park also has conducted a number of new construction projects in the park. These projects have resulted in small changes to vegetation, as new impervious surface is created and old surfaces are removed. Areas that are cleared of impervious surface have been replanted with native vegetation. Additional development projects are expected to continue in the future. Based on the net gain in vegetated areas, these projects would have long-term beneficial impact to vegetation.

The park's past and future land acquisitions also have resulted in impacts to vegetation. Activity outside the park boundary has included rapid population growth and development around the park which has led to reduction of a vegetative cover, reduced diversity of native plant species, and spread of nonnative, invasive plant species. By acquiring land within its legislative boundary, Valley Forge NHP prevented the additional loss of vegetative cover and native plant species. Future land acquisition would provide similar protection. The result of these actions would be long-term and beneficial.

Hazardous material response would result in future impacts on vegetation. Remediation of asbestos within the park proposes excavation of "hot spots" and/or application of fill to those areas. Excavation and fill activities would result in the displacement and/or loss of vegetation. Upon completion of these actions, new vegetation would be planted. However, given the disturbed nature of these sites, it is possible that invasive species could take root. Natural resource management efforts would include monitoring and managing these areas. The overall impact would be long-term, minor, and adverse.

As described above, climate change is expected to affect the composition of the park's forests over time. Tree species distribution is likely to change, with some tree species expanding into the park, while other tree species may decline or disappear. Climate change may also increase stress on tree species and forest ecosystems through weather extremes, which may leave them more vulnerable to pressure from pests, invasive species, and overbrowsing by deer. Although the changes due to climate change are unpredictable, both in their timing (whether they occur within the timeframe of this plan or beyond) and in magnitude or intensity of the impact — the impacts of climate change on park forests and other vegetation could range from minor to major in intensity. When added to the impacts of the no action alternative, the cumulative impacts would be long-term, adverse and would likely range from moderate to major in intensity. This cumulative impact would result from continued heavy grazing and loss of forest regeneration under the no action alternative, which would likely make the forests more vulnerable and less able to adapt to the environmental changes occurring as a result of climate change.

Finally, inappropriate visitor use has resulted in impacts to park vegetation. These uses have resulted in accidental fires and trampling of ground cover. Accidental fires have resulted in the clearing of small amounts of vegetation. Although fire is a natural process in a forest environment, the lack of native species in the park has opened these areas to the spread of invasive species. The trampling associated with social trails not only leads to loss of plant cover directly but also indirectly by causing soil compaction which prohibits the re-establishment of vegetation. Social trails also serve as a primary vector for the spread of nonnative plant species, allowing them to be introduced into and spread within areas where they were previously absent. These actions result in a long-term, minor to moderate, adverse impact.

These projects, along with the impacts of Alternative A, would result in a long-term, major, adverse cumulative impact on vegetation at Valley Forge NHP. Alternative A would contribute an appreciable adverse increment to the overall cumulative impact.

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## **Impacts of Alternative B**

### ***Impact Analysis***

Actions described under Alternative A would continue under Alternative B. In addition, under this alternative, several nonlethal actions would be implemented in

combination to protect forest resources and gradually reduce deer numbers in the park. These actions include the use of rotational fencing and reproductive control of does when an acceptable chemical reproductive control agent is available and feasible. Expanded CWD surveillance (live test and cull) and increased coordination with the PGC also would be implemented if a confirmed case of CWD was documented within five miles of the park boundary (assumed to be in park at this point) or the park falls within a state-established CWD containment zone.

Fencing of vegetation would occur in association with small scale-fencing and vegetation monitoring as described under Alternative A, with the addition of rotational fencing under Alternative B. Rotational fencing would include 9-15 fenced areas, each covering between 10 and 20 forested acres, and would be implemented parkwide. Fencing would be rotated when vegetation monitoring revealed an acceptable level of forest regeneration (i.e., every 10-15 years). Constructing, maintaining, and monitoring the 9-15 fenced areas would have some impact to the vegetation within the park due to the trampling of small tree seedlings, shrubs, and herbaceous vegetation, as well as the removal of existing woody vegetation for fence construction even though fences would be located to avoid most trees. In addition, tree branches within 5 feet of either side of the fence would be removed to avoid damaging the fence during high winds or from existing dead branches falling on the fence. This would minimize future maintenance requirements. The area impacted during construction would be about 172 acres (4.9%) of the park ( $46,700 \text{ linear feet/fenced area} \times 15 \text{ areas} \times 10\text{-foot-wide cleared area} = 7,500,000 \text{ square feet or } 172.18 \text{ acres}$ ). Trampling during fence construction and removal of deer from within fenced areas would have short-term, negligible, adverse impact, as construction would average only a few weeks every 10-15 years. Given the small size of the impacted area in relation to the size of the park (about 3,450 acres), and the limited nature of the action, the impact of fence construction and maintenance would be long-term, negligible and adverse.

Fencing would eliminate deer and deer browsing activities within fenced areas, which at any given time would protect a total of 140-210 forest acres or about 10-15% of the park's forested area (4-6% of the park's total area). Based on long-term vegetation monitoring within the park, it is expected that the typical native woody and herbaceous species expected for each forest association would be present, protected special status plant species would continue to exist and possibly expand, and forests would regenerate within fenced areas. Abundance of nonnative, invasive plant species within fenced areas would be expected to decrease and severe infestations would be removed through integrated pest management activities to promote the growth of native species and forest regeneration. By meeting the park's regeneration goal (NPS 2007i) within fenced areas, this action would have a long-term, beneficial impact on 10-15% of the forested area of the park after 15 years (the life of the plan). Impacts of fencing on herbaceous vegetation and shrubs within park forests would be similar to those described above but the benefit would be short-term. Without reduction of the deer population, once fencing is rotated, it is expected that browsing would once again significantly reduce the abundance and diversity of species in areas that were previously fenced. Therefore, under Alternative B, fencing would have a short-term beneficial impact on shrubs and herbaceous species within fenced areas and a long-term beneficial impact on tree species within fenced areas. These benefits are offset by the adverse impacts to vegetation outside fenced areas.

Long-term monitoring of forest plant communities indicates that outside fenced areas, the majority of native woody and herbaceous species expected for each forest association would be absent. No tree seedlings above 50 centimeters in height (except for nonnative species) would be present and the forest shrub layer would be largely absent or sparse (Diefenbach, Vreeland, and Heister 2008; Latham et al. 2005; Heister, Fairchild, Faulds 2002). Browsing impacts to those sensitive species palatable or preferred by deer could result in extirpation of the species from the park, reduction in abundance (# of individuals in a population), and/or loss of plant vigor. Based on the past history of monitoring, and the lack of any action taken to control the deer population, it is expected that under Alternative B, no forest regeneration would occur outside fenced areas within the life of this plan and that monitoring over the life of the plan would continue to show that more than 70% of the unfenced plots would have less than 24 seedlings per plot. Abundance of nonnative, invasive plant species would continue to increase. Ultimately, as trees die they would not be replaced leading to a shift in the total forested area of the park or they would be replaced by nonnative or less preferred browse species resulting in a potentially undesirable shift in species composition within the forest canopy and subcanopy.

Additionally, fencing would exclude deer from accessing food resources within 10%-15% of the forested area of the park. Therefore, browsing pressure in forested areas outside fencing may increase significantly under this alternative. Use of park meadows/grasslands may also increase due to the reduction of available forest resources. Although formal studies on the park's grasslands have yet to be completed, deer are not known to have a significant impact on grasses (native or nonnative). However, native meadow flowers and other nectar plants, that represent a critical habitat component for wildlife such as insects (e.g., butterflies), would be expected to be present at low densities and with relatively low diversity due to selective browsing by deer. The overall impact of rotational fencing on the majority of park vegetation, including vegetation within fenced areas once fencing is removed and meadows/grasslands, would continue to be long-term, major, and adverse.

For the purposes of this analysis, it is assumed that an acceptable chemical reproductive control agent would be available and feasible during the life of this plan as described in Chapter 2. Implementation of reproductive control would include the use of bait to concentrate deer in certain locations so that the darting could be done as efficiently as possible and as many deer as possible would be treated daily until 90% of the does had been treated. Bait would be placed on the ground, is expected to cover a very small area at any one time but distributed parkwide and be immediately removed. Concentration of deer in these areas may cause localized trampling of vegetation and a temporary increase in browsing pressure. Overall, parkwide impacts to vegetation in the areas around the bait would be short-term, negligible, and adverse, lasting only a few hours to a few days in any location.

The effect of reproductive control on the deer population, and thus deer browsing, could be beneficial to park vegetation if the target deer density could be achieved within the life of this plan. Researchers disagree on the amount of time needed to reduce a population size using reproductive controls (Hobbs, Bowden, and Baker 2000; Nielsen, Porter, and Underwood 1997; Rudolph, Porter, and Underwood 2000). The actual amount of time needed to observe a decrease would depend on a number of factors, such as the type of treatment, its effectiveness in stopping reproduction, the size of the population at the time of initial treatment, the actual mortality rate, and the percentage of the population that was treated. Other factors such as untreated deer moving into the park and treated deer leaving the park would also influence the time required to achieve reduced numbers. As described in

Chapter 2, the population model developed for the park in 2008 estimates that the time required for the population to be reduced to the deer density goal would be approximately 18-19 years, beyond the life of this plan. Therefore, unfenced vegetation in forested areas and meadows would continue to experience high browsing pressure. Impacts to vegetation would be the same as described above related to unfenced areas of the park and would be long-term, major, and adverse.

Under Alternative B, in unfenced areas of the park, the absence of tree regeneration, removal of the shrub and herbaceous layers, and a shift from native to nonnative plant species within the majority of park forests as well as the loss of nectar plants in meadows would continue to reduce the quality and quantity of habitat available to wildlife. Impacts to vegetative components of wildlife habitat would be the same as those described under Alternative A (long-term, major, and adverse).

Impacts associated with opportunistic, targeted, and enhanced targeted CWD surveillance would be the same as described under Alternative A (long-term and beneficial). If CWD was detected within five miles of the park boundary or the park falls within a state-established CWD containment zone, the park would implement CWD testing and removal of CWD-positive deer in addition to CWD surveillance activities described under Alternative A. Initial treatment of deer with a reproductive control agent, under Alternative B in the plan/EIS, requires capture for the purpose of marking individuals as “treated”. During initial treatment with a reproductive control agent, CWD samples would be collected for testing via tonsillar biopsy. CWD-positive animals would be removed from the population by qualified federal or state employees or contractors. The number of animals to be tested annually would be expected to be the same as the number initially treated with a reproductive control agent under Alternative B in the plan/EIS and the number removed would depend on the prevalence of the disease. Therefore, it is unknown how many deer would be removed but there is the potential for population level impacts from this disease (see Appendix C). Due to the potential for reduced browsing pressure associated with removal of CWD-positive deer, these actions would have a long-term beneficial impact on park vegetation.

The overall impact of Alternative B on vegetation would be long-term, major, and adverse.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on vegetation would be the same as those described under Alternative A. One slight difference would be under climate change. As previously described, climate change is expected to affect the composition of the park’s forests over time, as tree species expand into the park, change distribution, or decline, and increased environmental stress from climate change may leave tree species and forest ecosystems more vulnerable to other stressors, including overgrazing by deer. Although unpredictable, it is likely that the impacts of climate change on park forests and other vegetation would be long-term, adverse and range from minor to major in intensity. When added to the impacts of Alternative B, the overall cumulative impacts would be long-term, adverse and would likely range from moderate to major in intensity. Since Alternative B would not reduce deer browsing quickly, the adverse cumulative impacts would result from continued heavy grazing and loss of forest regeneration, which would likely make the forests more vulnerable and less able to adapt to the environmental changes occurring as a result of climate change.



These projects, along with Alternative B would result in a long-term, major, adverse cumulative impact on vegetation. Alternative B would contribute an appreciable, adverse increment to the overall cumulative impact.

## Impacts of Alternative C

### ***Impact Analysis***

Actions described under Alternative A would continue under Alternative C including opportunistic, targeted, and/or enhanced targeted CWD surveillance. In addition, under this alternative, the deer population would be reduced and maintained at the deer density goal through lethal reduction methods. If a confirmed case of CWD was documented within five miles of the park boundary or the park falls within a state-established CWD containment zone, active lethal CWD surveillance would be implemented within the park and closely coordinated with the PGC. Impacts associated with small-scale fencing related to forest vegetation monitoring and protection of special status plant species and other sensitive vegetation would be the same as described under Alternative A (long-term and beneficial).

Deer reduction and population maintenance would occur through the use of sharpshooting and capture and euthanasia. Use of bait, tree stands, and vehicles for conducting sharpshooting activities, occupying shooting areas, and dragging deer to locations for transport may result in trampling of vegetation, clearing of small branches, or temporary, non-invasive (no nails or screws) attachment of structures to trees. However, the area of impact would be very small (<1% of park vegetation). Impacts to vegetation are expected to be short-term, negligible, and adverse as tree stands will be installed and removed and vehicles will be used off-road only occur periodically as activities move around the park.

Actions related to the capture and euthanasia of deer, which would generally be used in circumstances where sharpshooting would not be appropriate, would be similar to those described for sharpshooting. Limited trampling would occur while traps were set (rather than bait stations), resulting in a short-term, negligible, adverse impact.

Under this alternative, it is expected that the park would achieve the target deer density within four years. Reduction in deer density from 193 deer per square mile to 31-35 deer per square mile would significantly reduce browsing pressure parkwide. Impacts associated with this action would be the same as described under Alternative B for fenced areas of the park but at a much larger scale (parkwide versus only within fenced areas). Long-term monitoring of park forests indicates the typical native woody and herbaceous species expected for each forest association would be present and forests would successfully regenerate parkwide. The closer the deer density got to 31-35 deer per square mile, the higher the chance of achieving successful forest regeneration (Horsley and Marquis 1983; Stout 1999; Marquis, Auchmoody, and Walters 1994). After approximately 10-15 years, monitoring would show that less than 70% of the plots would have fewer than 24 tree seedlings per plot. By meeting the park's regeneration goal (NPS 2007i), this action would have a long-term beneficial impact on 100% of the forested area of the park after 15 years (the life of the plan).

Impacts of reduced browsing on herbaceous vegetation and shrubs within park forests would be similar to those described under Alternative B for fenced areas. The diversity and abundance of shrubs and herbaceous plant species would increase and the cover of nonnative, invasive plant species would decrease parkwide. Severe

infestations of nonnative plants would also be addressed through integrated pest management activities to promote the growth of native species and forest regeneration. Special status plant species would continue to exist within the park, would increase in abundance, and would expand their distribution to suitable habitats parkwide. An increase in abundance and expanded distribution of special status plant species would significantly reduce the long-term risk of extirpation from catastrophic events, pests and disease, and other factors. This would result in a long-term beneficial impact to vegetation.

Under Alternative C, successful forest regeneration, re-establishment of shrub and herbaceous plant communities within forests, increased cover of native plant species (reduction in cover of nonnative plant species) and growth of nectar plants in meadows would significantly improve the quality and quantity of habitat available to wildlife. Increased plant biomass (associated with restoration of native plant communities) would provide high quality (highly nutritious) forage, an increased amount of forage, provide nesting sites for ground and shrub nesting species, increased availability of wildlife cover, and reduced competition for available resources (Latham et al. 2005). Based on these results, Alternative C would have a long-term beneficial impact on vegetative components of deer and wildlife habitat.

Impacts associated with opportunistic, targeted, and enhanced targeted CWD surveillance would be the same as described under Alternative A (long-term and beneficial). If CWD was detected within five miles of the park boundary or the park falls within a state-established CWD containment zone, the park would implement active lethal surveillance activities to more effectively detect and monitor CWD. These activities would be closely coordinated with the PGC. Active lethal surveillance would include a rapid reduction to the target deer density and possibly implementation of a one-time action to further reduce deer density to not less than 10 deer per square mile. Rapid reduction would be carried out through sharpshooting and capture and euthanasia and would be expected to achieve the target deer density in approximately one-half the time described above for sharpshooting. Reduction of the deer population to at or below the deer density goal for the purposes of disease detection and monitoring would have the same impacts on vegetation described above.

Overall, impacts to vegetation resulting from activities associated with CWD detection and monitoring would be long-term and beneficial.

The overall impact of Alternative C on vegetation would be long-term and beneficial.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to vegetation would be the same as those described under Alternative A. One slight difference would be under climate change. As previously described, climate change is expected to affect the composition of the park's forests over time, as tree species expand into the park, change distribution, or decline, and increased environmental stress from climate change may leave tree species and forest ecosystems more vulnerable to other stressors, including overgrazing by deer. Although unpredictable, it is likely that the impacts of climate change on park forests and other vegetation would be long-term, adverse and range from minor to major in intensity. When added to the impacts of Alternative C, the overall cumulative impacts would likely remain long-term and adverse. However, Alternative C would reduce deer browsing pressure quickly and maintain the deer population at a level that would sustain forest regeneration. The reduction in deer

browsing pressure may help offset some of the adverse effects of climate change by increasing the overall ability of the forest ecosystem to respond and adapt to changing environmental conditions.

These projects, along with Alternative C would result in a long-term beneficial cumulative impact on vegetation. Alternative C would contribute a beneficial increment to the overall cumulative impact.

## **Impacts of Alternative D**

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### ***Impact Analysis***

Actions described under Alternative A would continue under Alternative D. In addition, lethal reduction methods would be implemented to reduce the size of the deer population to the target deer density of 31-35 deer per square mile as described under Alternative C. Once the density goal was obtained, reproductive control would be used to maintain the deer population at the reduced level as described under Alternative B. If an acceptable chemical reproductive control agent was unavailable, infeasible, or ineffective then lethal reduction methods (sharpshooting and capture and euthanasia) would be used for deer population maintenance. If a confirmed case of CWD was documented within five miles of the park boundary or the park falls within a state-established CWD containment zone expanded CWD surveillance and monitoring would be implemented and closely coordinated with the PGC as described under Alternative C.

As described under Alternative C above, reduction in deer population size would significantly reduce browse pressure on plant communities parkwide. These actions would have a long-term beneficial impact on park vegetation, including forest regeneration, abundance and diversity of native woody and herbaceous species within forested communities, abundance and diversity of plant species in meadows, special status species, and vegetative elements of wildlife habitat.

Impacts associated with opportunistic, targeted, and enhanced targeted CWD surveillance would be the same as described under Alternative A (long-term and beneficial). Impacts associated with implementation of active lethal surveillance would be the same as described under Alternative C (long-term and beneficial).

The overall impact of Alternative D on vegetation would be long-term and beneficial.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to vegetation would be the same as those described under Alternative A. These projects, along with Alternative D would result in a long-term beneficial cumulative impact on vegetation. Alternative D would contribute a beneficial increment to the overall cumulative impact.

## **Conclusion**

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The overall impact to vegetation under Alternatives A and B would be long-term, major, and adverse because browsing pressure would remain high in either all or a major portion of the park throughout the life of this plan (15 years). For both alternatives, the overall cumulative impact would be long-term, major, and adverse. Alternatives A and B would contribute appreciable adverse increments to the cumulative impact on vegetation. Although there would be a major adverse impact

within the life of the plan to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, and (3) identified in relevant NPS planning documents as being of significance, there would be no impairment of park resources or values related to vegetation. As noted in Section 4.3 Impairment Analysis Method, the impairment of vegetation within Valley Forge NHP may result from the continued heavy browsing by deer beyond the life of this plan. The natural abundance, diversity, dynamics, and distribution of native plants and animals are key to a healthy ecological system and important to supporting the park's mission. Monitoring and research have shown a direct link between the deer population and the lack of forest structure, absence of native plant species, and spread of invasive plants. With little to no active management proposed under Alternative A, the deer population may continue to grow or stabilize at a high density, adversely impacting and possibly impairing vegetative resources in and around the park. Under Alternative B, the deer population would not be reduced to the deer density goal within the life of the plan, adversely impacting and possibly impairing vegetative resources in and around the park.

The overall impact to vegetation under Alternatives C and D would be long-term and beneficial. For both alternatives, the overall cumulative impact would be long-term and beneficial. Alternatives C and D would contribute beneficial increments to the cumulative impact on vegetation. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, and (3) identified in relevant NPS planning documents as being of significance, there would be no impairment of park resources or values related to vegetation as a result of Alternatives C or D.

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*The evaluation of deer was based primarily on a qualitative assessment of how expected changes to park vegetation (as a result of increased or decreased browsing pressure) would affect the quality and/or quantity of available deer habitat.*

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#### 4.3.2 Impacts on White-tailed Deer Population

The evaluation of impacts to deer was based primarily on a qualitative assessment of how expected changes to park vegetation (as a result of increased or decreased browsing pressure) would affect deer habitat and how these changes would affect the deer population itself. The evaluation also considered potential impacts to the deer population directly associated with implementation of the alternatives (e.g. change in daily movements to avoid sharpshooting) and the risk related to the amplification and spread of CWD if it should occur within the park. Intensity definitions for white-tailed deer were developed based on available information and research on demographics, condition, population dynamics, behavior, and disease in white-tailed deer.

Data on demographic factors such as sex ratio, age structure, and abundance are easily collected by natural resource managers and are used in modeling wildlife population dynamics. The dynamics of a population are determined by demographic factors and factors such as productivity, survival, harvest rate/mortality rate, and rate of population growth. These, in turn, are directly influenced by deer condition and indirectly by habitat quality (e.g. quality and quantity of available forage). Lastly, deer behavior and risk of disease occurrence and amplification are influenced by all the above.

Available information on the deer population (demographics, condition, population dynamics, behavior, and disease) was compiled and analyzed in relation to the management actions. The thresholds for the intensity of an impact are defined as follows:

## **Impact Thresholds**

**Negligible** There would be no observable or measurable impacts to the deer population (e.g., demographics, population dynamics, condition, behavior, disease risk) as a result of changes in habitat or directly related to implementation of the management action. Impacts would be well within natural fluctuations.

If CWD should be introduced into the population, there would a very high likelihood of early detection and a very low probability of disease amplification and spread.

**Minor** Impacts would be detectable but would not be outside the natural range of variability. Small changes to the deer population (e.g., demographics, population dynamics, condition, behavior) might occur. Occasional responses to disturbance by some individuals could be expected but without interference to factors affecting population levels. Sufficient habitat would remain functional to maintain viability of the deer population. Impacts would be outside reproduction periods.

If CWD should be introduced into the population, there would a high likelihood of early detection and a low probability of disease amplification and spread.

**Moderate** Impacts on the deer population (e.g., demographics, population dynamics, condition, behavior) could be outside the natural range of variability. Changes in deer abundance, survival, productivity, movements and other factors would occur, but the deer population would remain stable and viable. Frequent responses to disturbance by some individuals could be expected, with some adverse impacts to factors affecting population levels. Sufficient habitat would remain functional to maintain the viability of the deer population. Some impacts might occur during periods of reproduction or in key habitat.

If CWD should be introduced into the population, there would a reduced likelihood of early detection and an increased probability of disease amplification and spread.

**Major** Impacts on the deer population (e.g., demographics, population dynamics, condition, behavior) would be detectable, would be expected to be outside the natural range of variability, and would be extensive. Changes in deer abundance, survival, productivity, movements and other factors may be large, potentially resulting in decreased viability or stability. Frequent responses to disturbance by some individuals would be expected, with adverse impacts to factors negatively affecting population levels. Loss of habitat would affect the viability of the deer population.

If CWD should be introduced into the population, the likelihood of early detection would be low and the probability of disease amplification and spread would be high.

## **Area of Analysis**

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The area of analysis for assessing impacts on the deer population includes all of Valley Forge NHP. The area of analysis for cumulative impacts is contained within the park boundaries, as well.

## **Impacts of Alternative A**

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### ***Impact Analysis***

Under Alternative A, park staff would continue monitoring the deer population and vegetation. In addition, park staff would continue to fence special status species and other sensitive areas. Coordination with the PGC and limited CWD surveillance also would continue. In 2007, opportunistic, targeted, and enhanced targeted surveillance actions were categorically excluded using the appropriate NEPA process. As described in section 4.1.1: Vegetation, under Alternative A, impacts to vegetation and habitat (quality and quantity of available forage) for deer would be long-term, major, and adverse.

Increases in deer movements may result as park staff travel to and from monitoring plots, install and maintain fencing, and conduct deer counts. Deer population monitoring involves use of a spotlight from a vehicle along roadways and trails through the park and occasionally getting out of vehicles to better observe deer. These activities may occasionally disturb deer and cause a temporary change in deer movements. Vegetation monitoring is only conducted periodically and then over approximately a 30 day period. Population monitoring activities are conducted annually but only on 8 days of the year for 1-2 hours per day. Overall, it is expected the impacts of these actions on the deer population would be long-term, negligible, and adverse.

Under Alternative A, white-tailed deer density is expected to remain high, exhibiting a continued trend toward increasing numbers or stabilizing at a very high density. DeNicola, Etter, and Almendinger (2008) described the sex and age structure of non-hunted (suburban) deer populations as “fairly uniform and predictable”. Sex ratios were skewed toward female deer (2:1) and toward older animals. Similar demographics characterize the park deer herd, as reflected in data collected from deer killed on roadways (Heister 1996). This is attributed to high survival rates, male dispersal, and increased male mortality during fall (Heister 1996; Lovallo and Tzilkowski 2003). Hunted populations often exhibit even higher ratios of female to male deer (e.g. 3:1, 6:1) due to hunter preference for bucks (DeNicola, Etter, and Almendinger 2008). Under Alternative A, demographic characteristics of the deer population at Valley Forge NHP are not expected to change significantly. Therefore, maintenance of high deer density under Alternative A would have long-term, negligible, and adverse impacts on deer demographics.

High deer density and continuation of excessive browse pressure under Alternative A, would further decrease the quality and quantity of available forage and result in decreased physical condition within the deer herd over the long-term. Although little scientific evidence exists to suggest the deer at Valley Forge are not in good condition, Cypher, Yahner, and Cypher (1985) describe this scenario as “rather precarious.” Changes in habitat quality may affect maternal condition before birth and the quality and quantity of milk produced post-partum. Therefore, changes in fawn body size may be a first indicator of changes in deer health and degraded habitat quality (Heister 1996). Observations and research conducted in Valley Forge NHP indicate the park’s fawn population may be experiencing a decline in body size

over time (Heister 1996; Rowe and Heister 1999). However, other research indicates that body size of adult deer is similar to that in other deer populations across the state (Lovallo and Tzilkowski 2003). Based on the extensive amount of scientific literature describing the relationship between habitat quality and physical condition in deer, it is assumed that the physical condition of deer at Valley Forge will decline/continue to decline over time. Therefore, under Alternative A the impact on deer condition would be long-term, moderate and adverse.

As documented in the scientific literature, deer in poor physical condition would experience lowered productivity. Reproduction was chosen as a primary performance measure for deer health by the PGC because research has shown reproduction to be related to deer population health (Miller and Wentworth 2000). Deer in good physical condition have demonstrated significantly higher reproductive rates compared to deer in poor physical condition (Verme 1965, 1967, 1969; Hesselton and Jackson 1974). Productivity is influenced by both age and health with the relationship between poor body condition and productivity most pronounced in younger animals (fawns and yearlings) (PCWDTF 2007). In high density deer herds in Indiana reproduction virtually ceased in yearling females when deer density exceeded 30 deer/km<sup>2</sup> (Swihart et al. 1998).

No reproductive data exist for deer within the park. However, PGC estimates of reproductive rates in areas surrounding the park (WMU 5C) indicate low reproduction in yearlings (0.4 fawns per doe) and relatively high reproduction in adult females (1.8 fawns per doe). Across the state, the average reproductive rate is 1.0 fawns per doe. Under this alternative, reproductive rate in yearlings would be expected to remain low or decrease over time. Reproductive rate would be expected to remain high or decrease over time in adult females.

Deer in poor physical condition may also experience higher mortality rates because they are more susceptible to deer-vehicle collisions and winter starvation and have an increased rate of fawn abandonment (Beier 1987). As is typical of suburban deer populations, overall deer mortality is low (17%) and survival is high (83%) at Valley Forge (Lovallo and Tzilkowski 2003). Under Alternative A, the mortality rate would be expected to remain low with increases in winter mortality and fawn mortality as well as increased probability of population level impacts from mortality associated with catastrophic events (e.g. harsh winter weather). Therefore, under Alternative A, impacts on deer population dynamics (deer density, productivity, mortality) would be long-term, moderate, and adverse.

A decrease in the quality and quantity of available forage may also influence deer movements and overall home range size. Generally, the size of a deer's home range varies with deer density, sex, landscape conditions, and season of the year (Sanderson 1966; Harestad and Bunnell 1979; Loft, Menke, and Burton 1984; PGC 2003). The home range of female deer at Valley Forge is relatively small (0.35-0.46 square miles) compared to deer populations state-wide (average adult home range of one square mile)(Lovallo and Tzilkowski 2003; PGC 2003) reflecting the diversity of available forage types at the park (e.g. forest, field, residential, floodplain). However, it is unknown how long habitat in the park will be able to sustain this population. For example, in 1998, average vegetative cover in unfenced forest monitoring plots on Mount Misery and Mount Joy was 11% and 30%, respectively – significantly less than in fenced plots (30% and 39%, respectively). Plant cover is representative of plant biomass or the amount of available forage for deer. As vegetative cover in park forests nears zero, deer would be expected to travel further in search of quality forage and/or may rely more heavily on residential landscapes

surrounding the park that are constantly replenished. This would result in increased size of deer home range and increased movements across the park boundary into the surrounding community.

As forest vegetation continues to decline, deer may also shift their movements relative to use of habitat. Deer at Valley Forge are typically found in forests during the day and in meadows at night and currently use residential areas less than expected based on availability (Lovallo and Tzilkowski 2003). However, as forested habitat continues to degrade these patterns may shift to an increasing reliance on meadows and/or residential areas. Therefore, impacts on deer behavior (movements, habitat use) are expected to be long-term, minor and adverse under Alternative A.

As described in Appendix C: CWD Response Plan, high deer density is one of the primary risk factors for amplification of CWD. Under Alternative A, because there would be no control of the deer population, the risk of CWD amplification and the probability of spread if CWD does occur, would be high. Spread of CWD may result in negative impacts to deer health at the population level. Under this alternative, use of opportunistic, targeted and enhanced targeted CWD surveillance methods would facilitate detection of CWD-positive deer primarily after clinical signs are apparent. This could be up to one year after an individual acquires the disease. Therefore, the probability of early detection would be low. The impacts of this alternative on the risk of disease amplification and likelihood of spread, if CWD should occur, would be long-term, major, and adverse.

The overall impact of Alternative A on the white-tailed deer population would be long-term, moderate, and adverse.

### ***Cumulative Impacts***

Several past, present, and reasonably foreseeable future actions would contribute to the cumulative impact on the deer population at Valley Forge NHP, including transportation corridor development, natural resource management activities, cultural resource management activities, and development activity outside the park boundary.

Previous transportation corridor development has affected the deer population in and around Valley Forge NHP. The construction of new roads has fragmented the deer's home range and reduced the amount of available habitat, forcing them to expand their home range and make more road crossings. It has also increased the number of motorists and has in turn contributed to an increase in deer-vehicle collisions. Ongoing corridor maintenance has reduced vegetative cover along the regional roads and in the medians. This has made the animals along roadways more visible to motorists. Future development of the regional road system could compound these problems. However, traffic calming and road closures proposed in the Valley Forge NHP GMP/EIS (NPS 2007j) would reduce the potential for deer-vehicle collisions within the park. By fragmenting and/or altering habitat, transportation corridor development has had a long-term, minor, adverse impact on the deer population.

Many of the park's natural resource management activities have been focused on protecting sensitive species from the deer population and measuring the population's impact on vegetation. These actions may exclude the deer from some food sources. However, the areas that are fenced are so small they represent a negligible amount of the deer's home range. Other natural resource management plans, such as the field management plan and integrated pest management activities, have and would continue to dictate the management of different vegetative resources. These management options would have some consequence on what type of food sources



would be available to the deer. These activities generally would provide the deer population with additional food (e.g., mast producing trees) and cover and likely improve deer habitat quality. Therefore, these actions would have a long-term beneficial impact on the deer population.

Cultural resource management activities have had and could continue to have some impact on the deer population. Cultural resource management activities would involve new plantings throughout the park, however many of these plantings would represent deer-resistant species or be protected by fencing. Some unfenced plantings could provide the deer with an additional food source. However, the limited nature of these planned plantings would not represent a detectable increase in the deer population food supply. The clearing of historic viewsheds could also alter the deer population's feeding and movements but the associated loss of forest habitat would not represent a considerable change in the deer habitat. Therefore, these actions would be expected to have no impact on the deer population.

Activity outside the park boundary also has had impact on the deer population. Many of these activities are aimed at excluding deer from landscaping, reducing deer density or in some cases engaging in supplemental feeding of deer. The increasing level of development and efforts by adjacent landowners to limit deer browsing on residential landscapes (i.e., fencing, repellents, and archery) has reduced the amount of habitat available to the deer. In some cases, it also has led to the removal of a number of animals. As a result, it is possible that deer may have moved into the park to take advantage of the relatively undisturbed setting and available habitat. Properties that remain unfenced and are not hunted provide a desirable, high quality food source for deer. Future development would provide additional desirable habitat for the deer population. Other activities outside the park boundary include legal hunting which is controlled by the PGC. Although localized hunting may have some success in protecting individual properties, spring deer count data indicates the deer population size continues to increase in areas surrounding the park. Future management by the PGC may result in an increase in the number of deer legally taken each hunting season. This could result in a reduced deer density, reduced probability of occurrence and spread of CWD, and improved habitat conditions for a number of deer populations within the region. These actions have had and would continue to have long-term beneficial impacts on the deer population.

These projects, along with the impacts of Alternative A, would result in a long-term moderate, adverse cumulative impact on the deer population at Valley Forge NHP. Alternative A would contribute an appreciable adverse increment to the overall cumulative impact.

## **Impacts of Alternative B**

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### ***Impact Analysis***

Actions described under Alternative A would continue under Alternative B. In addition, under this alternative two nonlethal actions would be implemented to protect forest resources and gradually reduce deer numbers in the park. These actions include the use of rotational fencing and reproductive control of does when an acceptable chemical reproductive control agent is available and feasible. Expanded CWD surveillance (live test and cull) and increased coordination with the PGC would be implemented if a confirmed case of CWD was documented within 5 miles of the park boundary or the park falls within a state-established CWD containment zone. As described in section 4.1.1: Vegetation, under Alternative B, impacts to vegetation and habitat for deer would be long-term, major and adverse.

Increases in deer movements may result as park staff travel to and from monitoring plots, install and maintain rotational and small-scale fencing, conduct deer counts, and administer reproductive control agents. Installation of rotational fencing across 10%-15% of the forested area of the park may cause temporary displacement of deer from small areas of the park for up to one month. Deer population monitoring involves use of a spotlight from a vehicle along roadways and trails through the park and occasionally getting out of vehicles to better observe deer. Administration of reproductive control agents will require darting and tracking of deer. These activities may occasionally disturb deer and cause a temporary change in deer movements. These activities are conducted during short periods of time over a relatively small area at any one time. For example, population monitoring activities are conducted annually but only on 8 days of the year for 1-2 hours per day. Given the small size of the impacted area in relation to the size of the park (about 3,450 acres), and the limited nature of the actions, the impacts of these activities would be long-term, negligible and adverse.

Under Alternative B, white-tailed deer density would be expected to remain high, exhibiting a continued trend toward increasing numbers or stabilizing at a very high density, until reproductive control could be effectively implemented. Therefore, under Alternative B, impacts on deer demographics, condition, and population dynamics would be the same as described under Alternative A.

When successfully implemented, reproductive control would help reduce the impact on the deer population by gradually reducing deer density and promoting restoration of high quality habitat. However, the time required to achieve these results are estimated to be between 18 and 19 years, beyond the life of this plan.

Rotational fencing may have additional impacts related to localized intensity of impacts and deer behavior. Exclusion of deer from 10-15% of the forested area of the park would increase deer density in areas surrounding fences resulting in more severe browsing of vegetation and increased competition for available food resources. Impacts to deer (e.g. decreased physical condition, expanded home range, increased movements across park boundary) in these areas may be observed before they are evident in deer in other areas of the park. Fencing of 4%-6% of the total area of the park may also lead to long-term changes in movement patterns and re-routing of travel paths by deer to go around these areas. Rotational fencing would be spread across forested areas parkwide to minimize impacts to any one forested area. Therefore, the additional impacts of rotational fencing on deer behavior do not contribute appreciably to impacts described under Alternative A (long-term, moderate, and adverse).

Implementation of reproductive control also may result in additional impacts to deer behavior and condition associated with the application of a chemical reproductive control agent. Initial treatment of female deer with a reproductive control agent would require sedation and handling to mark individuals as "treated." This action may result in short-term, negligible, adverse impacts to female deer condition by temporarily increasing stress levels. However, condition in female deer also may experience a long-term benefit through the elimination of physical stress and increased nutritional demands associated with pregnancy and lactation. Metabolic demands are greatest for females during summer while lactating (Moen 1976).

In Pennsylvania, bucks in may lose 25%-30% of their body weight during the breeding season, placing them at increased risk of winter mortality (PGC 2003). Actions that extend the breeding season may result in additional loss of body weight

and increased winter mortality, particularly in poor or marginal habitat and during winters with heavy snowfall (PGC 2003). Some chemical reproductive control agents may cause repeated estrous cycling in females, and bucks may continue to breed with infertile females beyond the normal breeding season. In some cases, extended recurrent estrous cycling has resulting in breeding behavior extending into April-June (Fraker et al. 2002; McShea and Rappole 1997; Muller, Warrnen, and Evans 1997; White and White 1995; Knox, Miller, and Marchinton 1988). Deer bred in April-June would give birth late fall leading to high fawn mortality and increased stress to adult females. To minimize additional impacts on deer behavior related to implementation of reproductive control, this plan establishes, as a criteria for an acceptable chemical reproductive control agent, that “it would have limited behavioral impacts on the deer population.” Therefore, additional potential impacts of reproductive control on deer behavior do not contribute appreciably to impacts described under Alternative A (long-term, moderate, and adverse).

As described in Appendix C: CWD Response Plan, high deer density is one of the primary risk factors for CWD amplification if it should occur. Under Alternative B, because there would be no control of the deer population, the risk of CWD amplification and the probability of spread if CWD does occur, would remain high. Implementation of live testing via tonsillar biopsy and removal of CWD-positive deer would increase probability of early detection. However, live testing would be conducted during initial treatment of deer with a chemical reproductive control agent, thus the number of deer sampled may vary widely over time and would exclude male deer from the sampling effort. Therefore, these actions would not contribute substantially to reducing the risk of amplification or the probability of spread. If CWD should occur, disease spread may result in negative impacts to deer health at the population level. Overall, under Alternative B, impacts on the risk of disease amplification and probability of spread if CWD should occur, would be long-term, moderate and adverse.

The overall impact of Alternative B on the white-tailed deer population would be long-term, moderate, and adverse.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to the deer population would be the same as those described under Alternative A. These projects, along with Alternative B would result in a long-term, moderate, adverse cumulative impact on the deer population. Alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

## **Impacts of Alternative C**

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### ***Impact Analysis***

Actions and associated impacts described under Alternative A would continue under Alternative C. In addition, under this alternative, the deer population would be reduced and maintained at the deer density goal through lethal reduction methods. If a confirmed case of CWD was documented within five miles of the park boundary or the park falls within a state-established CWD containment zone, active lethal CWD surveillance would be implemented and closely coordinated with the PGC. As described in section 4.1.1: Vegetation, impacts to vegetation and habitat for deer would be long-term and beneficial under Alternative C.

Deer reduction and population maintenance would occur through the use of sharpshooting and capture and euthanasia. Increased deer movement may result as

park staff travel to and from bait sites and tree stands, occupy shooting areas, discharge firearms, and conduct trapping activities (for capture and euthanasia). These actions are expected to take place across a relatively small area at any one time and be of short duration. Given the small size of the impacted area in relation to the size of the park (about 3,450 acres), and the limited nature of the actions, the impacts of these activities would be short-term, moderate, and adverse. These impacts may be reduced to negligible as deer density is reduced and fewer deer need to be removed annually.

Under Alternative C, white-tailed deer density is expected to decrease to 31-35 deer per square mile within four years. Given the estimated number of deer to be removed it is expected that, at least initially, age and sex classes would be removed in proportion to their abundance. Thus, in the short-term, no impacts would be expected to occur related to deer population age structure and sex-ratio as a result of direct reduction activities. However, over time, a population experiencing reduction pressure would be expected to develop a younger age structure. Additionally, during maintenance activities, preference would be given to removal of females from the population. Thus, in the long-term, this activity may increase the proportion of adult males within the population. Due to the difficulty in identifying fawns as female or male at night during sharpshooting activities, it is expected that deer in this age group would continue to be removed in proportion to their availability. Given the increased proportion of females within the current population (1.4-2:1) it is expected these actions would move the sex-ratio closer to a more balanced equilibrium of 1:1. Males are expected to continue to disperse and experience higher rates of mortality in fall and winter, thus reducing the likelihood of significantly skewing the sex ratio toward males rather than females. Overall, under Alternative C, impacts to deer demographics would be long-term and beneficial.

Reduction of deer density would release plant communities from heavy browse pressure and significantly improve the quality and quantity of available forage for deer. An increase in the quality of deer habitat would result in increased physical condition of deer over the long-term. As described under Alternative A, adult deer at Valley Forge currently appear to be in at least average condition relative to other deer populations across the state (Lovallo and Tzilkowski 2003). Signs of declining condition are just being detected in yearlings and fawns (Rowe and Heister 1996; Heister 1996) which may be a first indicator of change in habitat quality for deer. Based on the extensive amount of scientific literature describing the relationship between habitat quality and physical condition in deer, it is expected that condition of deer at Valley Forge would improve over time. Capture and euthanasia would be implemented using box traps or other forms of physical restraint. This action may result in short-term, negligible impacts to deer condition by temporarily increasing stress level. However, under Alternative C, the overall impact of lethal reduction on deer condition would be long-term and beneficial. These impacts may be most pronounced in younger animals (yearlings and fawns).

Reproduction was chosen as a primary performance measure for deer health by the PGC because research has shown reproduction to be related to deer population health (Miller and Wentworth 2000). As documented in the scientific literature, deer in good physical condition would experience high productivity (Verme 1965, 1967, 1969; Hesselton and Jackson 1974). Reproductive rates of adult deer in good physical condition reportedly range from 1.71-1.94 fawns per doe. Reproductive rates of yearling does in good condition range from 1.53-1.89 fawns per doe (PGC 2003). Although no reproductive data exist for deer within the park, PGC estimates of reproductive rates in areas surrounding the park (WMU 5C) indicate low

reproduction in yearlings (0.4 fawns per doe) and relatively high reproduction in adult females (1.8 fawns per doe). Low reproductive rates in yearlings reflect the fact that productivity is influenced by both age and health, with the relationship between poor body condition and productivity most pronounced in younger animals (PCWDTF 2007). Under this alternative, reproductive rate would be expected to remain high or to increase over time in adult females. Reproductive rate in fawns and yearlings would be expected to increase significantly over time. Under Alternative C, lethal reduction would be expected to result in long-term and beneficial impacts on deer reproductive rates.

Deer mortality would be expected to increase significantly under Alternative C due to implementation of sharpshooting and capture and euthanasia to reduce deer density from 193 deer per square mile to 31-35 deer per square mile. Mortality associated with lethal management actions would be highest in the first four years and then remain relatively constant during population maintenance activities. Based on the population model developed by the PGC average mortality rate during population reduction (years 1-4) would be 48% (range 39% to 64%) and average mortality rate during population maintenance (years 5-10) would be 22% (range 12% to 25%) as a result of sharpshooting activities. Under Alternative C, mortality rate would be similar to hunted deer populations across Pennsylvania where the annual overall mortality rate for adult bucks, yearling bucks and adult does is 73%, 53%, and 10-40%, respectively (Rosenberry, pers. comm. 2008). During both population reduction and maintenance activities, primary causes of adult deer mortality would be sharpshooting and deer-vehicle collisions, also similar to hunted deer populations across Pennsylvania (PGC 2003). Mortality associated with other causes (e.g. poaching, accidents, etc.) would remain low. Based on experience in hunted populations in Pennsylvania, no adverse impacts to the deer population would be expected to result from change in mortality rate or cause of mortality during population reduction and maintenance activities. The immediate impact of increased mortality rate is lowered deer density, ultimately leading to the beneficial impacts on deer demographics, condition, and reproductive rate described above. Therefore, under Alternative C, increased deer mortality would result in long-term beneficial impacts on population dynamics (i.e., demographics, density, reproductive rate).

As described under Alternative A, home range of female deer at Valley Forge is relatively small (0.35-0.46 square miles) compared to deer populations state-wide (average adult home range of one square mile)(Lovallo and Tzilkowski 2003; PGC 2003) reflecting the diversity of available forage types at the park (e.g. forest, field, residential, floodplain). Under Alternative C, home range size would likely remain small as habitat quality improved. Daily movement patterns and habitat use as described by Cypher, Yahner, and Cypher (1985) at 31-35 deer per square mile would remain the same. Deer would continue to use forests during the day and meadows at night and movement patterns would reflect the year-round importance of meadows to deer in the park. Although, park data indicate that deer currently don't use residential areas in proportion to their availability, improved habitat quality in park forests may further reduce deer movement across the park boundary to surrounding residential communities. Therefore, under Alternative C, impacts on deer behavior (movement and habitat use) would be long-term and beneficial.

As described in Appendix C: CWD Response Plan, high deer density is one of the primary risk factors for the amplification and spread of CWD. Under Alternative C, if CWD was detected within five miles of the park boundary or the park falls within a state-established CWD containment zone, the park would implement active lethal surveillance activities to more effectively detect and monitor CWD. Active lethal

surveillance would include rapid reduction to the target deer density and possibly implementation of a one-time action to further reduce deer density to not less than 10 deer per square mile. Rapid reduction would be carried out through sharpshooting and capture and euthanasia and would be expected to achieve the target deer density in approximately one-half the time described above for sharpshooting. Because deer density would be significantly reduced, the risk of CWD amplification and the probability of spread if CWD should occur, would be relatively low. Additionally, testing of a significant number of deer before they exhibit clinical signs of CWD would maximize the likelihood early detection. Reduced deer density and the flexibility to respond in a coordinated fashion to actions being taken outside the park boundary by the PGC (within the CWD containment zone) would also reduce the probability of disease spread and promote elimination of CWD, if possible. Therefore, impacts to the deer population from activities associated with CWD detection and monitoring would be long-term and beneficial.

The overall impact of Alternative C on the white-tailed deer population would be long-term and beneficial.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to the deer population would be the same as those described under Alternative A. These projects, along with Alternative C would result in a long-term beneficial cumulative impact on the deer population. Alternative C would contribute a beneficial increment to the overall cumulative impact.

## **Impacts of Alternative D**

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### ***Impact Analysis***

Actions and associated impacts described under Alternative A would continue under Alternative D, including opportunistic, targeted, and enhanced targeted CWD surveillance. In addition, lethal reduction methods would be implemented to reduce the size of the deer population to the target deer density of 31-35 deer per square mile as described under Alternative C. Once the density goal was obtained, reproductive control would be used to maintain the deer population at the reduced level as described under Alternative B, if an acceptable chemical reproductive control agent was available, feasible and effective. In not, then sharpshooting and capture and euthanasia would be used for deer population maintenance. If a confirmed case of CWD was documented within five miles of the park boundary or the park falls within a state-established CWD containment zone active lethal CWD surveillance would be implemented and closely coordinated with the PGC as described under Alternative C. As described in section 4.1.1: Vegetation, impacts to vegetation and habitat for deer would be long-term and beneficial under Alternative D.

Overall impacts on the deer population associated with implementation of lethal reduction actions would be the same as described under Alternative C, long-term and beneficial. Overall impacts on the deer population associated with implementation of reproductive control would be the same as described under Alternative B, long-term, moderate, and adverse. Adverse impacts on breeding physiology and behavior associated with the application of chemical reproductive control agents (described under Alternative B) would be reduced to negligible because the increase in habitat quality would mitigate the impacts of an extended breeding season on males. However, the success of implementing reproductive control on a deer population that has undergone several years of lethal reduction efforts would depend on technological advances, the sensitivity of deer to humans, methods used by the sharpshooters,

changes in immigration with reduced deer density, and general deer movement behavior (Porter, Underwood, and Woodward 2004; Naugle et al. 2002). It should be expected that getting close enough to administer remote injections would become increasingly difficult after lethal reduction efforts, due to deer behavior changes in response to previous human interaction (Underwood 2005) and the fact that there are simply fewer deer. Overall, under Alternative D, impacts on the deer population would be long-term and beneficial.

Impacts associated with implementation of active lethal CWD surveillance would be the same as described under Alternative C (long-term and beneficial).

The overall impact of Alternative D on the white-tailed deer population would be long-term and beneficial.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to deer population would be the same as those described under Alternative A. These projects, along with Alternative D would result in a long-term beneficial cumulative impact on the deer population. Alternative D would contribute a beneficial increment to the overall cumulative impact.

### **Conclusion**

The overall impact to deer population under Alternatives A and B would be long-term, moderate, and adverse. For both alternatives, the overall cumulative impact would be long-term, moderate, and adverse. Alternatives A and B would contribute appreciable adverse increments to the cumulative impact on deer population. Although there would be a major adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, and (3) identified in relevant NPS planning documents as being of significance, there would be no impairment of park resources or values related to the white-tailed deer population.

The overall impact to deer population under Alternatives C and D would be long-term and beneficial. For both alternatives, the overall cumulative impact would be beneficial. Alternatives C and D would contribute beneficial increments to the cumulative impact on the deer population. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, and (3) identified in relevant NPS planning documents as being of significance, there would be no impairment of park resources or values related to the white-tailed deer population under Alternatives C or D.

### **4.3.3 Impacts on Other Wildlife, Wildlife Habitat, and Special Status Animal Species**

The availability of suitable high quality habitat is a critical factor determining the abundance and diversity of wildlife species present and loss of suitable habitat is the primary factor contributing to the listing of wildlife species as rare, threatened, or endangered at the federal and/or state level. As described in section 4.1.1: Vegetation (Alternatives A and B), continued high deer density would be expected to result in long-term, major, and adverse impacts to the vegetative elements of

wildlife habitat. Deer are considered by many researchers and ecologists to be a “keystone” herbivore. A keystone species may be defined as one that “(1) affects the distribution or abundance of many other species, (2) can affect community structure by strongly modifying patterns of relative abundance among competing species, or (3) affects community structure by affecting the abundance of species at multiple trophic levels” (Waller and Alverson 1997).

The evaluation of wildlife (other than deer) and wildlife habitat was based on a qualitative assessment of how expected changes to park vegetation, as described in section 4.1.1, would affect the abundance and diversity wildlife populations. Change in the quality and quantity of forage, availability of suitable nesting sites, amount of cover, and level of competition for existing resources may lead to significant changes in population size, reproductive success, rate of predation, and rate of mortality. Intensity definitions for wildlife and wildlife habitat were developed based on available information on known wildlife, including unique or important wildlife or wildlife habitat. This information was compiled and analyzed in relation to the management actions.

The Endangered Species Act (16 U.S.C. 1531 et seq.) mandates that all federal agencies consider the potential effects of their actions on species listed as threatened or endangered. If the NPS determines that an action may adversely affect a federally listed species, consultation with the USFWS is required to ensure that the action will not jeopardize the species’ continued existence or result in the destruction or adverse modification of critical habitat. No federally listed animal species occur in Valley Forge NHP, therefore, no consultation under Section 7 of the Endangered Species Act is required.

The NPS *Management Policies 2006* state that potential effects of agency actions will also be considered on state- or locally-listed species (NPS 2005a). The NPS is required to control access to important habitat for such species and to perpetuate the natural distribution and abundance of these species and the ecosystems upon which they depend. State-listed species of special concern occur in Valley Forge NHP and one of objectives of this plan/EIS is to protect and promote special status plant and animal species and their habitat. Therefore, it would be appropriate to include an analysis of the potential impacts to state-listed animal species is included in this section.

Only one of the five state-listed wildlife species that occur in the park is resident (occurs year round and breeds in park). This species, the redbelly turtle (*Pseudemys rubriventris*), is aquatic and therefore excluded from the analysis. The remaining four species are all birds whose presence in the park is described as occasional, rare, or extremely rare (NPS 2007e). None of these species breed in the park. Spending almost all of their time outside the park boundary, these birds are much more dependent on environmental conditions beyond the scope of this plan. However, it is generally assumed that alternatives that result in long-term beneficial impacts to wildlife and wildlife habitat would also benefit special status animal species. Alternatives that result in long-term, major, and adverse impacts to other wildlife and wildlife habitat would be expected to have a similar impact on special status animal species.

Available information on known wildlife and wildlife habitat was compiled and analyzed in relation to the management actions. The thresholds for the intensity of an impact are defined as follows:



### ***Impact Thresholds***

***Negligible*** There would be no observable or measurable impacts on the abundance and diversity of native species and/or the quality of their habitat. Impacts would be of short duration and well within natural fluctuations.

***Minor*** Impacts would be detectable, but would not be outside the natural range of variability. Small changes to population numbers, number of species present, habitat quality, and other factors might occur. Occasional responses to disturbance by some individuals could be expected, but without interference to factors affecting population levels. Sufficient habitat would remain functional to maintain viability of all species. Impacts would be outside critical reproduction periods for sensitive native species. Mitigation measures, if needed to offset adverse impacts, would be simple and very likely successful.

***Moderate*** Impacts on the abundance and diversity of native species and/or the quality of their habitat would be detectable and could be outside the natural range of variability. Changes to population numbers, number of species present, habitat quality, and other factors would occur, but species would remain stable and viable. Frequent responses to disturbance by some individuals could be expected, with some negative impacts to factors affecting population levels. Sufficient habitat would remain functional to maintain the viability of all native species. Some impacts might occur during critical periods of reproduction or in key habitat. Mitigation measures, if needed to offset adverse impacts, would be extensive and likely successful.

***Major*** Impacts on the abundance and diversity of native species and/or the quality of their habitat would be detectable, would be expected to be outside the natural range of variability, and would be extensive. Population numbers, number of species present, habitat quality, and other factors might experience large declines. Frequent responses to disturbance by some individuals would be expected, with negative impacts to factors resulting in a decrease in population levels. Loss of habitat might affect the viability of at least some native species. Extensive mitigation measures would be needed to offset any adverse impacts, and may not be successful.

### ***Area of Analysis***

The area of analysis for assessing impacts on other wildlife and wildlife habitat includes all of Valley Forge NHP. The area of analysis for cumulative impacts is contained within the park boundaries as well.

### ***Impacts of Alternative A***

#### ***Impact Analysis***

Under Alternative A, park staff would continue monitoring the deer population and vegetation. In addition, park staff would continue to fence special status species and other sensitive areas. Coordination with the PGC and limited CWD surveillance also would continue. In 2007, opportunistic, targeted, and enhanced targeted CWD surveillance actions, were categorically excluded using the appropriate NEPA process.

Increases in wildlife movements may result as park staff travel to and from monitoring plots, install and maintain fencing and conduct deer counts. Deer population monitoring involves use of a spotlight from a vehicle along roadways and trails through the park and occasionally getting out of vehicles to better observe deer. These activities may occasionally disturb common species of wildlife such as raccoons, groundhogs, and songbirds. Some disturbance may occur during the breeding season when events that cause adults to abandon their nests, even temporarily, could result in increased predation and decreased reproductive success. However, many common wildlife species in the park are frequently subject to disturbance due to high visitation and heavy recreational use, and therefore these species may be less sensitive to disturbance. Additionally, these activities would be expected to occur only periodically (annually to every five years) and for short duration (hours to days). Therefore, it is expected the impacts of these actions on wildlife species would be long-term, negligible, and adverse.

Small-scale fencing used for protecting sensitive plant species and monitoring vegetation would be designed to allow small animals to enter and exit the enclosed area. As described in section 4.1.1: Vegetation, fencing would result in a long-term beneficial impact on the plant communities within areas that were fenced, although this impact would be highly localized parkwide. Vegetation within fenced areas would provide high quality (more nutritious) forage, an increased amount of forage, nesting sites for ground and shrub nesting species, increased available wildlife cover, and reduced competition for those resources that are available within fencing (e.g. acorns and other mast and fruits) (Latham et al. 2005). Overall, under Alternative A, the impact on other wildlife species and wildlife habitat would be long-term and beneficial. However, due to the small scale of fenced areas (3.1 acres) benefits to wildlife would be expected to be highly localized.

The majority of park vegetation would remain unfenced and continue to experience heavy browse pressure. As described in section 4.1.1: Vegetation, impacts to vegetation, including vegetative elements of wildlife habitat, would be long-term, major, and adverse under Alternative A. Degraded habitat would result in a continued decline in the abundance and diversity of native wildlife species, particularly in park forests. Vegetation outside fenced areas would provide low quality (less nutritious) forage, a reduced amount of forage, few nesting sites for ground and shrub nesting species, and reduced available wildlife cover (Latham et al. 2005).

In northwestern Pennsylvania, long-term monitoring of bird communities in forested enclosures containing varied deer densities (10, 20, 38, and 64 deer per square mile) documented a reduction in species richness and abundance of 27% and 37%, respectively, for intermediate-canopy-nesting bird species at higher deer densities (deCalesta 1994). Loss of the forest understory may affect woodland birds (migratory and resident) and other species that require ground cover to maintain viable populations (box turtles, American toads, gray tree frogs, hognose snakes) most seriously. At Valley Forge, researchers predict that species such as the black-billed cuckoo, hooded warbler, and white-eyed vireo will continue to remain at low densities until the forest understory is restored (Yahner 2001).

At continued high densities, deer would also compete directly with other wildlife species for available resources. The production of acorns and other tree nuts, also known as mast, is a critical food source for many small mammals, birds, and deer preparing for the winter season. Particularly during low mast production years, abundant deer populations may directly compete with other wildlife for this important resource. Reduction in the availability of this critical food source

negatively impacts reproduction and over-winter survival of species such as the eastern chipmunk (*Tamias striatus*), gray squirrel (*Sciurus carolinensis*), and white-footed mouse (*Peromyscus leucopus*) (Martin, Zim, and Nelson 1951; Miller and Getz 1977, Gashwiler 1979, Ostfeld et al. 1996, Brooks and Healy 1988, McShea and Rappole 1992; McShea and Schwede 1993; McShea and Rappole 1997; McShea 2000). These impacts may be particularly important to insects such as butterflies, which are often dependent on a very narrow range of host plants (Strong, Lawton, and Southwood 1984; Stewart 2001) that are also preferred deer browse species. Removal of nectar plants and other host species from fields and forests may result in extirpation of species from the park which are dependent on them. Other species that have a more diverse diet or that spend more time in the upper forest canopy (versus the shrub/ground layer) or leaf litter (e.g. salamanders) would be less affected by continued high deer density in unfenced areas of the park. Based on these results, under Alternative A, impacts on the majority of other wildlife in the park would be long-term, major, and adverse.

Some species that use deer as a food source, including foxes and coyotes, could benefit from high deer density and open understory conditions. Other animals, such as box turtles, vultures, crows, and chickadees, may also feed on deer carcasses. Small predators, such as foxes, hawks, owls, and skunks may also benefit from a more open understory, as prey would be easier to find. This would result in a long-term beneficial impact to these few species.

Increases in wildlife movements may result from implementation of opportunistic, targeted, and/or enhanced targeted CWD surveillance. These activities would involve dragging carcasses through vegetation, tracking of deer exhibiting clinical signs of CWD, and other activities that may occasionally disturb wildlife species. However, disturbances caused by these activities would be short in duration and occur across a very small area of the landscape. Therefore, impacts of CWD surveillance on other wildlife and wildlife habitat would be short-term, negligible, and adverse.

The overall impact of Alternative A on other wildlife and wildlife habitat would be long-term, major, and adverse.

### **Cumulative Impacts**

Several past, present, and reasonably foreseeable future actions would contribute to the cumulative impact on other wildlife and wildlife habitat at Valley Forge NHP, including transportation corridor development, natural resource management activities, land acquisition, cultural resource management activities, and activity outside the park boundary.

Previous transportation corridor development has affected other wildlife and wildlife habitat in and around Valley Forge NHP. The construction of new roads has fragmented habitats, forcing the animals that inhabit them to extend their home ranges and make more road crossings. This has resulted in an increase in animal-vehicle collisions. Ongoing corridor maintenance has reduced vegetative cover along the regional roads and in the medians. This has made these areas less desirable habitats for most wildlife and made the animals more visible to motorists. Future development of the regional road system could compound these problems. However, traffic calming and road closures proposed in the park GMP/EIS would reduce the potential for collisions. Overall, transportation corridor development has had a long-term, minor, adverse impact on other wildlife and wildlife habitat.

Many of the park's natural resource management activities have been focused on protecting sensitive species from deer browsing and measuring the deer population's impact on vegetation. Other natural resource management plans, such as the field management plan and integrated pest management activities, would continue to dictate the management of different vegetative resources. These management options would have some consequence on what type of habitats would exist within the park. However, these plans would not eliminate a habitat type from the park or introduce new ones. Therefore, changes would not eliminate a species from the park or cause significant disruption to any wildlife populations. Other future plans include the reforestation of Waggonseiler and Fuller Fields, as well as participation in the Valley Creek Restoration Plan. Both of these activities would provide other wildlife with a more diverse and healthy habitat. Therefore, these actions would have a long-term beneficial impact on other wildlife and wildlife habitat.

The park's land acquisition has also had an impact on other wildlife and wildlife habitat. The rapid development throughout the region has greatly influenced different population's movements and food availability for various wildlife species. By acquiring land within its legislative boundary, Valley Forge NHP prevented the development of these lands. In doing so, it provided more habitats for a variety of wildlife species. The result of these actions has been and would continue to be long-term and beneficial.

Cultural resource management activities have had and could continue to have some impact on other wildlife and wildlife habitat. The park's GMP/EIS (2007j) was carefully planned to ensure that all cultural resource management activities respected and promoted a healthy ecosystem within the park. Cultural resource management activities would involve new plantings throughout the park. These plantings could provide some species with additional habitat. However, the limited nature of these planned plantings would not represent a measurable increase in habitat types. These actions would have a long-term beneficial impact on other wildlife and wildlife habitat.

Activity outside the park boundary has also had impact on other wildlife and wildlife habitat. The increasing level of development has limited available habitat. As a result, many of the existing species within the park have become less common throughout the surrounding region. Future development would have a similar impact on other wildlife and wildlife habitat. Other activities outside the park boundary include legal hunting. Hunting is controlled by the PGC. The removal of a certain number of different species each year keeps their respective populations from increasing too rapidly. Overall, these actions have had and would continue to have long-term, minor to moderate, adverse impacts on other wildlife and wildlife habitat.

As described above, climate change would likely affect the park's wildlife populations. Some species, including white-tailed deer, may benefit from climate change and may extend their ranges and/or increase in numbers in the park. Warming climate and shifting distributions and quality of forest habitat is expected to cause substantial changes in both resident and migratory bird abundance and distribution. Some may be relatively unaffected while others may lose breeding and migratory habitat due to changes in forest composition. As noted previously, it is difficult to predict the rate and magnitude of change to specific wildlife populations; however, as with vegetation, the impacts of climate change on the park's wildlife is likely to be long-term, adverse, and range from minor to major in intensity. When added to the impacts of the no action alternative, the adverse cumulative impacts would likely be long-term and would likely range from moderate to major in intensity. The adverse cumulative impacts would result from continued heavy

grazing and loss of forest regeneration under the no action alternative, which would likely make the forests more vulnerable and less able to adapt to the environmental changes occurring as a result of climate change, which in turn, would lead to additional loss of habitat for birds and other wildlife.

These projects, along with the impacts of Alternative A, would result in a long-term, major, adverse cumulative impact on other wildlife and wildlife habitat at Valley Forge NHP. Alternative A would contribute an appreciable adverse increment to the overall cumulative impact.

## **Impacts of Alternative B**

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### ***Impact Analysis***

Actions described under Alternative A would continue under Alternative B. In addition, under this alternative, two nonlethal actions would be implemented in combination to protect forest resources and gradually reduce deer numbers in the park. These actions include the use of rotational fencing and reproductive control of does when an acceptable chemical reproductive control agent is available and feasible. Expanded CWD surveillance (live test and cull) and increased coordination with the PGC would be implemented if a confirmed case of CWD was documented within five miles of the park boundary or the park falls within a state-established CWD containment zone.

As described under Alternative A, increases in wildlife movements may result as park staff travel to and from monitoring plots, install and maintain fencing and conduct deer counts. Additionally, under Alternative B, installation and maintenance of rotational fencing to exclude deer from 10%-15% of the forested area of the park will require some clearing of understory vegetation and/or limited tree removal resulting in permanent displacement of some wildlife. Fencing would be designed to allow passage of small mammals and birds once erected. The majority of other small to medium-sized animals would be expected to be able to pass through (e.g. reptiles and amphibians), climb over (e.g. raccoon, opossum), or burrow under (e.g. fox, groundhog) fencing. As described under Alternative A, these activities would be expected to occur only periodically and for short duration (hours to days). Therefore, it is expected the impacts of these actions on wildlife species would be long-term, negligible, and adverse under Alternative B.

The administration of chemical reproductive control agents would involve tracking and darting deer from tree stands and vehicles and possibly the use of bait. Increased movement of wildlife (e.g., birds, groundhogs, squirrels) may result as park staff travel to and from bait sites and tree stands, occupy darting areas, and track anesthetized deer. Bait piles also may be used by other wildlife resulting in a temporary concentration of some wildlife species (e.g., squirrels, birds) in these areas. These activities would be expected to occur across a small area of the park at any one time, and usually take place at night and over a relatively short time period. Therefore, it is expected the impacts of reproductive control on wildlife species would be long-term, negligible, and adverse under Alternative B.

Fencing would allow a diverse native plant community to develop, representing high quality wildlife habitat. Impacts on wildlife and wildlife habitat described for fenced areas under Alternative A would be the same under Alternative B (long-term and beneficial) but would occur over a larger area. However, due to the small area protected by fencing (10%-15% of the forested area of the park) benefits to wildlife would be expected to be limited.

Under Alternative B, white-tailed deer density would be expected to remain high throughout the life of the plan, exhibiting a continued trend toward increasing numbers or stabilizing at a very high density until reproductive control could be effectively implemented. As described under Alternative A, wildlife habitat in unfenced areas would continue to be degraded and high deer density would increase competition for available food resources between deer and other wildlife. Some wildlife species that have a more diverse diet or that spend more time in the upper canopy (versus the ground/shrub layer) would be less affected by high or increased deer density. Impacts described for unfenced areas under Alternative A, would be the same under Alternative B (long-term, major, and adverse).

As described under Alternative A, predators and other carnivores may benefit from the reduced understory and increased deer density. The impact on these species would be long-term and beneficial.

If successfully implemented, reproductive control would help reduce the impact on other wildlife by gradually reducing deer density and promoting restoration of high quality wildlife habitat. However, the time required to achieve these results are estimated to be between 18 and 19 years, beyond the life of this plan.

Currently, no wildlife species in the park, other than white-tailed deer, are susceptible to CWD. Implementation of live testing via tonsillar biopsy during reproductive control activities and removal of CWD-positive deer may result in temporary changes in wildlife movements. However, disturbance to wildlife as a result of these activities would be highly limited in both time and space. Therefore, under Alternative B, impacts on other wildlife and wildlife habitat would be short-term, negligible, and adverse.

The overall impact of Alternative B on other wildlife and wildlife habitat would be long-term, major, and adverse.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to other wildlife and wildlife habitat would be the same as those described under Alternative A. There is one slight difference under climate change.

As described above, climate change would likely affect the park's wildlife populations. Some species, including white-tailed deer, may be relatively unaffected or may even benefit from climate change but many others are likely to be adversely affected as a result of shifting distributions and quality of habitat due to changes in forest composition. As noted previously, it is difficult to predict the rate and magnitude of change to specific wildlife populations; however, as with vegetation, the adverse impacts of climate change on the park's wildlife would likely be long-term and range from minor to major in intensity. When added to the impacts of the no action alternative, the cumulative impacts would be long-term, adverse and would likely range from moderate to major in intensity. Since Alternative B would not reduce deer browsing quickly, the adverse cumulative impacts would result from continued heavy grazing and loss of forest regeneration, which would likely make the forests more vulnerable and less able to adapt to the environmental changes occurring as a result of climate change, which in turn, would lead to additional loss of habitat for birds and other wildlife.

These projects, along with Alternative B would result in a long-term, major, adverse cumulative impact on other wildlife and wildlife habitat. Alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

## Impacts of Alternative C

### **Impact Analysis**

Actions described under Alternative A would continue under Alternative C. In addition, under this alternative, the deer population would be reduced and maintained at the deer density goal through lethal reduction methods. If a confirmed case of CWD was documented within five miles of the park boundary or the park falls within a state-established CWD containment zone, active lethal CWD surveillance would be implemented and closely coordinated with the PGC. As described in section 4.1.1: Vegetation, impacts to vegetation and the vegetative elements of wildlife habitat would be long-term and beneficial under Alternative C.

Deer reduction and population maintenance would occur through the use of sharpshooting and capture and euthanasia. Increased movement of wildlife (e.g., birds, groundhogs, squirrels) may result as park staff travel to and from bait sites and tree stands, occupy shooting areas, discharge firearms, and conduct trapping activities (capture and euthanasia). These activities could temporarily disturb some species during the breeding season (e.g., owls). Bait piles also may be used by other wildlife resulting in a temporary concentration of some wildlife species (e.g., squirrels, birds) in these areas. However, these actions are expected to take place across a relatively small area at any one time and be of short duration. Given the small size of the impacted area and the limited nature of the actions, the impacts of these activities would be short-term, moderate, and adverse. These impacts may be reduced to negligible as deer density is reduced and fewer deer need to be removed annually.

Under Alternative C, white-tailed deer density is expected to decrease to 31-35 deer per square mile within four years. Reduction of deer density would release plant communities from heavy browse pressure and significantly improve the quality and quantity of wildlife habitat parkwide. As the forest herbaceous and shrub layers return, forests experience successful regeneration, and nectar plants return to meadows, wildlife communities would be provided with more, high quality forage, nesting sites for ground and shrub nesting bird species, and increased wildlife cover. This would lead to increased reproductive success and higher survival for most wildlife species. Under Alternative C, wildlife would be expected to increase in both species diversity and abundance and special status wildlife species may occur in the park more frequently.

Additionally, there would be less competition from deer for available resources such as acorns (Latham et al. 2005). Reproduction and over-winter survival of species such as the eastern chipmunk (*Tamias striatus*), gray squirrel (*Sciurus carolinensis*), and white-footed mouse (*Peromyscus leucopus*) would be expected to increase under Alternative C (Martin, Zim, and Nelson 1951; Miller and Getz 1977; Gashwiler 1979; Ostfeld, Jones, and Wolff 1996; Brooks and Healy 1988; McShea and Rappole 1992; McShea and Schwede 1993; McShea and Rappole 1997; McShea 2000). The impacts on these species would be long-term and beneficial.

Other species that have a more diverse diet or that spend more time in other habitat (e.g., amphibians, reptiles) or the upper canopy (e.g., woodpeckers) would be less affected by a reduced deer density, but would still benefit from changes in the native plant community (e.g., increased cover).

Predators that use deer as a food source, such as coyotes, could be adversely affected by a lower deer density or improved cover that may reduce hunting success. Other

animals that feed on deer carcasses, such as fox and vultures would also be adversely affected. However, none of these species solely depend on deer as a food source. As described above under Alternative C, small mammal reproductive success and survival would increase, leading to an increase in the size of the prey base. An increase in the prey base would ultimately benefit predators such as owls, hawks, fox, and coyotes. Therefore, these species would experience a long-term beneficial impact. Overall, under Alternative C, impacts of actions resulting from sharpshooting and capture and euthanasia on other wildlife and wildlife habitat would be long-term and beneficial.

Under Alternative C, if CWD was detected within five miles of the park boundary or the park falls within a state-established CWD containment zone, the park would implement active lethal surveillance activities to more effectively detect and monitor CWD. Active lethal surveillance would include rapid reduction to the target deer density and possibly implementation of a one-time action to further reduce deer density to not less than 10 deer per square mile. Rapid reduction would be carried out through sharpshooting and capture and euthanasia and would be expected to achieve the target deer density in approximately one-half the time described above for sharpshooting. Implementation of these actions may result in intensification of the changes in wildlife movements described above. These activities could temporarily disturb some species during the breeding season (e.g., owls). However, disturbance to wildlife as a result of these activities would be limited in both time and space. Therefore, impacts of these activities on other wildlife and wildlife habitat would be short-term, negligible to minor, and adverse.

Achieving the deer density goal more rapidly and/or reducing deer density to not less than 10 deer per square mile also would improve wildlife habitat more quickly. The impacts of these actions on other wildlife and wildlife habitat would be long-term and beneficial. Since white-tailed deer are the only species in the park susceptible to CWD, no additional direct impacts to other wildlife species would be expected to occur if CWD were present in the park. Overall, under Alternative C, the impacts of active lethal CWD surveillance on other wildlife and wildlife habitat would be long-term and beneficial.

The overall impact of Alternative C on other wildlife and wildlife habitat would be long-term and beneficial.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to other wildlife and wildlife habitat would be the same as those described under Alternative A.

As described above, climate change would likely affect the park's wildlife populations. Some species, including white-tailed deer, may be relatively unaffected or may even benefit from climate change but many others are likely to be adversely affected as a result of shifting distributions and quality of habitat due to changes in forest composition. As noted previously, it is difficult to predict the rate and magnitude of change to specific wildlife populations; however, as with vegetation, the adverse impacts of climate change on the park's wildlife would likely be long-term and range from minor to major in intensity. When added to the impacts of Alternative C, the overall cumulative impacts would likely remain long-term and adverse. However, Alternative C would reduce deer browsing pressure quickly and maintain the deer population at a level that would sustain forest regeneration. The reduction in deer browsing pressure may help offset some of the adverse effects of climate change



by increasing the overall ability of the forest ecosystem to respond and adapt to changing environmental conditions which, in turn, would likely help wildlife adapt.

These projects, along with Alternative C would result in a long-term beneficial cumulative impact on other wildlife and wildlife habitat. Alternative C would contribute a beneficial increment to the overall cumulative impact.

## **Impacts of Alternative D**

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### ***Impact Analysis***

Actions described under Alternative A would continue under Alternative D. In addition, lethal reduction methods would be implemented to reduce the size of the deer population to the target deer density of 31-35 deer per square mile as described under Alternative C. Once the density goal was obtained, reproductive control would be used to maintain the deer population at the reduced level as described under Alternative B if an acceptable chemical reproductive control agent was available. If not, then sharpshooting and capture and euthanasia would be used for deer population maintenance. If a confirmed case of CWD was documented within five miles of the park boundary or the park falls within a state-established CWD containment zone active lethal CWD surveillance would be implemented and closely coordinated with the PGC as described under Alternative C. As described in section 4.1.1: Vegetation, impacts to vegetation and the vegetative elements of wildlife habitat would be long-term and beneficial under Alternative D.

Under Alternative D, impacts of actions associated with sharpshooting and capture and euthanasia on other wildlife and wildlife habitat would be the same as described under Alternative C (long-term and beneficial). Impacts on other wildlife and wildlife habitat associated with implementation of reproductive control would be the same as described under Alternative B (long-term, negligible, and adverse). Lastly, impacts associated with implementation of active lethal CWD surveillance would be the same as described under Alternative C (long-term and beneficial).

The overall impact of Alternative D on other wildlife and wildlife habitat would be long-term and beneficial.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to other wildlife and wildlife habitat would be the same as those described under Alternative A. These projects, along with Alternative D would result in a long-term beneficial cumulative impact on other wildlife and wildlife habitat. Alternative D would contribute a beneficial increment to the overall cumulative impact.

## **Conclusion**

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The overall impact to other wildlife and wildlife habitat under Alternatives A and B would be long-term, major, and adverse. For both alternatives, the overall cumulative impact would be long-term, major, and adverse. Alternatives A and B would contribute appreciable adverse increments to the cumulative impact on other wildlife and wildlife habitat. Because there would be a major adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, and (3) identified in relevant NPS planning documents as being of significance, there is potential for

impairment of park resources or values related to other wildlife and wildlife habitat. The natural abundances, diversities, dynamics, and distributions of native plants and animals are key to a healthy ecological system and important to supporting the park's mission. Monitoring and research have shown a direct link between the deer population and the lack of forest structure, absence of native plant species, and spread of invasive plants. With little to no active management proposed under Alternative A, the deer population may continue to grow or stabilize at a high density, and under Alternative B, the deer population would not be reduced to the deer density goal within the life of the plan. Therefore, the continued high deer density may result in the potential for impairment of resources related to wildlife habitat under Alternatives A or B.

The overall impact to other wildlife and wildlife habitat under Alternatives C and D would be long-term and beneficial. For both alternatives, the overall cumulative impact would be beneficial. Alternatives C and D would contribute beneficial increments to the cumulative impact on other wildlife and wildlife habitat. Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, and (3) identified in relevant NPS planning documents as being of significance, there would be no impairment of park resources or values related to other wildlife and wildlife habitat as a result of Alternatives C or D.

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## 4.4 Impacts on Cultural Resources

Federal actions that have the potential to affect cultural resources are subject to a variety of laws. The National Historic Preservation Act is the principal legislative authority for managing cultural resources associated with federal projects. Generally, section 110 of the act requires federal agencies to establish preservation programs for the identification, evaluation, and nomination of historic properties to the National Register of Historic Places (National Register). Section 106 of the act requires all federal agencies to consider the effects of their actions on cultural resources listed on or determined eligible for listing on the National Register. Such resources are termed historic properties. Federal agencies must minimize harm to historic properties that would be adversely affected by a federal undertaking. Agreement on how to mitigate adverse effects on historic properties is reached through consultation with the SHPO; the Tribal Historic Preservation Officer, if applicable; and the Advisory Council on Historic Preservation (Advisory Council), as necessary.

Through this legislation, the NPS is charged with the protection and management of cultural resources in its custody. This is furthered implemented through DO #28: Cultural Resource Management and its supplement, DO #28A: Archeology (NPS 1998b); NPS *Management Policies 2006* (NPS 2005a); and the 1995 "Servicewide Programmatic Agreement among the National Park Service, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers." These documents charge NPS managers with avoiding, or minimizing to the greatest degree practicable, adverse impacts on park resources and values. Although the NPS has the discretion to allow certain impacts in parks, that discretion is limited by the statutory requirement that park resources and values remain unimpaired, unless a specific law directly provides otherwise.

The NPS categorizes cultural resources as archeological resources, cultural landscapes, historic structures, museum objects, and ethnographic resources. As noted under “Issues and Impact Topics” in Chapter 1: Purpose and Need for Action, only impacts to cultural landscapes, historic structures, and archeological resources are of potential concern for this plan/EIS. There would be no impacts on the other cultural resources.

The descriptions of effects on cultural resources presented in this section are intended to comply with the requirements of both NEPA and section 106 of the NHPA. In accordance with the regulations of the Advisory Council implementing section 106 (36 CFR Part 800, “Protection of Historic Properties”), impacts on cultural resources are to be identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that are either listed on or eligible to be listed on the National Register; (3) applying the criteria of an adverse effect to affected cultural resources either listed on or eligible to be listed on the National Register; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

Under the Advisory Council regulations, a determination of either *adverse effect* or *no adverse effect* must also be made for affected cultural resources eligible for listing on the National Register. An *adverse effect* occurs whenever an action alters, directly or indirectly, any of the characteristics that qualifies the resource for inclusion on the National Register (for example, diminishing the integrity of the resource’s location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the proposal that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5, “Assessment of Adverse Effects”). A determination of *no adverse effect* means there would either be no effect or that the effect would not diminish in any way the characteristics that qualify the cultural resource for inclusion on the National Register.

CEQ regulations and NPS DO #12 also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact, e.g., reducing the intensity of an impact from major to moderate or minor. Any resultant reduction in the intensity of an impact due to mitigation, however, is an estimate of the effectiveness of mitigation under NEPA only. Cultural resources are nonrenewable resources, and adverse effects generally consume, diminish, or destroy the original historic materials or form, resulting in a loss in the integrity of the resource that can never be recovered. Therefore, although actions determined to have an adverse effect under section 106 of the NHPA may be mitigated, the effect remains adverse.

A section 106 summary is included in the impact analysis sections for cultural landscapes, historic structures, and archeological resources. The section 106 summary is an assessment of the effect of the undertaking (implementation of the alternative) only on cultural resources listed on or eligible for the National Register, based on the criteria of effect and criteria of adverse effect found in the regulations of the Advisory Council.

#### 4.4.1 Impacts on Cultural Landscapes

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*Cultural landscapes are the result of the long interaction between people and the land, and the influence of human beliefs and actions over time upon the landscape.*

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##### Methodology and Intensity Thresholds

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Cultural landscapes are the result of the long interaction between people and the land, and the influence of human beliefs and actions over time upon the natural landscape. Shaped through time by land use and management practices, as well as politics and property laws, levels of technology, and economic conditions, cultural landscapes provide a living record of an area's past, as well as a visual chronicle of its history. The dynamic nature of modern human life, however, contributes to the continual reshaping of cultural landscapes; making them a good source of information about specific times and places, but at the same time rendering their long-term preservation a challenge.

In order for a cultural landscape to be listed on the National Register, it must possess significance (the meaning or value ascribed to the landscape) and have integrity of those features necessary to convey its significance. The character-defining features of a cultural landscape include spatial organization and land patterns, topography, vegetation, circulation patterns, water features, structures/buildings, site furnishings and objects. The Cultural Landscape Inventory and Report (Susan Maxman Architects and John Milner Associates, Inc. 2002) and the GMP (NPS 2007j) identify those features at Valley Forge NHP that contribute to the significance of the various cultural landscapes. For the purpose of this assessment, the alternative approaches for deer management may affect the open and closed patterns of the natural landscape and the plantings associated with the designed landscape, including commemorative plantings, tree allées along roads, and landscapes around buildings. The discussion of impacts on cultural landscapes will focus on these features.

For purposes of analyzing potential impacts on cultural landscapes, the thresholds of change for the intensity of an impact are defined as follows:

- |                          |  |
|--------------------------|--|
| <b><i>Negligible</i></b> | Impact is at the lowest levels of detection with neither adverse nor beneficial consequences. An assessment of effect according to section 106 of the NHPA would result in a determination of <i>no adverse effect</i> .   |
| <b><i>Minor</i></b>      | Alteration of a pattern(s) or feature(s) of the landscape would not diminish the overall integrity of the landscape. An assessment of effect according to section 106 of the NHPA would result in a determination of <i>no adverse effect</i> .  |
| <b><i>Moderate</i></b>   | Alteration of a pattern(s) or feature (s) of the landscape would diminish the overall integrity of the cultural landscape. An assessment of effect according to section 106 of the NHPA would result in a determination of <i>adverse effect</i> . A memorandum of agreement (MOA) is executed among the NPS and applicable state or tribal historic preservation officer and, if necessary, the Advisory Council in accordance with 36 CFR 800.6(b). Measures identified in the MOA to minimize or mitigate adverse impacts reduce the intensity of impact under NEPA from major to moderate. |
| <b><i>Major</i></b>      | Alteration of a pattern(s) or feature (s) of the landscape would diminish the overall integrity of the landscape. An assessment of effect according to section 106 of the NHPA would result in a   |

determination of *adverse effect*. Measures to minimize or mitigate adverse impacts cannot be agreed upon and the NPS and applicable state historic or tribal preservation officer and/or Advisory Council are unable to negotiate and execute a MOA in accordance with 36 CFR 800.6(b).

## Area of Analysis

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For the purpose of this analysis, the area of potential effect is defined as Valley Forge NHP.

## Impacts of Alternative A

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### **Impact Analysis**

Under Alternative A, park staff would continue to monitor vegetation and the deer population. The park also would continue to fence select species and sensitive areas. Coordination with the PGC and CWD surveillance would continue. Maintaining small fenced areas would protect select species from deer browsing. However, these actions would have little effect on the overall landscape. Therefore, the impact of maintaining current monitoring and fencing activities would be long-term and beneficial at a very minor scale, but would not reduce parkwide adverse impacts.

Under Alternative A, deer populations would be expected to increase or the population may stabilize at a very high density, and browsing would continue throughout the park, causing a decline in the long-term abundance and diversity of native plant species and contributing to further establishment of invasive exotic species within the park. As a result, the character-defining feature of the open and closed pattern of the cultural landscape would deteriorate. The degree of impact would depend on the size of the future deer population and the degree of continued decline in forest regeneration. If the existing situation continues, the open and closed patterns would be lost, resulting in a long-term, major, adverse impact on the cultural landscape.

As small ornamental trees die, the park would continue to decline to invest in replacements, since small trees are destroyed by deer within one season. This would result in the continuing loss of commemorative groves and individual dogwood and redbud trees.

Plantings in the designed landscape, such as the tree allées along roadways, commemorative groves and smaller plantings, and building landscapes, would continue to decline due to age. Typically, the park would replace larger species; however, any new plantings would be at risk of deer browse and most likely would not be successful. This would result in the loss of features that contribute to the cultural landscape. The loss of these features would result in a loss of integrity of the cultural landscape.

The overall impact of Alternative A on cultural landscapes would be long-term, major, and adverse.

### **Section 106 Summary**

After applying the Advisory Council criteria of adverse effects (36 CFR 800.5 Assessment of Adverse Effects), the NPS concludes that implementation of Alternative A would have an *adverse effect* on cultural landscapes.

### ***Cumulative Impacts***

Several past, present, and reasonably foreseeable future actions would contribute to the cumulative impact on cultural landscapes at Valley Forge NHP, including transportation corridor development, changes in air quality, natural resource management activities, cultural resource management activities, new construction in the park, land acquisition, hazardous material response, activity outside the park boundary, and inappropriate visitor use.

Previous transportation corridor development altered the landscape and composition of vegetation in and around Valley Forge NHP. These developments resulted in the removal of a number of different species of vegetation which are key components of the cultural landscape. The development of these transportation corridors also changed the landscape patterns which are also components of the cultural landscape. Most of these developments, however, have avoided the park. Future transportation corridor development projects include road closures and traffic calming. These actions would reduce the impact of the transportation network on the cultural landscape by slowing or removing vehicles within the historic setting. These developments would result in a long-term, minor, adverse impact.

Over the last twenty years, the entire Philadelphia region, including Valley Forge NHP, has experienced changes in air quality. Pollutants released into the air have led to acid deposition during storm events. The pollutants deposited on the earth by the rain have changed the quantity and quality of vegetation throughout the region. This has resulted in changes to the cultural landscape. Improvements in air quality standards and pollution prevention technology have recently improved the trend in air quality. Over time this should reduce the impact on vegetation in the park. The result of these actions would be a long-term beneficial impact.

Natural resource management activities in the park also have had and should continue to impact the vegetative patterns that are a component of the cultural landscape. Past and present actions include fencing of rare plant species and riparian areas, monitoring forest plant communities, and implementing field management plan and integrated pest management. These actions preserve naturally occurring plant and animal species and promote healthy vegetation. In the future, the park plans to continue these actions with an increased focus on invasive species management. The park also plans to reforest Waggoner and Fuller Fields and continue to participate in the Valley Creek Restoration Plan. This would enhance the vegetative communities that are important to the cultural landscape. These actions all would have long-term beneficial impacts on cultural landscapes.

The park has conducted and is proposing a number of new construction projects within the park boundary. These projects have resulted in small changes to vegetation, as new impervious surface is created and old surfaces are removed. These changes have altered the cultural landscape. However, areas that are cleared of impervious surface have been replanted with native vegetation. Additional development projects are expected to continue in the future. These projects have been and would continue to be designed to avoid changing important landscape features. These projects would have a long-term, minor, adverse impact on cultural landscapes.

A private developer has proposed major construction on an inholding within the park boundary. This project would have a long-term, major, adverse impact on cultural landscapes.

The park's past land acquisitions also have resulted in impacts to the cultural landscape. By acquiring land within its legislative boundary, Valley Forge NHP prevented these lands from being developed for residential or commercial uses. Preventing this development keeps the surrounding community from intruding on the cultural landscape. Future land acquisition would provide similar protection. The result of these actions would be long-term and beneficial.

Activity outside the park boundary has included rapid growth around the park. As development encroaches, viewsheds in the park are adversely affected and the understanding of the cultural landscape is diminished, a long-term, moderate, adverse impact, depending on the distance from the boundary, visibility, and mitigation.

Cultural resource management activities in the park also impact cultural landscapes. Future plans call for rehabilitation of key cultural landscapes. The filling of the quarries to their historic topography would provide a long-term and beneficial impact on cultural landscapes. Re-establishment of historic viewsheds would be long-term and beneficial.

Hazardous material response would result in future beneficial impacts on cultural landscapes. Remediation of asbestos within the park will include excavation of "hot spots" and application of fill to those areas. In every case, this work would take place in areas already greatly altered.

Inappropriate visitor use has resulted in impacts on cultural landscapes. These uses have resulted in accidental fires and trampling of low lying species found on earthworks. Accidental fires have resulted in the clearing of small amounts of vegetation. These areas have been open to successional development of vegetation and the spread of invasive species. The development of social trails has also created conditions that result in loss of vegetative cover and enhance the spread of invasive species. Trampling not only leads to loss of plant cover directly but also indirectly by causing soil compaction which prohibits the re-establishment of vegetation. Social trails also serve as a primary vector for the spread of nonnative plant species, allowing them to be introduced into and spread within areas where they were previously absent. The loss of native vegetation and the trampling of existing vegetation results in a loss of elements important to the cultural landscape. These actions result in a long-term, minor to moderate, adverse impact.

These projects, along with the impacts of Alternative A, would result in a long-term major, adverse cumulative impact on cultural landscapes at Valley Forge NHP. Alternative A would contribute an appreciable adverse increment to the overall cumulative impact.

## **Impacts of Alternative B**

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### ***Impact Analysis***

Several nonlethal actions would be implemented under this alternative, including the use of rotational fencing and reproductive control for does. Under this alternative, park staff would continue fencing and monitoring vegetation and the deer population. In addition, coordination with the PGC, and the park's CWD Response Plan would be implemented. Maintaining small fenced areas could protect select species from deer browsing. However, these actions would have little effect on the landscape. Therefore, the impact of maintaining current monitoring and fencing activities would be long-term and beneficial, but would not reduce adverse impacts.

Rotational fencing would enclose approximately 10-20 acres each. Assuming 9-15 fenced areas were established, 140-210 acres or about 10%-15% of woody vegetation (6% of the park) would be protected from deer browsing at any time during the plan, allowing for the regeneration of some forest vegetation within the fenced areas. Although habitat is becoming limited within the park, deer browsing would be more concentrated outside the fenced areas and could cause some continued decline in native plant populations in these areas and minimal forest regeneration. The inability of existing forests to successfully regenerate would result in a long-term, moderate, adverse impact on cultural landscapes.

In addition, the woven-wire, 8-foot-high rotational fencing would introduce a new structural element into the park's cultural landscape that would be inconsistent with the park's contributing buildings and structures. Based on the park's landscape and heavy visitor use, it would be difficult to locate these fences in areas that would not intrude on the park's historic landscape. However, the screening itself would alter the landscape and viewshed. During the winter and early spring, the lack of vegetation would make the fencing more visible in the park landscape. This would result in a long-term, minor, adverse impact on cultural landscapes.

Alternative B would also include the use of reproductive control techniques for does. This management option would not rapidly reduce the deer population. Therefore, during the life of the plan, the integrity of the landscape would continue to be diminished due to the inability of the forests to successfully regenerate or for new plantings to survive browsing. This would result in a long-term, moderate, adverse impact.

Beyond the life of the plan, deer population growth would be controlled through reproductive controls. The gradual reduction in the population would decrease the amount of browsing. This would allow the forests to successfully regenerate and new plantings to survive browsing, reestablishing important elements of the cultural landscape. This would result in a long-term beneficial impact to the park's cultural landscape.

If CWD were detected within five miles of the park boundary or the park fell within a state-established containment zone and reproductive control were being implemented, then a program of enhanced targeted CWD surveillance would be initiated. Under this plan, the park would initiate testing of deer via tonsillar biopsy and removal of CWD-positive deer from the population. This action would result in the removal of infected deer from the landscape, reducing the probability of CWD spread. However, this approach is unlikely to significantly reduce spread or promote elimination of CWD because deer would continue to remain at a relatively high population density and CWD-positive deer would remain in the landscape until test results were obtained. The impacts on cultural landscapes related to the implementation of the CWD plan would be similar to those described under Alternative A. The result would be a long-term, major, adverse impact on the cultural landscape.

The overall impact of Alternative B on cultural landscapes would be long-term, moderate, and adverse.

### **Section 106 Summary**

After applying the Advisory Council criteria of adverse effects (36 CFR 800.5 Assessment of Adverse Effects), the NPS concludes that implementation of Alternative B would have an *adverse effect* on cultural landscapes.



### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on cultural landscapes would be the same as those described under Alternative A. These projects, along with Alternative B, would result in a long-term, moderate, adverse cumulative impact on cultural landscapes. Alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

### **Impacts of Alternative C**

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#### ***Impact Analysis***

Under this alternative, lethal reduction would be used to reduce the deer population size. Park staff would continue fencing and monitoring vegetation and the deer population. Coordination with the PGC, and the park's CWD Response Plan would be implemented. Maintaining small fenced areas could protect select species from deer browsing. However, these actions would have little effect on the landscape. Therefore, the impact of maintaining current monitoring and fencing activities would be long-term and beneficial, but would not reduce adverse impacts.

Reducing the deer population from 193 deer per square mile (as of 2007) to 31-35 deer per square mile within approximately three years would result in diminished browsing pressure. This reduced pressure would allow the park's forested vegetation to successfully regenerate, thus maintaining the open and closed patterns of the cultural landscape. Decreased browsing, as well as the small fenced areas, would also help protect select landscape plantings and other landscape features. The park also could rehabilitate select landscape areas without the fear of plants being destroyed. These actions would result in a long-term beneficial impact on the cultural landscapes.

Sharpshooting activities related to deer reduction, such as setting up bait stations, occupying shooting areas, and dragging deer to locations for processing and transport; would have some temporary impacts on vegetation and, as a result, the cultural landscape. Sharpshooting could require portable tree stands to be temporarily hung in trees. Removing deer carcasses from the kill site could require dragging over vegetation, which would trample some woody vegetation. However, the area of impact from these actions would be small (less than 1% of park vegetation), resulting in a short-term, negligible, adverse impact on cultural landscapes.

If CWD were detected within five miles of the park boundary or the park fell within a state-established CWD containment zone, the park would implement active lethal surveillance as outlined in Section 2.5: Elements Common to the Action Alternatives. Under this plan, the park would initiate rapid lethal reduction of the deer population. The rapid reduction in the deer population density would quickly promote the successful regeneration of important landscape features. The result would be a long-term beneficial impact on the cultural landscape.

The overall impact of Alternative C on cultural landscapes would be long-term and beneficial.

### ***Section 106 Summary***

After applying the Advisory Council criteria of adverse effects (36 CFR 800.5 Assessment of Adverse Effects), the NPS concludes that implementation of Alternative C would have *no adverse effect* on cultural landscapes.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on cultural landscapes would be the same as those described under Alternative A. These projects, along with Alternative C, would result in a long-term beneficial cumulative impact on cultural landscapes. Alternative C would contribute a beneficial increment to the overall cumulative impact.

### **Impacts of Alternative D**

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#### ***Impact Analysis***

Under Alternative D, lethal reduction would be implemented to reduce the size of the deer population, as described in Alternative C. Once the goal of 31-35 deer per square mile was obtained, reproductive control, as described in Alternative B, and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. The impacts on cultural landscapes related to implementing these actions would be similar to those described in Alternative C. In addition, the impacts related to implementing active lethal surveillance under the CWD Response Plan would also be the same as described above.

The overall impact of Alternative D on the cultural landscape would be long-term and beneficial.

#### ***Section 106 Summary***

After applying the Advisory Council criteria of adverse effects (36 CFR 800.5 Assessment of Adverse Effects), the NPS concludes that implementation of Alternative D would have *no adverse effect* on cultural landscapes.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on cultural landscapes would be the same as those described under Alternative A. These projects, along with Alternative D, would result in a long-term beneficial cumulative impact on cultural landscapes. Alternative D would contribute a beneficial increment to the overall cumulative impact.

### **Conclusion**

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Depending on the alternative, the overall long-term adverse impact on cultural landscapes would range from negligible to major. Because deer browsing would continue unimpeded, the overall impact on cultural landscapes under Alternative A would be long-term, major, and adverse, and the overall cumulative impact would be long-term, major, and adverse. Alternative A would contribute appreciable adverse increments to the cumulative impact on cultural landscapes. For section 106, Alternative A would result in an *adverse effect*. Because there would be a major adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, and (3) identified in relevant NPS planning documents as being of significance, there may be an impairment of park resources or values related to cultural landscapes. As noted in Section 4.3: Impairment Analysis Method, this impairment may result from the continued heavy browsing by deer. Monitoring and research have shown a direct link between the deer population and the lack of forest structure, absence of native species, and spread of invasive plants. With little to no active management proposed under Alternative A, the deer population may continue to grow or stabilize at a high density, adversely impacting and possibly impairing the character-defining cultural landscape elements.

Under Alternative B, the deer population would not be reduced to the deer density goal within the life of the plan, adversely impacting the forest structure and thus the cultural landscape. Because larger areas would be protected via fencing than under Alternative A, the impact on cultural landscapes is long-term, moderate, and adverse. For section 106, Alternative B would result in an *adverse effect*. The overall cumulative impact would be long-term, moderate, and adverse with Alternative B contributing an appreciable adverse increment to the overall cumulative impact. Because there would be no major adverse impact to cultural landscapes, Alternative B would not result in impairment of cultural landscapes.

The overall impact on cultural landscapes under Alternatives C and D would be beneficial, reducing the existing long-term, adverse impact from major to negligible. Under section 106, Alternatives C and D would have *no adverse effect*. For both alternatives, the overall cumulative impact would be long-term and beneficial. Alternatives C and D would contribute beneficial increments to the cumulative impact on cultural landscapes. Because there would be no major adverse impacts, there would be no impairment of park resources or values related to cultural landscapes as a result of Alternative C or D.

## 4.4.2 Impacts on Historic Structures

### Methodology and Intensity Thresholds

In order for a structure to be listed on the National Register, it must be associated with an important historic context, i.e. possess significance - the meaning or value ascribed to the structure, and have integrity of those features necessary to convey its significance, i.e., location, design, setting, workmanship, materials, feeling, and association. An updated draft National Register nomination for the park is on review as of this writing. Its delineations of significant and contributing features are the basis for the analysis of impacts in this section. For the purposes of this assessment, the alternative approaches for deer management may affect the following historic structures: original historic earthworks and reconstructed forts. The discussion of impacts on historic structures will focus on these features.

For purposes of analyzing potential impacts on historic structures, the thresholds of change for the intensity of an impact are defined as follows:

- |                          |  |
|--------------------------|--|
| <b><i>Negligible</i></b> | Impact is at the lowest levels of detection, with neither adverse nor beneficial consequences. An assessment of effect according to section 106 of the NHPA would result in a determination of <i>no adverse effect</i> .  |
| <b><i>Minor</i></b>      | Alteration of a character-defining feature(s) would not diminish the overall integrity of the resource. An assessment of effect according to section 106 of the NHPA would result in a determination of <i>no adverse effect</i> .   |
| <b><i>Moderate</i></b>   | Alteration of a character-defining feature(s) would diminish the overall integrity of the resource. An assessment of effect according to section 106 of the NHPA would result in a determination of <i>adverse effect</i> . A MOA is executed among the NPS and applicable state or tribal historic preservation officer and, if necessary, the Advisory Council in accordance with 36 CFR 800.6(b). Measures identified in the MOA to minimize or mitigate adverse impacts reduce the intensity of impact under NEPA for major to moderate. |

**Major** Alteration of a character-defining feature(s) would diminish the overall integrity of the resource. An assessment of effect according to section 106 of the NHPA would result in a determination of *adverse effect*. Measures to minimize or mitigate adverse impacts cannot be agreed upon, and the NPS and applicable state or tribal historic preservation officer and/or Advisory Council are unable to negotiate and execute a MOA in accordance with 36 CFR 800.6(b).

### Area of Analysis

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For the purpose of this analysis, the area of potential effect is defined as Valley Forge NHP and is limited to the historic earthworks and partially reconstructed forts and redans.

### Impacts of Alternative A

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#### **Impact Analysis**

Over the years, deer browsing and trampling has contributed to the erosion of historic original earthworks and ten partially reconstructed forts and redans. All of the park's original earthworks are located on Mount Misery, in areas where public access is limited. Therefore, the deterioration can be directly attributable to the deer population.

Under Alternative A, park staff would continue monitoring vegetation and the deer population. The park also would continue to fence select species and sensitive areas. Coordination with the PGC, and initiation of CWD surveillance would be implemented. Maintaining small fenced areas would protect select species from deer browsing. However, these actions would have no effect on the park's historic structures. Therefore, the impact of maintaining current monitoring and fencing activities would be long-term and beneficial, but would not reduce adverse impacts to historic structures.

Under Alternative A, park staff would continue to monitor the vegetation and the deer population; however, no management actions would be taken to control or maintain the population. Deer populations would be expected to increase or the population may stabilize at a very high density, and browsing and trampling would continue throughout the park. Unprotected earthworks and the forts and redans would continue to erode, as additional plantings to protect these structures would not be successful. As a result, these features may be diminished or lost, resulting in a long-term, major, adverse impact on historic structures.

The overall impact of Alternative A on historic structures would be long-term, major, and adverse.

#### **Section 106 Summary**

After applying the Advisory Council criteria of adverse effects (36 CFR 800.5 Assessment of Adverse Effects), the NPS concludes that implementation of Alternative B would have an *adverse effect* on historic structures.

#### **Cumulative Impacts**

Several past, present, and reasonably foreseeable future actions would contribute to the cumulative impact on historic structures at Valley Forge NHP, including cultural resource management activities and inappropriate visitor use.

As described in the park's GMP/EIS (NPS 2007j), cultural resource management activities would include preservation of the encampment-period earthworks, a long-term beneficial impact. However, if the deer population continues to increase or stabilize at a very high density, these efforts would be unsuccessful and infeasible.

Inappropriate visitor use, such as the formation of social trails, has contributed to the erosion of the historic earthworks and reconstructed forts in publicly accessible areas. If this use is not managed, through plantings or enforcement, trampling would continue to cause erosion of these structures. This would result in a long-term, moderate, adverse impact.

These projects, along with the impacts of Alternative A, would result in a long-term major, adverse cumulative impact on historic structures at Valley Forge NHP. Alternative A would contribute an appreciable adverse increment to the overall cumulative impact.

## **Impacts of Alternative B**

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### ***Impact Analysis***

Several nonlethal actions would be implemented under this alternative, including the use of rotational fencing and reproductive control for does. Under this alternative, park staff would continue fencing and monitoring vegetation and the deer population. Coordination with the PGC, and the park's CWD Response Plan would be implemented. Maintaining small fenced areas could protect select species from deer browsing. However, these actions would have no effect on the park's historic structures. Therefore, the impact of maintaining current monitoring and fencing activities would be long-term and beneficial, but would not reduce adverse impacts to historic structures.

The rotational fenced areas would enclose approximately 10-20 acres each. Assuming 9-15 fenced areas were established, 140-210 acres or about 10%-15% of woody vegetation (6% of the park) would be protected from deer browsing at any time during the plan, allowing for the regeneration of forest vegetation within the fenced areas. Although habitat is becoming limited within the park, deer browsing would be more concentrated outside the fenced areas and would cause continued erosion of the historic earthworks and forts and redans. If the fences were placed around the structures, then deer browse and trampling would be eliminated. Depending on the location of the fences, the impact on historic structures would be long-term, moderate to major, and adverse.

If CWD were detected within five miles of the park boundary or the park fell within a state-established containment zone and reproductive control were being implemented, then a program of enhanced targeted CWD surveillance would be initiated. Under this plan, the park would initiate testing of deer via tonsillar biopsy and removal of CWD-positive deer from the population. This action would result in the removal of infected deer from the landscape, reducing the probability of CWD spread. However, this approach is unlikely to significantly reduce spread or promote elimination of CWD, because deer would continue to remain at a relatively high population density and CWD-positive deer would remain in the landscape until test results were obtained. Existing deer browse and trampling would remain high. The impacts on historic structures related to the implementation of the CWD plan are similar to those described under Alternative A. The result would be a long-term, major, adverse impact on historic structures.

The overall impact of Alternative B on historic structures would be long-term, moderate to major, and adverse.

### **Section 106 Summary**

After applying the Advisory Council criteria of adverse effects (36 CFR 800.5 Assessment of Adverse Effects), the NPS concludes that implementation of Alternative B would have an *adverse effect* on historic structures.

### **Cumulative Impacts**

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on historic structures would be the same as those described under Alternative A. These projects, along with Alternative B, would result in a long-term, moderate to major, adverse cumulative impact on historic structures. Alternative B would contribute a noticeable adverse increment to the overall cumulative impact.

## **Impacts of Alternative C**

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### **Impact Analysis**

Under this alternative, lethal reduction would be used to reduce the deer population size. Under this alternative, park staff would continue fencing and monitoring vegetation and the deer population. Coordination with the PGC, and the park's CWD Response Plan would be implemented. Maintaining small fenced areas could protect select species from deer browsing. However, these actions would have no effect on the park's historic structures. Therefore, the impact of maintaining current monitoring and fencing activities would be long-term and beneficial, but would not reduce adverse impacts to historic structures.

Reducing the deer population from 193 deer per square mile (as of 2007) to 31-35 deer per square mile within approximately three years would result in diminished trampling and browsing pressure. This reduced pressure would lessen trampling and allow vegetation to be maintained on the historic earthworks and forts and redans, and erosion would be minimized. These actions would result in a long-term beneficial impact on the historic structures.

If CWD were detected within five miles of the park boundary or the park fell within a state-established CWD containment zone, the park would implement active lethal surveillance as outlined in Section 2.5: Elements Common to the Action Alternatives. Under this plan, the park would initiate rapid lethal reduction of the deer population. The result would be a long-term beneficial impact on historic structures.

The overall impact of Alternative C on historic structures would be long-term and beneficial.

### **Section 106 Summary**

After applying the Advisory Council criteria of adverse effects (36 CFR 800.5 Assessment of Adverse Effects), the NPS concludes that implementation of Alternative C would have *no adverse effect* on historic structures.

### **Cumulative Impacts**

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on historic structures would be the same as those described under Alternative A. These projects, along with Alternative C, would result in a long-term, beneficial cumulative impact on historic structures. Alternative C would contribute a beneficial increment to the overall cumulative impact.

## Impacts of Alternative D

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### ***Impact Analysis***

Under Alternative D, lethal reduction would be implemented to reduce the size of the deer population, as described in Alternative C. Park staff would continue fencing and monitoring vegetation and the deer population. Coordination with the PGC, and the park's CWD Response Plan would be implemented. Maintaining small fenced areas could protect select species from deer browsing. However, these actions would have no effect on the park's historic structures. Therefore, the impact of maintaining current monitoring and fencing activities would be long-term and beneficial, but would not reduce adverse impacts.

Once the goal of 31-35 deer per square mile was obtained, reproductive control, as described in Alternative B, and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. The impacts on historic structures related to implementing these actions would be similar to those described in Alternative C. In addition, the impacts related to implementing active lethal surveillance under the CWD Response Plan would also be the same as described above. Overall, Alternative D would result in a long-term, beneficial impact on historic structures.

The overall impact of Alternative D on historic structures would be long-term and beneficial.

### ***Section 106 Summary***

After applying the Advisory Council criteria of adverse effects (36 CFR 800.5 Assessment of Adverse Effects), the NPS concludes that implementation of Alternative C would have *no adverse effect* on historic structures.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on historic structures would be the same as those described under Alternative A. These projects, along with Alternative D, would result in a long-term, beneficial cumulative impact on historic structures. Alternative D would contribute a beneficial increment to the overall cumulative impact.

## Conclusion

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Because deer browsing and trampling would continue unimpeded, the overall impact on historic structures under Alternative A would be long-term, major, and adverse, and the overall cumulative impact would be long-term, major, and adverse. Alternative A would contribute appreciable adverse increments to the cumulative impact on historic structures. For section 106, Alternative A would result in an *adverse effect*. Because there would be a major adverse impact due to the loss of some historic earthworks and forts and redans, this would constitute an impairment of historic structures. Because the resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, and (3) identified in relevant NPS planning documents as being of significance would be destroyed, Alternative A would result in an impairment of park resources or values related to historic structures.

Under Alternative B, the deer population would not be reduced to the target deer density within the life of the plan, continuing the erosion of historic structures.

Depending on the location of the large fenced areas, the long-term, adverse impact on historic structures would range from moderate to major. For section 106, Alternative B would result in an *adverse effect*. The overall cumulative impact would be long-term, moderate to major, and adverse with Alternative B contributing a noticeable adverse increment to the overall cumulative impact. Because there would be a major adverse impact to historic structures, Alternative B would result in impairment of historic structures.

The overall impact on historic structures under Alternatives C and D would be beneficial. Under section 106, Alternatives C and D would have *no adverse effect*. For both alternatives, the overall cumulative impact would be long-term and beneficial. Alternatives C and D would contribute beneficial increments to the cumulative impact on historic structures. Because there would be no major adverse impacts, there would be no impairment of park resources or values related to historic structures as a result of Alternative C or D.

### 4.4.3 Impacts on Archeological Resources

#### Methodology and Intensity Thresholds

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The archeological sites within the park contribute to its national register significance. Three archeological overviews and assessments were completed for the park by 2002. The delineation of significant and contributing features forms the basis for the analysis of impacts in this section.

For purposes of analyzing impacts on archeological resources, the following thresholds of change for the intensity of an impact are based on the potential of the site to yield information important in prehistory or history, as well as the historic context of the affected site:

- |                          |  |
|--------------------------|--|
| <b><i>Negligible</i></b> | Impact is at the lowest levels of detection with neither adverse nor beneficial consequences. An assessment of effect according to section 106 of the NHPA would result in a determination of <i>no adverse effect</i> .   |
| <b><i>Minor</i></b>      | Disturbance of a site(s) results in little, if any, loss of integrity. An assessment of effect according to section 106 of the NHPA would result in a determination of <i>no adverse effect</i> .  |
| <b><i>Moderate</i></b>   | Disturbance of a site(s) results in loss of integrity. An assessment of effect according to section 106 of the NHPA would result in a determination of <i>adverse effect</i> . A MOA is executed among the NPS and applicable state or tribal historic preservation officer and, if necessary, the Advisory Council in accordance with 36 CFR 800.6(b). Measures identified in the MOA to minimize or mitigate adverse impacts reduce the intensity under NEPA from major to moderate. |
| <b><i>Major</i></b>      | Disturbance of a site(s) results in loss of integrity. An assessment of effect according to section 106 of the NHPA would result in a determination of <i>adverse effect</i> . Measures to minimize or mitigate adverse impacts cannot be agreed upon and the NPS and applicable state or tribal historic preservation officer and/or Advisory Council are unable to negotiate and execute a MOA in accordance with 36 CFR 800.6(b).   |



## Area of Analysis

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For the purpose of this analysis, the area of potential effect is defined as Valley Forge NHP.

## Impacts of Alternative A

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### ***Impact Analysis***

Under Alternative A, park staff would continue to monitor the vegetation and the deer population. The park would also initiate coordination with the PGC and implement the CWD Response Plan; however, no management actions would be taken to control or maintain the population. Deer populations would be expected to increase or the population may stabilize at a very high density, and browsing and trampling would continue throughout the park. Visual observations made by long-time park staff have noted that deer trampling has eroded unprotected archeological sites, such as exposed hut holes and charcoal hearths. Under this alternative, these resources would continue to erode. These features may be lost, resulting in a long-term, major, adverse impact on archeological resources.

Park staff also would continue to construct and maintain small fencing to protect sensitive species or landscape plantings. Installing fences around sensitive plant species and landscape plantings throughout the park could cause minimal ground surface disturbance and potentially disturb unknown archeological resources. As the deer population grows over time or stabilizes at a high density, more and more small fenced areas could be required to further protect sensitive resources, increasing the likelihood that some archeological resources could be disturbed. This would result in a long-term, minor, adverse impact.

Continued trampling of encampment-era archeological resources by deer and continued erosion of soil protecting these resources because of the absence of vegetative cover would result in a long-term, major, adverse impact. The monitoring of sensitive areas would aid in minimizing potential adverse effects. This would result in a long-term, major, adverse impact.

The overall impact of Alternative A on archeological resources would be long-term, major, and adverse.

### ***Section 106 Summary***

After applying the Advisory Council criteria of adverse effects (36 CFR 800.5 Assessment of Adverse Effects), the NPS concludes that implementation of Alternative A would have an *adverse effect* on archeological resources.

### ***Cumulative Impacts***

Several past, present, and reasonably foreseeable future actions would contribute to the cumulative impact on archeological resources at Valley Forge NHP, including cultural resource management activities, land acquisition, activity outside the park boundary, and inappropriate visitor use.

As described in the park's GMP (NPS 2007j), cultural resource management activities would include stabilization and protection of archeological resources against destruction from erosion and inappropriate visitor use, a long-term, beneficial impact. However, if the deer population continues to increase or stabilize at a very high density, these efforts would be unsuccessful and infeasible.

Land acquisition by the park has protected archeological resources from being destroyed by development. Additional future land acquisitions would further protect these resources, a long-term beneficial impact.

New construction within the park boundary could adversely impact archeological resources. Because the entire park is considered an archeological site, any ground disturbance has the potential to encounter unknown archeological resources. Construction on the federal lands of the park would include avoidance, or appropriate coordination, monitoring, and mitigation to avoid adverse impacts. These actions would result in long-term, minor to moderate, adverse impacts. A private developer has proposed major construction on an inholding within the park boundary. This project would have a long-term, major, adverse impact on cultural landscapes.

Inappropriate visitor use, such as the formation of social trails, has contributed to the exposure of archeological resources in publicly accessible areas. If this use is not managed through plantings or fencing, trampling would continue to cause soil erosion and exposure of these resources, a long-term, moderate, adverse impact.

These projects, along with the impacts of Alternative A, would result in a long-term major, adverse cumulative impact on archeological resources at Valley Forge NHP. Alternative A would contribute an appreciable adverse increment to the overall cumulative impact.

## **Impacts of Alternative B**

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### ***Impact Analysis***

Under Alternative B, park staff would continue to monitor vegetation and the deer population. The park also would continue to fence select species and sensitive areas. Coordination with the PGC, and initiation of the park's CWD Response Plan would be implemented. Maintaining small fenced areas would protect select species from deer browsing. However, these actions would have no effect on the park's archeological resources.

Under Alternative B, several nonlethal actions would be implemented. Actions would include the use of rotational fencing and reproductive control of does, as well as the actions included under Alternative A. However, the deer population would not be reduced to the deer density goal within the life of the plan, continuing the trampling and erosion of archeological resources. Although habitat is becoming limited within the park, deer browsing would be more concentrated outside the fenced areas and would cause continued erosion of archeological resources. If the fences were placed around key structures, such as hut holes or the charcoal hearths, then deer browse and trampling would be eliminated in these areas. Archeological resources located outside the rotational fencing would face increased trampling, as the deer population was forced to those portions of the park. The impact on these archeological resources would be long-term, major, and adverse.

Archeological resources located within the rotational fencing would be protected against trampling. Vegetation regeneration would provide additional protection and stability to these resources. However, once the fencing was removed, the new herbaceous vegetation would attract intense deer browsing. This would increase the chance of archeological resources being trampled. Therefore, there would be a short-term beneficial impact to archeological resources within the rotational fencing. However, over the long-term, this impact would be major and adverse.

Each fenced area would be approximately 1,000 square feet and a minimum of 8 feet tall; with woven wire fence, metal fence posts, and wooden 4- by 4-inch posts set in concrete on the corners and at every 100-foot interval. Installing the rotational fencing, particularly the placement of the concrete-reinforced wooden posts, would result in numerous areas of ground surface disturbance at the base of the posts. Of particular concern are those resources throughout the park that have not yet been identified, recorded, and protected by the NPS. Monitoring would take place in all areas of fence construction, and installation would stop should any unknown archeological resources be discovered. The presence of extensive archeological resources in the park limits the number and extent of areas suitable for rotational fencing. The construction of rotational fencing would result in a long-term, moderate, adverse impact.

If CWD were detected within five miles of the park boundary or the park fell within a state-established containment zone and reproductive control were being implemented, then a program of enhanced targeted CWD surveillance would be initiated. Under this plan, the park would initiate testing of deer via tonsillar biopsy and removal of CWD-positive deer from the population. This action would result in the removal of infected deer from the landscape, reducing the probability of CWD spread. However, deer would remain at a relatively high population density and CWD-positive deer would remain in the park until test results were obtained. The result would be a long-term, major, adverse impact on archeological resources.

The overall impact of Alternative B on archeological resources would be long-term, major, and adverse.

### **Section 106 Summary**

After applying the Advisory Council criteria of adverse effects (36 CFR 800.5 Assessment of Adverse Effects), the NPS concludes that implementation of Alternative B would have an *adverse effect* on archeological resources.

### **Cumulative Impacts**

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on archeological resources would be the same as those described under Alternative A. These projects, along with Alternative B, would result in a long-term, major, adverse cumulative impact on archeological resources. Alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

## **Impacts of Alternative C**

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### **Impact Analysis**

Under Alternative C, park staff would continue to monitor vegetation and the deer population. The park also would continue to fence select species and sensitive areas. Coordination with the PGC, and initiation of the park's CWD Response Plan would be implemented. Maintaining small fenced areas would protect select species from deer browsing. However, these actions would have no effect on the park's archeological resources.

Under this alternative, lethal reduction would be used to reduce the deer population. The location of bait stations and traps would be planned to avoid known archeological resources. Because these activities would involve minimal surface disturbance, unknown archeological resources would not be at risk. This would result in a long-term, negligible, adverse impact to archeological resources.

Reducing the deer population from 193 deer per square mile (as of 2007) to 31-35 deer per square mile within approximately three years would result in diminished trampling and browsing pressure, allowing vegetation to be maintained on archeological resources, and minimizing erosion. These actions would result in a long-term beneficial impact on archeological resources, especially the hut holes and charcoal hearths.

If CWD were detected within five miles of the park boundary or the park fell within a state-established CWD containment zone, the park would implement active lethal surveillance as outlined in Section 2.5: Elements Common to the Action Alternatives. Under this plan, the park would initiate rapid lethal reduction of the deer population. The result would be a long-term beneficial impact on archeological resources.

The overall impact of Alternative C on archeological resources would be long-term and beneficial.

### **Section 106 Summary**

After applying the Advisory Council criteria of adverse effects (36 CFR 800.5 Assessment of Adverse Effects), the NPS concludes that implementation of Alternative C would have *no adverse effect* on archeological resources.

### **Cumulative Impacts**

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on archeological resources would be the same as those described under Alternative A. These projects, along with Alternative C, would result in a beneficial cumulative impact on archeological resources. Alternative C would contribute a beneficial increment to the overall cumulative impact.

### **Impacts of Alternative D**

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#### **Impact Analysis**

Under Alternative D, park staff would continue monitoring vegetation and the deer population. The park also would continue to fence select species and sensitive areas. Coordination with the PGC, and initiation of the park's CWD Response Plan would be implemented. Maintaining small fenced areas would have no effect on the park's archeological resources.

Under Alternative D, lethal reduction would be implemented to reduce the size of the deer population, and reproductive control with lethal reduction (if needed) would be used to maintain lower population numbers. The location of bait stations and traps would be planned to avoid known archeological resources. Because these activities would involve minimal surface disturbance, unknown archeological resources would not be at risk. These actions represent the only ground disturbance potential, as this alternative does not include rotational fencing. This would result in a long-term, negligible, adverse impact to archeological resources.

Reducing the deer population from 193 deer per square mile (as of 2007) to 31-35 deer per square mile within approximately three years would result in diminished trampling and browsing pressure, allowing vegetation to be maintained on archeological resources, and minimizing erosion. These actions would result in a long-term beneficial impact on archeological resources, especially the hut holes and charcoal hearths.

If CWD were detected within five miles of the park boundary or the park fell within a state-established CWD containment zone, the park would implement active lethal surveillance as outlined in Section 2.5: Elements Common to the Action Alternatives. Under this plan, the park would initiate rapid lethal reduction of the deer population. The result would be a long-term beneficial impact on archeological resources.

The overall impact of Alternative D on archeological resources would be long-term and beneficial, reducing adverse impacts to negligible.

### **Section 106 Summary**

After applying the Advisory Council criteria of adverse effects (36 CFR 800.5 Assessment of Adverse Effects), the NPS concludes that implementation of Alternative D would have *no adverse effect* on archeological resources.

### **Cumulative Impacts**

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on archeological resources would be the same as those described under Alternative A. These projects, along with Alternative D, would result in a long-term beneficial cumulative impact on archeological resources. Alternative D would contribute a beneficial increment to the overall cumulative impact.

### **Conclusion**

Depending on the alternative, the overall long-term adverse impact on archeological resources would range from negligible to major. Because deer browsing and trampling would continue unimpeded, the overall impact on archeological resources under Alternative A would be long-term, major, and adverse, and the overall cumulative impact would be long-term, major, and adverse. Alternative A would contribute appreciable adverse increments to the cumulative impact on archeological resources. Because there would be a major adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, and (3) identified in relevant NPS planning documents as being of significance, there is potential for an impairment of park resources or values related to archeological resources.

Under Alternative B, the deer population would not be reduced to the deer density goal within the life of the plan, continuing the erosion of some archeological resources. Because rotational fencing would only provide temporary protection to a limited number of the park's resources, the overall impact would be long-term, major, and adverse. For section 106, Alternative B would result in an *adverse effect*. The overall cumulative impact would be long-term, major, and adverse, with Alternative B contributing an appreciable adverse increment to the overall cumulative impact. Because there would be a major adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the park's establishing legislation, (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, and (3) identified in relevant NPS planning documents as being of significance, there is potential for an impairment of park resources or values related to archeological resources.

The overall impact on archeological resources under Alternatives C and D would be beneficial, reducing the existing long-term, adverse impact from major to negligible. Under section 106, Alternatives C and D would have *no adverse effect*. For both alternatives, the overall cumulative impact would be long-term and beneficial.

Alternatives C and D would contribute beneficial increments to the cumulative impact on archeological resources. Because there would be no major adverse impacts, there would be no impairment of park resources or values related to archeological resources as a result of Alternative C or D.

## 4.5 Impacts on Visitor Use and Experience

The NPS *Management Policies 2006* (NPS 2005a) state that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Management goals include making available to the public traditional outdoor recreational opportunities that are not detrimental to the natural or cultural resources of the park.

Preservation and conservation are key components of the NPS *Management Policies 2006*. The NPS achieves its preservation and conservation purposes by working to maintain all native plants and animals as parts of the natural ecosystem, emphasizing preservation and conservation over recreation. The NPS will achieve this by preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur (NPS 2005a).

Past visitor use data and comments from the public were used to estimate the effects of the alternative actions on visitors. The impact on the ability of visitors to experience a full range of park resources was analyzed by examining resources mentioned in the park's significance statement. The thresholds for the intensity of an impact are defined as follows:

### **Impact Thresholds**

- |                          |   |
|--------------------------|---|
| <b><i>Negligible</i></b> | Visitors would not be affected or changes in visitor use and/or experience would be below or at the level of detection. Any impact would be short-term. The visitor likely would not be aware of the impacts associated with the alternative.                           |
| <b><i>Minor</i></b>      | Changes in visitor use and/or experience would be detectable, although the changes would be slight and likely short-term. The visitor would be aware of the impacts associated with the alternative, but the impacts would be slight.                                   |
| <b><i>Moderate</i></b>   | Changes in visitor use and/or experience would be readily apparent and likely long-term. The visitor would be aware of the impacts associated with the alternative and would likely express an opinion about the changes.   |
| <b><i>Major</i></b>      | Changes in visitor use and/or experience would be readily apparent, severely adverse, and have important long-term consequences. The visitor would be aware of the impacts associated with the alternative and would likely express a strong opinion about the changes. |

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*NPS Management Policies 2006 state that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks.*

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## Area of Analysis

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For the purpose of this analysis, the area of potential effect is defined as Valley Forge NHP.

## Impacts of Alternative A

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### ***Impact Analysis***

Under Alternative A, NPS staff would continue to monitor the vegetation and deer populations at Valley Forge NHP. The park also would initiate coordination with the PGC and CWD surveillance. Park staff would continue to construct small fenced areas to protect sensitive species and plant communities from deer browsing. Fencing used for these actions could provide some visual intrusion into the viewshed and historic landscape. These actions would have beneficial impacts on select resources but would have no impact on the visitor use and experience.

Under this alternative, as long as the closest confirmed case of CWD was at least 60 miles from the park boundary, the park would continue to use a contractor to remove roadkill deer from the park. This would have a long-term beneficial impact.

A recent survey of park visitors and local residents noted that approximately 50% of the respondents believed the presence of deer at Valley Forge NHP created positive wildlife viewing opportunities, despite adverse impacts to vegetation (Leong and Decker 2007). Under Alternative A, no action would be taken to reduce the deer population at the park. Although there may be some fluctuations in the population due to disease or other environmental factors, the deer population would continue to grow over time or stabilize at a high density. This would make viewing opportunities more frequent. However, the increasing population could eliminate habitat and food sources for other species. This would reduce or eliminate opportunities to view wildlife species other than deer. In addition, an increase in deer numbers could also adversely affect the health of the herd, and if the deer population drastically declined due to disease or malnutrition, or if visitors saw ill or emaciated deer, visitor experience could be adversely affected. This would result in a long-term, moderate, adverse impact.

Other visitor activities would be impacted by the lack of control over the deer population. Visitors who come to the park for recreational or cultural activities would continue to note changes in the landscape. Visitors who participated in hiking, biking, or guided tours would become more aware of the degradation of the natural communities and the decline or loss of forests due to lack of successful regeneration, and the absence of the full suite of vegetative and faunal species that should be present, adversely affects visitors who wish to experience the natural environment. Similarly, visitors who came to the park for cultural events could see the historic landscape and resources continue to degrade. This would result in a long-term, moderate, adverse impact.

Educational activities would continue at the park. Because there would be no changes in natural resource management, educational programs would remain unchanged. The park would continue to educate visitors about the impacts of the growing deer population. These educational activities would have a long-term beneficial impact.

The overall impact of Alternative A on visitor use and experience would be long-term, negligible, and adverse.

### ***Cumulative Impacts***

Several past, present, and reasonably foreseeable future actions would contribute to the cumulative impact on visitor use and experience at Valley Forge NHP, including transportation corridor development, changes in air quality, natural resource management activities, new construction in the park, land acquisition, asbestos release site remediation, activity outside the park boundary, and inappropriate visitor use.

Transportation corridor development has had and would continue to affect visitor use and experience at Valley Forge NHP. Past developments have improved access throughout the community and to the park. Regular maintenance activities within existing transportation corridors may create some short-term impacts to visitor use and experience. However, these activities provide a long-term benefit to the visitor. As traffic levels have increased, some of these transportation corridors have adversely impacted the visitor experience in the park. Future plans seek to address these problems by closing or rerouting roads and implementing traffic calming measures. Improved access options, such as public transit, would further improve the visitor experience. New trail connections would also improve the visitor experience within the park. These actions would have a long-term beneficial impact on the visitor use and experience at Valley Forge NHP.

Changes in air quality have impacted the visitor experience at Valley Forge NHP. Both Chester and Montgomery County have been identified by the EPA as nonattainment areas for one-hour and eight-hour concentrations of ozone. These counties are within attainment for other criteria pollutants (NPS 2007j). Poor air quality can impact the conditions in which the visitor experiences the park. An example of these limitations occurs when high particulate matter in the air reduces visibility within the park. High ozone levels impact vegetation that comprises an important piece of the visitor experience. As air quality trends improve, these conditions should improve as well. These improvements would result in a long-term beneficial impact.

Because the park's natural environment comprises an important piece of the visitor experience, the park's natural resource management activities have an effect on the visitor use within the park. Past and current natural resource management activities have focused on fencing of sensitive species and monitoring forest communities. These activities have little impact on the use of the park, but have contributed to improving educational programs offered to visitors. The park's field management plan has also shaped the environment in which visitors experience the park. Future plans include these actions along with improved pest management. These efforts would allow for the growth of more native plant and animal species and lead to a greater understanding of the region's environment. Reforestation of Waggoner and Fuller fields would further this understanding. Some visitors that appreciate the open understory and clear views through much of the park would have their experience altered by future natural resource management. Despite these changes, the majority of the park's visitors would have an improved experience. Therefore, these actions would result in long-term beneficial impacts on the visitor use and experience at Valley Forge NHP.

New construction within the park boundary has an impact on the visitor use and experience at Valley Forge NHP. During the construction process, short-term impacts could occur as portions of the park were closed to visitors and construction noise carried across the park. However, once construction was complete, the new facilities or restored areas would provide new access and recreational opportunities at the park. These developments would have long-term beneficial impacts on visitor use and experience.



Land acquisition has an impact on visitor use and experience. By acquiring land within its legislative boundary, the park has protected the natural and cultural resources of those lands from being lost to development. Land acquisition allows the NPS to protect the lands and resources that visitors want to see and experience. These actions have had and would continue to have a long-term beneficial impact on visitor use and experience.

Cultural resource management activities impact visitor use and experience. Future plans to re-establish historic viewsheds and restore the cultural landscape would further the visitor's understanding and appreciation of the history of Valley Forge. These actions would have a long-term beneficial impact on visitor use and experience.

Asbestos Release Site remediation has had and would continue to have repeated, short-term impacts on the visitor use and experience. A 112-acre portion of the park is closed to visitors. Future remediation would bring heavy machinery, noise, and demolition of some wooded areas (although they are comprised primarily of exotic invasive species). On completion, however, the area would be reopened to safe public use, a long-term beneficial impact.

Activity outside the park boundary can impact visitor use and experience. Past, present, and future development transforms the region's rural character into a developed community. This detracts from the historic nature of the park, but also magnifies the importance of the protection the park provides. Hunting has and would continue to occur outside the park. This hunting plays a small role in controlling the growing deer population in the area. This can have positive and negative impacts on the visitor experience. These actions would have a long-term, minor to moderate, adverse impact on visitor use and experience.

Inappropriate visitor use has and could continue to impact the visitor experience. Disregard a lack of understanding of park resources has resulted in accidental fires and the development of social trails, leading to degradation and loss of park resources. The natural and cultural resources contained within the park are a primary source of the visitor experience. When the resources are damaged, so is the visitor experience. These actions have a long-term, minor to moderate, adverse impact on the visitor use and experience.

These projects, along with the impacts of Alternative A, would result in a long-term, beneficial cumulative impact on visitor use and experience at Valley Forge NHP. Alternative A would contribute an imperceptible adverse increment to the overall cumulative impact.

## **Impacts of Alternative B**

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### ***Impact Analysis***

Under Alternative B, several nonlethal actions would be implemented in the park. Actions include the use of rotational fencing and reproductive control of does. Under Alternative B, NPS staff would continue to monitor the vegetation and deer populations at Valley Forge NHP. The park would initiate coordination with the PGC and its CWD Response Plan. Park staff would continue to construct small fenced areas to protect sensitive species and plant communities from deer browsing. Fencing could provide some visual intrusion into the viewshed and historic landscape. These actions would have beneficial impacts on select resources but would have no impact on the visitor use and experience. Impacts related to the CWD Response Plan are discussed below.

Under this alternative, as long as the closest confirmed case of CWD were at least 60 miles from the park boundary, the park would continue to use a contractor to remove roadkill deer from the park. This would have a long-term beneficial impact, but would not noticeably reduce adverse impacts.

Under Alternative B, approximately 9-15 fenced areas, encompassing 10-20 acres each, would be constructed throughout the park. The rotational fencing would enclose 10-15% of the park's forested area, or a maximum of 6% of the park's land. The use of rotational fencing would impact most visitors in the long-term, as the 8-foot-high fenced areas would be obvious and closed to visitation. Visitors hiking in the park to view wildlife and scenery would be most affected. Hikers and nature photographers who may desire a more natural, park experience would also be affected. Other visitors also would be aware of the rotational fencing. These structures may impede their views of the park or keep them from accessing select areas within the park. When fencing was rotated, new areas would become impacted and additional time would be required for the visitor to adjust to these locations and structures. This would result in a long-term, moderate, adverse impact.

Visitors would be affected by fence construction and maintenance activities. Construction activities would result in visual intrusions, as crews entered and worked in select areas of the forest. Not all visitors would be impacted, only those in areas where the activities occurred. These impacts would be short-term, minor, and adverse; but would occur repeatedly over the life of the plan.

The use of reproductive controls on does would be based on available technology. Approximately 460 deer would need to be treated each year during September and October (the two months prior to the rut). This level of treatment would occur throughout the life of the plan (15 years). Visitor use is typically high during these two months, so that although treatment would occur during off-peak visitor hours (early morning and evening) to the extent possible, it is likely that some visitors would be aware of the treatment activities. To minimize impacts, visitor access would be restricted around areas where bait was placed to attract deer for treatment. These areas would be chosen to minimize visitor inconvenience. However, area closures could concentrate visitors in other popular park locations, potentially diminishing the quality of visitor experiences. The impact from these actions would be short-term, minor, and adverse.

To ensure that visitors would understand the nature of the treatment efforts, the park would conduct educational programs to inform visitors about the procedures and explain why the treatments are necessary. This would provide visitors with the knowledge that the natural environment would eventually improve. Such information could offset adverse impacts related to visual aesthetics caused by the rotational fencing. Initially, this would result in short-term, negligible, adverse impacts. Over the long-term, these actions would result in a beneficial impact, as the forest regenerates due to protection afforded by the rotational fencing.

With reproductive control, deer would be marked with ear tags. Visitors could be troubled by the sight of deer with artificial markings, particularly those who come to Valley Forge NHP to see deer. Again, educational material would alert visitors to deer management activities and explain their purpose and expected outcomes. This would result in long-term beneficial impacts.

As reproductive controls eventually took effect, the deer population would begin to decrease very gradually. Some visitors might notice reductions in the excessive

browsing pressure that has damaged forest resources. Reduction in browsing would lead to an increased ability to view native plants and animals, including birds, wildflowers, and other wildlife. Visitors would experience an increased ability to view fall foliage and would once again be able to view spring wildflowers — two popular activities at the park. Although the deer population would be reduced, other animals would be present and visible in increased numbers. Visitors would be able to experience Valley Forge NHP as an example of the natural regeneration of disturbed lands, and experience the dynamic demonstration of nature's ability to regenerate. Based on the amount of time it might take for reproductive controls to reduce the deer population, however, these benefits may not be realized during the life of the plan. This would still result in a long-term beneficial impact.

If CWD were detected within five miles of the park boundary or the park fell within a state-established containment zone and reproductive control were being implemented, then a program of enhanced targeted CWD surveillance would be initiated. Under this plan, the park would initiate testing of deer via tonsillar biopsy and removal of CWD-positive deer from the population. This action would result in the removal of infected deer from the landscape reducing the probability of CWD spread. However, this approach is unlikely to significantly reduce spread or promote elimination of CWD because deer would continue to remain at a relatively high population density and CWD-positive deer would remain in the park until test results were obtained. Ultimately, this may result in visitors observing numerous deer exhibiting clinical symptoms of CWD (e.g., starvation). The impacts on visitor use and experience related to the implementation of this plan are similar to those described under Alternative A. The result would be a long-term, moderate, adverse impact.

The overall impact of Alternative B on the visitor use and experience would be long-term, negligible, and adverse.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to visitor use and experience would be the same as those described under Alternative A. These projects, along with Alternative B would result in a long-term beneficial cumulative impact on visitor use and experience. Alternative B would contribute an imperceptible adverse increment to the overall cumulative impact.

## **Impacts of Alternative C**

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### ***Impact Analysis***

Under Alternative C, NPS staff would continue to monitor the vegetation and deer populations at Valley Forge NHP. The park would initiate coordination with the PGC and its CWD Response Plan. Park staff would continue to construct small fenced areas to protect sensitive species and plant communities from deer browsing. Fencing could provide some visual intrusion into the viewshed and historic landscape. These actions would have beneficial impacts on select resources but would have no impact on the visitor use and experience. Impacts related to the CWD Response Plan are discussed below.

Under this alternative, the park would continue to use a contractor to remove roadkill deer from the park. This would have a long-term beneficial impact.

Under this alternative, lethal reduction would be implemented. Visitors would be aware of these actions primarily by closures required to conduct the lethal reduction activities. Sharpshooting would occur during late fall and winter, when deer are more visible and visitation is low. Relatively few visitors would be affected by these closures, as the weather is less conducive to picnicking, bicycling, jogging, or hiking. To lessen impacts to those winter visitors who do use the park, sharpshooting would occur primarily at night (between dusk and dawn) when visitation would be at its lowest. The public would also be notified of any park closures in advance of the activities. Information would be provided to the public on the park website and at exhibits at the Welcome Center. After the second year of implementation, the number of deer taken each year would be reduced, thus reducing the impact to visitors over time. Lethal reduction activities would result in a long-term, minor, adverse impact to visitor use and experience.

If necessary, deer would be captured as humanely as possible. Capture and euthanasia would be used only in special circumstances, and activities would occur at dawn or dusk, when visitation is low. If this method were employed, these areas would be closed to visitors. Although this would limit visitor movements and opportunities, it would avoid any unpleasant interactions with the lethal removal of deer. Impacts to visitor use would be long-term, negligible, and adverse.

In limited situations where access to a carcass would be difficult or not in a highly visible area, surface disposal may be acceptable. In these circumstances, every effort would be made to reduce the visibility of the carcass to visitors or park neighbors. Because the priority would be to donate meat, surface disposal would include only a few carcasses, under exceptional circumstances. Whenever several deer were unsuitable for donation to charities, the carcasses would be collected and disposed of by a contractor. Carcasses would be removed quickly, to avoid visibility to visitors. In addition, sharpshooting would occur during winter months when visitation to Valley Forge NHP is at its lowest. Therefore, few, if any, visitors would be exposed to deer remains or disposal activities. This would result in a long-term, minor, adverse impact.

The park plans to implement deer management educational and interpretive efforts to make visitors aware of the reasons for the deer population reduction and its benefit to forest regeneration and the deer population health. This would provide visitors with the knowledge that the natural environment would eventually improve. Such information could offset adverse impacts related to the sharpshooting activities. Initially, this would result in short-term, negligible, adverse impacts. Over the long-term, these actions would result in a beneficial impact, as understanding grew and as the forest successfully regenerated due to protection afforded by the reduced deer population.

As the deer population began to decrease, visitors would notice reductions in the excessive browsing pressure that has damaged forest resources. A reduction in browsing would result in an increased ability to view flowering small trees and shrubs and wild flowers as well as fall foliage. Reduced browsing also would minimize threats to the park's cultural resources. It would result in improved habitat for a variety of species, thus enhancing the quantity and quality of wildlife viewing opportunities. Successful forest regeneration would help ensure that visitors would be able to experience Valley Forge NHP as an example of the natural regeneration of disturbed lands, and to experience the dynamic demonstration of nature's ability to regenerate. Maintaining a viable herd size would help ensure a more balanced ecosystem into the future. These long-term beneficial impacts to visitor experience would be realized fairly quickly, as lethal reduction would have an immediate impact on the size of the deer population.

Implementation of this alternative would result in a decreased ability to view deer. Viewing deer is a positive experience many visitors have at the park. However, visitors and local residents also noted that the presence of malnourished, sick, or injured deer detracts from this experience and creates heightened tension (Leong and Decker 2007). Reduced numbers would create a more natural, healthy environment for the Valley Forge deer population. Initially, this could detract from current visitors' experiences in viewing large numbers of deer. While this would limit the opportunities to view these animals, it would make sightings more special and pleasant. Visitors would also be more likely to see healthy deer. This would result in a long-term beneficial impact, with adverse impacts being reduced to negligible over the long-term.

If CWD were detected within five miles of the park boundary or the park fell within a state-established CWD containment zone, the park would implement active lethal surveillance as outlined in Section 2.5: Elements Common to the Action Alternatives. Under this plan, if the initial deer density goal has not been achieved, the park would initiate a rapid reduction of the deer population to obtain the deer density goal of 31-35 deer per square mile. This would achieve a balance between the deer population and the surrounding environment more rapidly than proposed under this alternative. This would achieve beneficial impacts to the visitor experience more quickly.

The overall impact of Alternative C on the visitor use and experience would be long-term, negligible, and adverse.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to visitor use and experience would be the same as those described under Alternative A. These projects, along with Alternative C, would result in a long-term beneficial cumulative impact on visitor use and experience. Alternative C would contribute an imperceptible adverse increment to the overall cumulative impact.

## **Impacts of Alternative D**

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### ***Impact Analysis***

Under Alternative D, NPS staff would continue to monitor the vegetation and deer populations at Valley Forge NHP. The park would initiate coordination with the PGC and its CWD Response Plan. Park staff would continue to construct small fenced areas to protect sensitive species and plant communities from deer browsing. Fencing used for these actions could provide some visual intrusion into the viewshed and historic landscape. These actions would have beneficial impacts on select resources but would have no impact on the visitor use and experience. Impacts related to the CWD Response Plan are discussed below.

Under this alternative, the park would continue to use a contractor to remove roadkill deer from the park. This would have a long-term beneficial impact to the visitor experience.

Under Alternative D, lethal reduction would be implemented to reduce the size of the deer population, as described in Alternative C. Once the goal of 31–35 deer per square mile were attained, reproductive control, as described in Alternative B, and lethal reduction (if needed) would be used to maintain the deer population at the

reduced level. Because there would be no rotational fencing, the impacts related to these actions would be similar to those described under Alternative C.

If CWD were detected within five miles of the park boundary or the park fell within a state-established CWD containment zone, the park would implement active lethal surveillance as outlined in Section 2.5: Elements Common to the Action Alternatives. Under this plan, if the initial deer density goal has not been achieved, the park would initiate a rapid reduction of the deer population to obtain the initial deer density goal of 31-35 deer per square mile. This would achieve a balance between the deer population and the surrounding environment more rapidly than proposed under this alternative. This would achieve beneficial impacts to the visitor experience more quickly.

The overall impact of Alternative D on the visitor use and experience would be long-term, negligible, and adverse.

### **Cumulative Impacts**

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to visitor use and experience would be the same as those described under Alternative A. These projects, along with Alternative D, would result in a long-term beneficial cumulative impact on visitor use and experience. Alternative B would contribute an imperceptible adverse increment to the overall cumulative impact.

### **Conclusion**

The overall impact to visitor use and experience under Alternatives A, B, C, and D would be long-term, negligible, and adverse. For Alternatives A, B, C, and D, the overall cumulative impact would be beneficial. Alternatives A, B, C, and D would contribute imperceptible adverse increments to the cumulative impact on visitor use and experience.

## **4.6 Impacts on Socioeconomic Resources and Adjacent Lands**

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*NEPA requires that economic and social impacts be analyzed in an EIS when they are interrelated with natural or physical impacts.*

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NEPA requires that economic and social impacts be analyzed in an EIS when they are interrelated with natural or physical impacts. Economic impacts would potentially result from deer browsing damage to crops and landscaping on private lands adjacent to the park as a result of changes in deer populations at Valley Forge NHP; therefore, they are addressed in this document.

Because of the expected increase in deer populations over time and the limited supply of deer forage within the park, deer that frequent the park may also browse on agricultural crops and landscaping plants outside the park on adjacent public and private lands. As presented in the “White-tailed Deer Population” section of Chapter 3: Affected Environment, movement of deer that spend less than 50% of their time within the park may extend, on average, approximately 1,325 feet from the park boundary. It is assumed that deer that are habituated to the park and may seek food sources outside the park as the quality and quantity of browse within the park decreases. Recent studies indicate that the sex and age of the deer and quality of habitat will result in home ranges of varying sizes. Yearling males will move many miles, whereas adult females usually have smaller, more consistent annual home ranges. Deer in high quality habitat will travel less than deer in poorer quality habitat (MD DNR 2005; Lovallo and Tzilkowski 2003). In

addition, the Iowa Department of Natural Resources reports that white-tailed deer home range may expand seasonally based on breeding activity and food availability (Iowa Department of Natural Resources 2005).

Damage to landscaping on private land is a common problem throughout the northeastern United States. Economic losses associated with deer damage to landscaping plants have been estimated through studies in a number of northeastern states. Impact threshold definitions for socioeconomic resources and adjacent land use focus on landscaping depredation to neighboring lands and incidents of deer-vehicle collisions, and were defined as follows:

### ***Impact Thresholds***

|                          |  |
|--------------------------|--|
| <b><i>Negligible</i></b> | No effects would occur, or the effects on neighboring landowners' ornamental plantings would be below or at the level of detection.  |
| <b><i>Minor</i></b>      | The effects on neighboring landowners' ornamental plantings would be small but detectable. The impact would be slight, but would not be detectable outside the neighboring lands and would affect only a few adjacent landowners. The risk for deer-vehicle collisions resulting in financial loss would be minimal. |
| <b><i>Moderate</i></b>   | The effects on neighboring landowners' ornamental plantings would be readily apparent. Changes would be limited and confined locally, and they would affect more than a few landowners. The risk for deer-vehicle collisions resulting in financial loss would be elevated.  |
| <b><i>Major</i></b>      | The effects on neighboring landowners' ornamental plantings would be readily apparent. Changes would be substantial and extend beyond the adjacent landowners to additional landowners. The risk for deer-vehicle collisions resulting in financial loss would be at the maximum level.                              |

### **Area of Analysis**

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The area of analysis includes Valley Forge NHP and the private lands included within the 1,325-foot area that extends beyond the park's boundary and contains the deer population's home range.

### **Impacts of Alternative A**

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#### ***Impact Analysis***

Under Alternative A, NPS staff would continue to monitor the vegetation and deer populations at Valley Forge NHP. The park would initiate coordination with the PGC and CWD surveillance. Park staff would continue to construct small fenced areas to protect sensitive species and plant communities from deer browsing. Fencing would not notably alter deer behavior or movement. These actions would have beneficial impacts on select resources but would have no impact on socioeconomic resources or adjacent lands.

Under this alternative, as long as the closest confirmed case of CWD were more than 60 miles from the park boundary, the park would continue to use a contractor to remove roadkill deer from the park. This would have a long-term beneficial impact, but would not noticeably reduce adverse impacts.

The deer population would continue to grow over time or stabilize at a high density. Annual fluctuations in population numbers would continue due to winter temperatures, snow depths, and duration of snow cover, food availability, reproduction and mortality rates due to herd health, and other factors. Deer would continue to use their existing home range, which may extend up to 1,325 feet beyond the park's boundaries. Over time, the deer may extend their home range further from the park in search of more desirable food sources. As a result, some increased browsing could occur outside the park where food may be more plentiful. Ornamental plantings grown on private lands adjacent to the park could be browsed more heavily, resulting in adverse economic impacts to landowners. The degree of physical and economic damage on adjacent lands would be dependent on anticipated growth in deer populations, the types of plantings, the market value of current plantings, and the actions that landowners use to manage deer. This would result in a long-term, moderate, adverse impact.

The overall impact of Alternative A on socioeconomic resources and adjacent lands would be long-term, moderate, and adverse.

### ***Cumulative Impacts***

Several past, present, and reasonably foreseeable future actions would contribute to the cumulative impact on socioeconomic resources and adjacent lands at Valley Forge NHP, including transportation corridor development, natural resource management activities, land acquisition, and activity outside the park boundary.

Transportation corridor development will continue throughout the life of this plan. This development serves the increasing traffic volumes in the growing region. Future developments would not only enhance capacity but seek to control speeds and remove traffic from select roads. This would allow the region to retain some its character as it continues to grow. It could also improve the value of the lands surrounding the park. The results of these actions have and would continue to be long-term and beneficial.

Natural Resource Management within the park has and should continue to have an impact on socioeconomic resources and adjacent lands. The condition of the park's natural resources plays a role in the condition of resources on adjacent lands. By continuing to manage its resources to the greatest extent possible, these actions have been and would continue to be long-term and beneficial.

The park's past and future land acquisition has had and would continue to have impacts on socioeconomic resources and adjacent lands. Previous land acquisition prevented certain parcels from being developed. While this limited the amount of new residential or commercial development that could occur, it increased the value of the existing properties. The proximity to the park also has an influence on property values. Future land acquisition within the park boundary would have similar impacts on the region. The results would be long-term and beneficial.

Activity outside the park boundary has impacted socioeconomic resources and adjacent lands. Over the last 20 years there has been rapid development of residential and commercial uses throughout the region. Within the study area, this development has focused on new residential units. Other activities outside the park boundary include the use of repellents, fencing, and professional archers to protect ornamental plantings from deer browse. These activities cost the landowners money, but have proven to be somewhat effective. The results of these actions have been and would continue to be long-term and beneficial. However, if the deer population continues to grow or stabilizes at a high density, these actions could become ineffective, resulting in damages to adjacent lands.



These projects, along with the impacts of Alternative A, would result in a long-term, moderate, adverse cumulative impact on socioeconomic resources and adjacent lands at Valley Forge NHP. Alternative A would contribute an appreciable adverse increment to the overall cumulative impact.

## Impacts of Alternative B

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### ***Impact Analysis***

Under Alternative B, NPS staff would continue to monitor the vegetation and deer populations at Valley Forge NHP. The park would initiate coordination with the PGC and its CWD Response Plan. Park staff would continue to construct small fenced areas to protect sensitive species and plant communities from deer browsing. Fencing would not notably alter deer behavior or movement. These actions would have beneficial impacts on select resources but would have no impact on socioeconomic resources and adjacent lands. Impacts related to the CWD Response Plan are discussed below.

Under this alternative, the park would continue to use a contractor to remove roadkill deer from the park (as long as the closest confirmed case of CWD were more than 60 miles from the park boundary). This would have a long-term beneficial impact, but would not noticeably reduce adverse impacts.

Several nonlethal actions would be implemented under this alternative to protect forest resources and reduce deer numbers in the park. Reproductive control of deer, if successful, would gradually reduce the population over the long term. However, deer numbers within the park would not be immediately reduced, and numbers would fluctuate annually. The home range of the park's deer population could expand, resulting in greater deer browsing outside the park where food may be more plentiful. However, the number of deer that would seek food sources outside the park could be slightly greater under this alternative because the rotational fencing in the park would exclude deer from browsing on about 140-210 acres or about 10-15% of the park's forested area (6% of the park's total area) at any given time.

The availability and effectiveness of reproductive controls in the future could reduce the intensity of these impacts because the deer population would decrease gradually, minimizing landscaping damage and reducing the need for protection mechanisms. In the meantime, landowners adjacent to the park would continue to incur additional costs for fencing, repellents, and other forms of deer control to protect their landscaping. Because deer would be displaced from the park due to the rotational fencing, these costs would most likely be greater than in Alternative A. Increased deer browsing could also encourage landowners to incur the additional time and costs associated with harvesting deer on their lands. Because population reduction may not be realized in the life of the plan, this would result in a long-term, moderate, adverse impact.

Neighboring landowners would be exposed to increased noise levels during September and October from the use of dart guns. Noise from the use of dart guns would continue each year during September and October for the life of this plan. Neighbors would also hear noise during the construction or relocation of rotational fencing. Neighbors would be affected more than visitors because they live in the area year-round. However, the neighboring lands are subject to a variety of noises from other sources and the increase would be barely measurable. The increased noise levels outside the park would result in a short-term, negligible, adverse impact that would be repeated through the life of the plan.

If CWD were detected within five miles of the park boundary or the park fell within a state-established containment zone AND reproductive control were being implemented, then a program of enhanced targeted CWD surveillance would be initiated. Under this plan, the park would initiate testing of deer via tonsillar biopsy and removal of CWD-positive deer from the population. This action would result in the removal of infected deer from the landscape reducing the probability of CWD spread. However, this approach is unlikely to significantly reduce spread or promote elimination of CWD because deer would continue to remain at a relatively high population density and CWD-positive deer would remain on the landscape until test results were obtained. The impacts on socioeconomic resources related to the implementation of this plan are similar to those described under Alternative A. The result would be a long-term, moderate, adverse impact.

The overall impact of Alternative B on socioeconomic resources and adjacent lands would be long-term, moderate, and adverse.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to socioeconomic resources and adjacent lands would be the same as those described under Alternative A. These projects, along with Alternative B, would result in a long-term, moderate, adverse cumulative impact on socioeconomic resources and adjacent lands. Alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

### **Impacts of Alternative C**

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#### ***Impact Analysis***

Under Alternative C, NPS staff would continue to monitor the vegetation and deer populations at Valley Forge NHP. The park would initiate coordination with the PGC and its CWD Response Plan. Park staff would continue to construct small fenced areas to protect sensitive species and plant communities from deer browsing. Fencing would not notably alter deer behavior or movement. These actions would have beneficial impacts on select resources but would have no impact on socioeconomic resources and adjacent lands. Impacts related to the CWD Response Plan are discussed below.

Under this alternative, the park would continue to use a contractor to remove roadkill deer from the park. This would have a long-term beneficial impact, but would not noticeably reduce adverse impacts.

Under this alternative lethal reduction activities, and capture and euthanasia where appropriate, would quickly reduce the population size. This approach would continue into year four, or until the park deer density was approximately 31-35 deer per square mile. Additional deer would be removed in subsequent years to maintain the population. Initial sharpshooting activities may push additional deer from one area of the park to another, or out of the park. However, the reduction of the existing park deer population may result in fewer deer leaving the park and browsing on landscaping on adjacent lands, depending on where the sharpshooting was focused and the home range locations of the deer. During the reduction activities, deer movements could become erratic and unpredictable. This could result in temporarily expanded home ranges. However, once the lethal reduction activities were reduced, observations at similar locations indicate that the deer would return to their original home range. This would result in a short-term, moderate, adverse impact and a long-term, beneficial impact.

The degree of reduction in damage to vegetation outside the park boundary is unknown. Available studies, such as McNew and Curtis (1997) and Brown, Decker, and Curtis (2004), indicate that per acre damage is greater in regions where deer populations are highest or most protected from measures such as hunting. Per-acre damage is much less in regions where deer population sizes are lower. Efficient reduction in deer density would avoid short-term damage to landscapes, resulting in a long-term beneficial impact, with adverse impacts being reduced to minor over the long-term.

A corresponding decline in private costs for fencing and other forms of deer control to protect landscaping could occur as the park deer population was reduced. Assuming that park deer are using adjacent lands as part of their home range, fewer deer and decreased deer browsing on private land could also result in reduced time and costs associated with harvesting deer on private lands. As a result, reduced time and monetary costs associated with protection measures would result in a long-term beneficial impact, with adverse impacts being reduced to minor over the long-term.

Noise impacts would be noticeable to neighboring landowners, since sharpshooting would occur at night, when there is less ambient noise. The use of suppression devices on firearms would decrease the impact intensity. Sharpshooting activities would occur during the fall or winter months, and primarily for the first two years of this plan, decreasing in scope as the deer population became smaller. By the fourth or fifth year, sharpshooting would only be used to maintain the herd size. Therefore, impacts would be less frequent. In addition, some neighboring landowners have already been exposed to hunting in the area. This would result in a short-term, minor, adverse impact.

If CWD were detected within five miles of the park boundary or the park fell within a state-established CWD containment zone, the park would implement active lethal surveillance as outlined in Section 2.5: Elements Common to the Action Alternatives. Under this plan, if the initial deer density goal has not been achieved, the park would initiate a rapid reduction of the deer population to obtain the goal of 31-35 deer per square mile. This would achieve a balance between the deer population and the surrounding environment more rapidly than proposed under this alternative. Impacts on private landscapes surrounding the park would be reduced more quickly. The more intense lethal reduction effort could result in more movement of the deer population, however, possibly increasing the potential for deer-vehicle collisions. This increased potential would last a short time, as the desired deer density would be achieved quickly. The result would be a long-term beneficial impact.

The overall impact of Alternative C on socioeconomic resources and adjacent lands would be long-term and beneficial.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to socioeconomic resources and adjacent lands would be the same as those described under Alternative A. These projects, along with Alternative C, would result in a long-term beneficial cumulative impact on socioeconomic resources and adjacent lands. Alternative C would contribute a beneficial increment to the overall cumulative impact.

## Impacts of Alternative D

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### ***Impact Analysis***

Under Alternative C, NPS staff would continue to monitor the vegetation and deer populations at Valley Forge NHP. The park would initiate coordination with the PGC and its CWD Response Plan. Park staff would continue to construct small fenced areas to protect sensitive species and plant communities from deer browsing. Fencing would not notably alter deer behavior or movement. These actions would have beneficial impacts on select resources but would have no impact on socioeconomic resources or adjacent lands. Impacts related to the CWD Response Plan are discussed below.

Under this alternative, the park would continue to use a contractor to remove roadkill deer from the park. This would have a long-term beneficial impact, but would not noticeably reduce adverse impacts.

Under Alternative D, lethal reduction would be implemented to reduce the size of the deer population, as described in Alternative C. Once the goal of 31–35 deer per square mile were obtained, reproductive control, as described in Alternative B, and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. Because there would be no rotational fencing, the impacts related to these actions would be the same as those described under Alternative C. However, the success of implementing reproductive controls on a deer population that has undergone several years of lethal reduction efforts would depend on technological advances, the sensitivity of deer to humans, methods used by the sharpshooters, changes in immigration with reduced deer density, and general deer movement behavior (Porter, Underwood, and Woodward 2004; Naugle et al. 2002). It should be expected that getting close enough to administer remote injections would become more difficult after lethal reduction efforts, due to deer behavior changes in response to previous human interaction (Underwood 2005). If reproductive controls were found to be unsuccessful, deer numbers could be kept low via lethal reduction. A decreased population would provide additional protection to local properties. The overall impact would be long-term and beneficial.

Under this alternative, the noise from lethal reduction activities would be eliminated after year three or four. This would result in a short-term minor, adverse impact and long-term beneficial impacts.

If CWD were detected within five miles of the park boundary or the park fell within a state-established CWD containment zone, the park would implement active lethal surveillance as outlined in Section 2.5: Elements Common to the Action Alternatives. Under this plan, if the initial deer density goal has not been achieved, the park would initiate a rapid reduction of the deer population to obtain the goal density of 31–35 deer per square mile. This would achieve a balance between the deer population and the surrounding environment more rapidly than proposed under this alternative. Impacts on private landscapes surrounding the park would be reduced more quickly. However, the more intense lethal reduction effort could result in more movement of the deer population, possibly increasing the potential for deer-vehicle collisions. This increased potential would last a short time, as the desired deer density would be achieved quickly. The result would be a long-term beneficial impact, with adverse impacts being reduced to minor over the long-term.

The overall impact of Alternative D on socioeconomic resources and adjacent lands would be long-term and beneficial.

### **Cumulative Impacts**

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to socioeconomic resources and adjacent lands would be the same as those described under Alternative A. These projects, along with Alternative D, would result in a long-term beneficial cumulative impact on socioeconomic resources and adjacent lands. Alternative D would contribute an appreciable adverse increment to the overall cumulative impact.

### **Conclusion**

The overall impact to socioeconomic resources and adjacent lands under Alternatives A and B would be long-term, moderate, and adverse. For Alternatives A and B, the overall cumulative impact would be long-term, moderate, and adverse. Alternatives A and B would contribute appreciable adverse increments to the cumulative impact on socioeconomic resources and adjacent lands.

The overall impact to socioeconomic resources and adjacent lands under Alternatives C and D would be long-term and beneficial. For Alternatives C and D, the overall cumulative impact would be beneficial. Alternatives C and D would contribute beneficial increments to the cumulative impact on socioeconomic resources and adjacent lands.

## **4.7 Impacts on Public Safety**

The safety of both visitors and NPS employees at Valley Forge NHP could be affected by implementation of the proposed deer management actions. Impacts to visitor and employee safety would be related to the probability of being involved in a deer-vehicle collision or encountering a deer tick under all alternatives, presence of fences and the use of dart guns under alternative B, and the use of firearms under Alternatives C or D.

The *NPS Management Policies 2006* state that, “while recognizing that there are limitations on its capability to totally eliminate all hazards, the Service . . . will seek to provide a safe and healthful environment for visitors and employees.” The policies also state, “the Service will reduce or remove known hazards and apply other appropriate measures, including closures, guarding, signing, or other forms of education” (NPS 2005a).

The purpose of this impact analysis is to identify the level of impact that implementing each of the proposed alternatives would have on the safety of visitors and employees at Valley Forge NHP. Past accident data were used to assess the impacts of the alternative actions on the safety of visitors and employees. The impact thresholds for public safety are defined below.

### **Impact Thresholds**

**Negligible** There would be no discernible effects to visitor safety; slight injuries could occur, but none would be reportable.

There would be no discernible effects to employee safety; slight injuries could occur but none would be reportable.

**Minor** Any reported visitor injury would require first aid that could be provided by park staff.

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*NPS Management Policies 2006 state that, “while recognizing that there are limitations on its capability to totally eliminate all hazards, the Service...will seek to provide a safe and healthful environment for visitors and employees.”*

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Any reported employee injury would require first aid provided by the park and would involve less than eight hours of lost work time.

**Moderate** Any reported visitor injury would require further medical attention beyond what was available at the park.

Any reported employee injury would require medical attention beyond what is available at the park and would result in eight or more hours of lost work time.

**Major** A visitor injury would result in permanent disability or death.

An employee injury would result in permanent disability or death.

### **Area of Analysis**

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The study area for this analysis, including analysis of cumulative impacts, is Valley Forge NHP.

### **Impacts of Alternative A**

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#### **Impact Analysis**

Under Alternative A, park staff would continue to fence small areas that contain sensitive vegetation. They would also continue to monitor vegetation and deer population and to use a contractor to remove road-killed deer from park roads (as long as the closest confirmed case of CWD were more than 60 miles from the park boundary). Under this alternative, the park would initiate coordination with the PGC and CWD surveillance. No accidents or injuries have occurred as a result of these activities, and no accidents are anticipated from their continuation. These activities would result in long-term, negligible, adverse impacts to public safety.

A high deer population provides more host animals and may support higher than normal deer tick populations compared to environments with a lower deer density. Deer ticks are responsible for transmission of the spirochete that causes Lyme disease to humans. With no reduction in the deer population, there would be no anticipated changes in tick populations within the park. Nor would there be a reduction in the number of deer-vehicle collisions. Although the number of visitors and employees that have encountered a deer tick or acquired Lyme disease within the park is unknown, and there have not been any reported injuries related to deer-vehicle collisions, the chance for such impacts would continue. This would result in a long-term, major, adverse impact.

The overall impact of Alternative A on public safety would be long-term, major, and adverse.

#### **Cumulative Impacts**

Several past, present, and reasonably foreseeable future actions would contribute to the cumulative impact on public safety at Valley Forge NHP, including transportation corridor development, natural resource management activities, hazardous material response, utility improvements, and inappropriate visitor use.

Transportation corridor development includes maintenance activities that are designed to keep the corridors safe for travelers. Maintenance includes new paving, improving drainage, and managing vegetation alongside the roads. Corridor

development also includes new roads and transportation services designed to manage the increasing population and corresponding traffic volumes. Future development also includes traffic calming and road closures, designed to improve safety within the transportation corridors. The results of these actions have been and would continue to be long-term and beneficial.

Hazardous materials found within the park are buried underground and were not an immediate threat to public safety. However, the potential for them to be unearthed posed a threat to public safety. Therefore, the hazardous material response efforts were initiated. These efforts complied with all local, state, and federal regulations to ensure that public safety was protected. As a result of these actions, overall public safety was improved. Future actions would also comply with all safety regulations and would further improve public safety. The result of these actions has been and would continue to be long-term and beneficial.

Inappropriate visitor use has had an impact on public safety. Accidental fires have posed a threat to visitors and staff. Social trails also pose a threat to public safety. The park has carefully designed a trail system to provide a safe experience in the park. When visitors make their own trails, they risk injury. Continued use of these social trails results in erosion which can further the threat of a tripping hazard. Continued use of these trails in the future would magnify this threat. The results of these actions have been and would continue to be long-term, minor to moderate, and adverse.

These projects, along with the impacts of Alternative A, would result in a long-term, major, adverse impact on public safety at Valley Forge NHP. Alternative A would contribute an appreciable adverse increment to the overall cumulative impact.

## **Impacts of Alternative B**

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### ***Impact Analysis***

Under Alternative B, park staff would continue to fence small areas that contain sensitive vegetation or represent an area where management actions involving vegetation require fencing for successful establishment and/or maintenance. They would continue to monitor vegetation and deer population, and to use a contractor to remove road-killed deer from park roads (as long as the closest confirmed case of CWD were more than 60 miles from the park boundary). Under this alternative, the park would initiate coordination with the PGC and implement the CWD Response Plan. No accidents or injuries have occurred as a result of these activities, and no accidents are anticipated from their continuation. Therefore, these actions would result in long-term, negligible, adverse impacts to public safety. Impacts related to the CWD Response Plan are described below.

Several nonlethal actions would be implemented under Alternative B, including the use of rotational fencing and reproductive control of does. Rotational fencing would be constructed throughout the park and would be relocated as vegetation regrowth exceeded deer browsing height (60 inches). Employees could be injured while constructing the fences; however, park staff exercise caution and apply safety techniques in all construction projects. This would result in a long-term, negligible, adverse impact to public safety.

Under this alternative does would be treated with a reproductive control agent that would most likely be administered remotely with a dart gun. The application of annual treatments would be required. Areas selected for administering the

reproductive controls would be chosen to minimize threats to visitor and employee safety. These areas would be closed to public use for the duration of the activity. Treatment would occur during September and October, which are high visitor use months, but during off-peak visitor hours (early morning and evening). To reduce impacts to visitor safety, preference would be given to conducting the treatment on weekdays. If dart guns were not used, does would be lured into a trap site so that they could be treated with the drugs and tagged. Again, these areas would be closed to visitor use, and precautions would be taken to minimize safety impacts. No impacts to visitor safety from increased monitoring are expected, as such activities would apply primarily to monitoring rotational fencing, which would be closed to visitors, and open forested areas, where park staff would exercise safety precautions. This would result in a long-term, negligible, adverse impact.

Under this alternative, qualified federal employees or contractors would treat does with a reproductive agent. A large number of does (approximately 10 per day over the course of 46 days) would need to be treated during September and October. This activity would increase the potential of employee accident or injury. Safety precautions would be followed, and training in the use of treatment and deer restraint methods would help ensure employee safety. If more than one shooting location were used to administer reproductive controls with dart guns, these areas would be adequately separated. If dart guns were not used, does would be captured and reproductive controls applied manually. No injuries to employees are expected from this method since the capture and treatment of deer would be conducted by qualified federal employees or contractors who are professionally trained to perform these tasks. In addition, federal employees or contractors would be qualified in handling live deer in order to prevent disease transmission and prevent harm to employees. This would result in a short-term, minor, adverse impact.

If the reproductive control treatment resulted in side effects such as repeated estrous cycling and an extended rut period, then deer movements may be increased for an extended period of time, potentially leading to a temporary increase in the number of deer-vehicle collisions. This impact would decrease over the long term as deer population size was gradually reduced. This would result in a short-term, moderate, adverse impact.

With no reduction in the deer population, there would be no anticipated reductions in tick populations within the park or the number of deer-vehicle collisions. In fact, by preventing the deer population from accessing areas enclosed by the rotational fencing, more deer may be encouraged to move to other parts of the park or surrounding areas, thus increasing the possibility of deer-vehicle collisions. This possibility also would increase as darting activities became more prevalent. It is expected that deer movement would become more frequent and erratic as darting activities took place. Although there have not been any reported injuries related to deer-vehicle collisions and the number of visitors and employees who have encountered a deer tick or acquired Lyme disease within the park is unknown, the chance for such an injury would continue to increase. This would result in a long-term, major, adverse impact.

If CWD were detected within five miles of the park boundary or the park fell within a state-established containment zone AND reproductive control were being implemented, then a program of enhanced targeted CWD surveillance would be initiated. Under this plan, the park would initiate testing of deer via tonsillar biopsy and removal of CWD-positive deer from the population. This action would result in the removal of infected deer from the landscape, reducing the probability of CWD



spread. However, this approach is unlikely to significantly reduce spread or promote elimination of CWD because deer would remain at a relatively high population density and CWD-positive deer would remain in the park until test results were obtained. The impacts on public safety related to the implementation of this plan are similar to those described under Alternative A. This would result in a long-term, major, adverse impact.

The overall impact of Alternative B on public safety would be long-term, major, and adverse.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to public safety would be the same as those described under Alternative A. These projects, along with Alternative B, would result in a long-term, major, adverse cumulative impact on public health and safety. Alternative B would contribute an appreciable adverse increment to the overall cumulative impact.

## **Impacts of Alternative C**

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### ***Impact Analysis***

Under Alternative C, park staff would continue to fence small areas that contain sensitive vegetation or represent an area where management actions involving vegetation require fencing for successful establishment and/or maintenance. They would continue to monitor vegetation and deer population, and to use a contractor to remove road-killed deer from park roads. Under this alternative, the park would initiate coordination with the PGC and its CWD Response Plan. No accidents or injuries have occurred as a result of these activities, and no accidents are anticipated from their continuation. Therefore, these actions would result in long-term, negligible, adverse impacts to public safety. Impacts related to the CWD Response Plan are described below.

Under Alternative C, qualified federal employees or contractors would conduct lethal reduction of the deer population. Deer would be shot with high-power, small caliber rifles at close range. Measures taken to ensure the safety of Valley Forge NHP's visitors would include shooting at night during late fall or winter months when visitation is low, closing areas to visitors when shooting is required, notifying the public in advance of any park closures, providing exhibits regarding deer management actions in the visitor center, and posting information on the park's website. Park law enforcement personnel would patrol the perimeter areas where sharpshooting would occur to ensure that no visitors entered the area. Sharpshooting would not occur within 300 feet of any building within the park boundary or on adjacent land. Bait would be used to attract deer to safe removal locations. Park staff would approve the location of bait stations before sharpshooting took place. The park would comply with all federal firearm laws administered by the Bureau of Alcohol, Tobacco, and Firearms. The majority of deer reduction activities would occur during the first two years of this plan, decreasing in scope (and the potential for accident) during ensuing years as the deer population declined. It is unlikely that visitors would be exposed to capture and euthanasia actions, which would occur primarily at night. If this method were required to remove multiple deer, the area would be temporarily closed to visitors. The safety measures used under this alternative would ensure the safety of all visitors. This would result in a long-term, negligible, adverse impact.

The safety of park employees could be affected by lethal reduction activities proposed under this alternative. Qualified federal employees or contractors would conduct the lethal reduction activities, and their experience in such efforts would help ensure the safety of park employees. If more than one shooting location was used to conduct sharpshooting activities, these areas would be adequately separated. Qualified federal employees or contractors also would capture and euthanize deer, sporadically, on an as-needed basis. Therefore, adverse impacts to the safety of employees could increase. Every precaution would be taken to ensure the safety of employees, and employees would apply safety training and awareness activities designed to reduce safety risks. Activities would be in compliance with all federal firearm laws administered by the Bureau of Alcohol, Tobacco, and Firearms. Any injuries or accidents that could occur under this alternative would be treatable at the park and would be expected to result in less than eight hours of lost work time. This would result in a long-term, minor, adverse impact.

Although the direct relationship is unknown, research suggests that a decrease in the local deer population could reduce the number of deer-vehicle collisions (Curtis 2002). This decrease would not be realized in the early years of the plan, as the deer population would remain at high levels and changes in deer movements as a result of the sharpshooting activities may temporarily increase the number of deer-vehicle collisions. As the population was reduced and deer reduction activities became less prevalent, however, a reduction in deer-vehicle collisions could be expected. Deer have most likely become accustomed to foraging on ornamental plants grown outside the park and would not cease to do so. However, the number of deer crossing the roads to reach these ornamental plantings and to get from one area of the park to another would decrease.

A similar relationship may exist between deer density and deer tick populations. As the deer population was reduced and deer reduction activities became less prevalent, a potential reduction in deer tick populations could be expected, reducing the probability of visitors and employees encountering a deer tick. The number of host species available to deer ticks would also decrease, possibly decreasing tick populations and Although there have not been any reported injuries related to deer-vehicle collisions and the number of visitors and employees that have encountered a deer tick or acquired Lyme disease within the park is unknown, the chance for such impacts should decrease proportionately with the reduction of the deer population. This would result in a long-term beneficial impact.

If CWD were detected within five miles of the park boundary or the park fell within a state-established CWD containment zone, the park would implement active lethal surveillance as outlined in Section 2.5: Elements Common to the Action Alternatives. Under this plan, the park would initiate lethal reduction of the deer population, as described under Alternative C. This would achieve the desired deer density (31-35 deer per square mile) more rapidly.

The overall impact of Alternative C on public safety would be long-term, minor, and adverse.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to public safety would be the same as those described under Alternative A. These projects, along with Alternative C, would result in a long-term, minor, adverse cumulative impact on public health and safety. Alternative C would contribute a noticeable adverse increment to the overall cumulative impact.

## Impacts of Alternative D

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### ***Impact Analysis***

Under Alternative D, park staff would continue to fence small areas that contain sensitive vegetation or represent an area where management actions involving vegetation require fencing for successful establishment and/or maintenance. They would continue to monitor vegetation and deer populations, and to use a contractor to remove roadkilled deer from park roads. Under this alternative, the park would initiate coordination with the PGC and its CWD Response Plan. No accidents or injuries have occurred as a result of these activities, and no accidents are anticipated from their continuation. Therefore, these actions would result in long-term, negligible, adverse impacts to public safety. Impacts related to the CWD Response Plan are described below.

Under Alternative D, lethal reduction would be implemented to reduce the size of the deer population, as described in Alternative C. Once the goal of 31-35 deer per square mile were attained, reproductive control, as described in Alternative B, and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. This alternative would not present any of the threats to public health related to rotational fencing. It also would limit the amount of time that sharpshooting could impact public safety.

Impacts related to deer-vehicle collisions and deer ticks/Lyme disease would be the same as those described in Alternative C. There could be some chances for increased collisions based on the behavioral changes that are expected to occur at the reproductive control agent is administered, however,. This would result in a short-term adverse impact.

If CWD were detected within five miles of the park boundary or the park fell within a state-established CWD containment zone, the park would implement active lethal surveillance as outlined in Section 2.5: Elements Common to the Action Alternatives. Under this plan, the park would initiate lethal reduction of the deer population, as described under Alternative C. This would achieve the initial deer density goal (31-35 deer per square mile) more rapidly.

The overall impact of Alternative D on public safety would be long-term, minor, and adverse.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to public safety would be the same as those described under Alternative A. These projects, along with Alternative D, would result in a long-term, minor, adverse cumulative impact on public health and safety. Alternative D would contribute a noticeable adverse increment to the overall cumulative impact.

### ***Conclusion***

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The overall impact to public safety under Alternatives A and B would be long-term, major, and adverse. For Alternatives A and B, the overall cumulative impact would be long-term, major, and adverse. Alternatives A and B would contribute appreciable adverse increments to the cumulative impact on public safety. The overall impact to public safety under Alternative C and D would be long-term, minor, and adverse.

For Alternatives C and D, the overall cumulative impact would be long-term, minor, and adverse. Alternatives C and D would contribute noticeable adverse increments to the cumulative impact on public safety.

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## 4.8 Impacts on Park Operations

The discussion of impacts to operations focuses on (1) the number of staff available to manage the program and ensure visitor and resident safety, and (2) the ability of park staff to protect and preserve resources given current funding and staffing levels. It was assumed that under all alternatives the park’s annual budget would be increased to implement a particular alternative. However, this funding is not guaranteed; each alternative discusses the impacts of receiving or not receiving additional funding. Park staff knowledge was used to evaluate the impacts of each alternative, and the evaluation is based on the description of operations presented in Chapter 3: Affected Environment. Definitions of impact levels are as follows:

### *Impact Thresholds*

|                          |   |
|--------------------------|---|
| <b><i>Negligible</i></b> | Operations would not be affected, or the impacts would be at low levels of detection and would not have an appreciable effect on operations.  |
| <b><i>Minor</i></b>      | The impact would be detectable and likely short-term, but would be of a magnitude that would not have any appreciable effect on operations.   |
| <b><i>Moderate</i></b>   | The impacts would be readily apparent, likely long-term, would result in a substantial change in operations in a manner noticeable to staff and to public.  |
| <b><i>Major</i></b>      | The impacts would be readily apparent, long-term, would result in substantial change in park operation in a manner noticeable to staff and the public and be markedly different from existing operations. |

### **Area of Analysis**

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For the purpose of this analysis, the area of potential effect is defined as Valley Forge NHP.

### **Impacts of Alternative A**

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#### ***Impact Analysis***

Under Alternative A the park would continue limited use of fencing to protect sensitive species and landscapes, and would continue to monitor deer populations and vegetation, with assistance from the Mid-Atlantic I&M Program. Under this alternative, the park would initiate coordination with the PGC and CWD surveillance. These actions are part of current operations and would not represent a noticeable change to park staffing or funding. This would result in a long-term, negligible, adverse impact.

The park’s deer population would continue to grow over time, although numbers would fluctuate annually due to winter temperatures, snow depths and duration, and food quality and quantity. Three employees would remain solely dedicated to natural resource management, including a natural resource interpreter. The work performed

by these staff would include coordinating and performing deer and vegetation monitoring. Current deer management would continue as a recurring component of Valley Forge NHP's resource management activities, as adverse impacts to forest health would continue indefinitely into the future. Any additional management responsibilities or reduction in the funding available to these staff would limit the time and resources available to support these deer management activities. The result would be a long-term, minor to moderate, adverse impact to park operations.

If CWD were confirmed within 60 miles from the park boundary then park staff would assume responsibility for removal of deer from roadways and ensuring appropriate testing and carcass disposal. Disposal methods for CWD-positive deer are described in Section 2.5: Elements Common to the Action Alternatives. These additional management responsibilities and expenses would be a long-term, moderate adverse impact.

Under this alternative, Valley Forge NHP staff would monitor the costs of the deer management activities, including costs related to staff time, training, administrative, legal, public relations, and monitoring. If deer management costs increased substantially, funds and personnel from other park divisions might have to be reallocated from other park activities, resulting in a long-term, moderate, adverse impact on other divisions. The result would be long-term, negligible, and adverse.

There would not likely be any adverse or beneficial impacts to natural resource interpretation programs currently conducted at the park, as there are sufficient funds and personnel to run these programs, and present funding and staffing are expected to continue.

The overall impact of Alternative A on park operations would be long-term, moderate, and adverse.

### ***Cumulative Impacts***

Several past, present, and reasonably foreseeable future actions would contribute to the cumulative impact on park operations at Valley Forge NHP, including new construction in the park, land acquisition, Asbestos Release Site remediation, and inappropriate visitor use.

New construction in the park would impact park operations. Although previous and future construction projects rely on contractors to perform the work, the park staff continues to oversee and manage these projects. New construction projects, described earlier in this chapter, also result in changes to infrastructure. New infrastructure requires less maintenance than older facilities; however, an increase in the number of facilities result in an increase in maintenance and staffing needs. New structures allow the park staff to more effectively carryout the mission of Valley Forge NHP. The result of these actions has been and would continue to be long-term and beneficial, reducing adverse impacts to minor.

Past and future land acquisitions have and would continue to impact park operations. Land acquisition would add additional property to the park. This property would require security, maintenance, and natural and cultural resource staff to extend their operations. Without increased staff and funding at the park, additional land acquisition would limit the amount of time or resources that could be spent on any one area. Land acquisitions have and could continue to benefit educational and interpretive programs in the park. The result of these actions has been and would continue to be long-term, minor, and adverse.

Asbestos Release Site Remediation has and could continue to impact park operations. These actions require a great deal of planning and coordination by park staff with local, state, and federal officials. It also requires staff time to educate the public on current risks and planned remediation, as well as securing areas that are to be included in the response. Following future remediation and restoration of these lands to public use, additional staff time will be required for maintenance and resource management. The results of these actions have been and would continue to be long-term, minor, and adverse.

Inappropriate visitor use also has and could continue to impact park operations. Accidental fires require emergency response from a number of divisions within the park. Once the fire is suppressed, natural resource staff must work to assess the damage done to vegetation, develop a planting plan for the site, and install new plantings. In some cases, fires may damage trails or structures. In these cases, the park's maintenance division must also assess and repair damages. The development of social trails also requires unplanned staff time. Social trails are created by visitors moving through restricted areas of the park. In order to reduce these movements, park security must spend additional time focusing on these areas. Natural resource staff must also assess the impact of these social trails and seek to mitigate impacts on soils and vegetation. Staff are also required to tend to visitors who are injured on social trails. These incidents occur at greater frequency than on established trails. The result of these actions has been and would continue to be long-term, minor, and adverse.

These projects, along with the impacts of Alternative A, would result in a long-term, moderate, adverse cumulative impact on park operations at Valley Forge NHP. Alternative A would contribute an appreciable adverse increment to the overall cumulative impact.

## **Impacts of Alternative B**

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### ***Impact Analysis***

Under Alternative B the park would continue limited use of fencing to protect sensitive species, and would continue to monitor deer populations and vegetation, with assistance from the Mid-Atlantic I&M Program. Under this alternative, the park would initiate coordination with the PGC and implement its CWD Response Plan. These actions are part of current operations and would not represent a noticeable change to park staffing or funding. This would result in a long-term, negligible, adverse impact. Impacts related to the CWD Response Plan are discussed below.

Under this alternative, several nonlethal actions would be implemented. The nonlethal management measures outlined under Alternative B would require the park to request assistance from qualified federal employees or contractors, for which additional funding would be needed. Additional funding would likely be needed for the initial construction of the rotational fencing, as well as for long-term maintenance. It is anticipated that the construction of 15 fenced areas would take up to 150 working days to complete (NPS 2008a). Because the construction of these fences would be completed by a contractor, park operations would not be noticeably affected. The proposed locations for the construction of fencing would be surveyed by the park archeologist, with possible assistance from contracted archeologists. One staff member would be on-site during the construction to supervise the work and ensure that no natural or cultural resources were impacted. This would result in a long-term, minor, adverse impact.

In addition to an increase in temporary staffing, additional funding would be required to install the 10-15 fenced areas (each 10-20 acres in size) would be approximately \$233,000 for supplies and labor. After the initial construction, the fenced areas would be relocated every 10 years, at an estimated cost of \$175,000 for supplies and labor. It is assumed that the labor would be carried out by a contractor. These costs would be in addition to the park's present budget. This would result in a long-term, major, adverse impact.

Maintaining the rotational fencing would require additional funding to support federal employees or contractors, especially if large storm events or natural disasters required the fencing to be repaired or removed. This effort is estimated to require one person-day per area per year and up to four visits per year. Using an average rate of \$160 per day, for 15 days to cover all of the fencing, the yearly labor cost would be at least \$2,400. An additional \$8,000 per year would be estimated for materials and additional visits for weather-related maintenance needs. Limited oversight and supervision would be required of the park staff for this effort. The additional funding required for regular maintenance of the rotational fencing would result in a long-term, moderate, adverse impact.

Alternative B would include reproductive control of does. Costs for this would depend on the number of deer tested and the current available technology. Assuming the use of Leuprolide (or similar agent) as described in Chapter 2: Alternatives, costs would be range from \$1,000 to \$2,000 per deer. If 460 does are treated, the annual cost would total \$920,000. Labor for the reproductive control efforts would be provided by qualified federal employees or contractors. Monitoring associated with the reproductive controls would be included in existing monitoring activities, avoiding additional costs. The additional funds required for implementing reproductive controls of does would result in a long-term, major, adverse impact.

This alternative would also involve increased educational and interpretive activities, and would therefore require additional funding and staff time to implement these activities. There would be a long-term, minor, adverse impact to resource interpretation, depending on the level of activities required.

If CWD is confirmed within 60 miles from the park boundary, then park staff would assume responsibility for removal of deer from roadways and ensuring appropriate testing and carcass disposal. Disposal methods for CWD-positive deer are described in Section 2.5: Elements Common to the Action Alternatives. The impacts on operations related to the implementation of this plan are similar to those described under Alternative A. The result would be a long-term, moderate, adverse impact.

If CWD were detected within five miles of the park boundary or the park fell within a state-established containment zone and reproductive control were being implemented, then a program of enhanced targeted CWD surveillance would be initiated. Under this plan, the park would initiate testing of deer via tonsillar biopsy and removal of CWD-positive deer from the population. Approximately one additional hour of labor would be required to conduct tonsillar biopsies and process tissue samples. The number of deer tested would gradually decrease over time as the deer population was reduced. This would result in a short-term, moderate, adverse impact.

The timeframe and disposal methods for CWD-positive deer are described in Section 2.5: Elements Common to the Action Alternatives. This reduction could lead to the park achieving the desired deer density (31-35 deer per square mile) more

rapidly than proposed under this alternative. This would achieve a balance between the deer population and the surrounding environment more rapidly. It would also reduce the chance of CWD spreading through the rest of the population. The impacts on operations related to the implementation of this plan are similar to those described below under Alternative C. The result would be a long-term, moderate, adverse impact.

The overall impact of Alternative B on park operations would be long-term, moderate, and adverse.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to park operations would be the same as those described under Alternative A. These projects, along with Alternative B would result in a long-term, moderate, adverse cumulative impact on park operations. Alternative B, would contribute an appreciable adverse increment to the overall cumulative impact.

### **Impacts of Alternative C**

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Under Alternative C the park would continue limited use of fencing to protect sensitive species, and would continue to monitor deer populations and vegetation, with assistance from the Mid-Atlantic I&M Program. Under this alternative, the park would initiate coordination with the PGC and its CWD Response Plan. These actions are part of current operations and would not represent a noticeable change to park staffing or funding. This would result in a long-term, negligible, adverse impact. Impacts related to the CWD Response Plan are discussed below.

Under Alternative C, lethal reduction would be used to quickly reduce the deer population size, with capture and euthanasia used in certain circumstances. The existing deer population would be reduced over a period of three to four years to 31–35 deer per square mile, or a park population of 164–186 (based on 2007 data). Additional deer would be removed in subsequent years to maintain the population. The addition of these lethal management measures would require additional staff time to manage the program and accompany the qualified federal employees or contractors conducting lethal reduction activities. Removal activities would require setting up bait, locating deer, lethal reduction, handling the disposition of carcasses and meat, and coordinating with volunteers, if any. In addition to the actual reduction activity, time would be required to coordinate the details of the reduction activity, with limited NPS staff involvement to support these operations. This would result in a long-term, minor, adverse impact.

Costs to the park for lethal reduction through sharpshooting would vary, depending on a number of factors, including the number of deer to be removed each year, access to deer, number and location of bait stations, amount of data to be collected from the deer, and processing or disposal requirements. Based on similar removal efforts (NPS 2008a), the estimated cost for the park to implement lethal reduction through sharpshooting would be \$200 per deer initially (years 1-4), increasing to \$400 per deer as the population decreased and more effort was required to locate deer, including actions to maintain the herd at the reduced level once the initial goal was achieved. Over the 15-year planning period for the deer management plan, sharpshooting efforts are estimated to cost approximately \$438,000. The majority of project funding, including all deer reduction activities and management of these, would be the responsibility of the park. The budget for these actions would remain relatively unchanged over the life of the plan. As fewer deer were removed, the cost for disposal would diminish. However, the amount of time required to remove each



deer would increase as the population was reduced and deer became more wary of humans. This would increase the related costs, balancing the reduction in disposal costs. Any assistance offered by the park's staff would be considered part of regular duties, rather than project specific, and would not require additional project funding (NPS 2008a). This would mean that other projects and duties would not be addressed, however. The result would be a long-term, major, adverse impact.

Where lethal reduction by sharpshooting was not possible, due to safety or security concerns, capture and euthanasia would be implemented by qualified federal employees or contractors. Because this method would only be used in certain situations, the cost would vary depending on the conditions at each removal site, including the location of the removal, accessibility, type of trap or immobilization drug used, how deer were disposed of, and the type of euthanasia used. Based on experience of park personnel and the range of costs identified for capturing deer under the reproductive control action, the costs would range from \$100 to \$1,000 per deer. Based on the amount of time required by park staff to participate in these activities and the funding increase that would be needed, there would be a long-term, moderate, adverse impact.

This alternative would also involve increased educational and interpretive activities, and would therefore require additional funding and staff time to implement. This would result in long-term, minor to moderate, adverse impacts to resource interpretation staff, depending on the level of activities required.

This alternative would result in a greater decrease in the deer population over a shorter period of time, when compared to Alternative A or B. As the number of deer declined in the park, the need for deer management and associated educational/interpretive activities would decline, allowing park staff to apply their efforts to other management areas. This would reduce the length of time the adverse impacts described above would exist. This would result in a long-term beneficial impact, with adverse impacts being reduced to negligible over the long-term.

If CWD were confirmed within 60 miles from the park boundary then park staff would assume responsibility for removal of deer from roadways and ensuring appropriate testing and carcass disposal. Disposal methods for CWD-positive deer are described in Section 2.5: Elements Common to the Action Alternatives. The impacts on operations related to the implementation of this plan are similar to those described under Alternative A. The result would be a long-term, moderate, adverse impact.

If CWD were detected within five miles of the park boundary or the park fell within a state-established CWD containment zone, the park would implement active lethal surveillance as outlined in Section 2.5: Elements Common to the Action Alternatives. Under this plan, if the target deer density has not been achieved, the park would initiate a rapid reduction of the deer population to the initial deer density goal of 31-35 deer per square mile. This would achieve a balance between the deer population and the surrounding environment more rapidly than proposed under this alternative. Depending on the success of state's actions to reduce deer density in areas surrounding the park, a one-time reduction of the deer population to not less than 10 deer per square mile may also be implemented. Additional labor and expense to implement this action would result in a short-term, moderate adverse impact to park operations.

The overall impact of Alternative C on park operations would be long-term, moderate, and adverse.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to park operations would be the same as those described under Alternative A. These projects, along with Alternative C would result in a long-term, moderate, adverse cumulative impact on park operations. Alternative C would contribute an appreciable adverse increment to the overall cumulative impact.

## **Impacts of Alternative D**

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### ***Impact Analysis***

The park would continue limited use of fencing to protect sensitive species and would continue to monitor deer populations and vegetation, with assistance from the Mid-Atlantic I&M Program. Under this alternative, the park would initiate coordination with the PGC and its CWD Response Plan. These actions are part of current operations and would not represent a noticeable change to park staffing or funding. This would result in a long-term, negligible, adverse impact. Impacts related to the CWD Response Plan are discussed below.

Under Alternative D, lethal reduction would be implemented to reduce the size of the deer population, as described in Alternative C. Once the goal of 31-35 deer per square mile were attained, reproductive control, as described in Alternative B, and lethal reduction (if needed) would be used to maintain the deer population at the reduced level. However, the success of implementing reproductive controls on a deer population that has undergone several years of lethal reduction efforts would depend on technological advances, the sensitivity of deer to humans, methods used by the sharpshooters, changes in immigration with reduced deer density, and general deer movement behavior (Porter, Underwood, and Woodward 2004; Naugle et al. 2002). It should be expected that getting close enough to administer remote injections would become more difficult after lethal reduction efforts, due to deer behavior changes in response to previous human interaction (Underwood 2005). If reproductive controls were found to be unsuccessful, deer numbers could be kept low via lethal reduction. The result would be a long-term, major, adverse impact to park operations.

If CWD were confirmed within 60 miles from the park boundary then park staff would assume responsibility for removal of deer from roadways and ensuring appropriate testing and carcass disposal. Disposal methods for CWD-positive deer are described in Section 2.5: Elements Common to the Action Alternatives. The impacts on operations related to the implementation of this plan are similar to those described under Alternative A. The result would be a long-term, moderate, adverse impact.

If CWD were detected within five miles of the park boundary or the park fell within a state-established CWD containment zone, the park would implement active lethal surveillance as outlined in Section 2.5: Elements Common to the Action Alternatives. Under this plan, if the target deer density has not been achieved, the park would initiate a rapid reduction of the deer population to the initial deer density goal of 31-35 deer per square mile. This would achieve a balance between the deer population and the surrounding environment more rapidly than proposed under this alternative. Depending on the success of state's actions to reduce deer density in areas surrounding the park, a one-time reduction of the deer population to not less

than 10 deer per square mile may also be implemented. Additional labor and expense to implement this action would result in a short-term, moderate adverse impact to park operations.

The overall impact of Alternative D on park operations would be long-term, moderate, and adverse.

### ***Cumulative Impacts***

Past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts to park operations would be the same as those described under Alternative A. These projects, along with Alternative D, would result in a long-term, moderate, adverse cumulative impact on park operations. Alternative D would contribute an appreciable adverse increment to the overall cumulative impact.

### **Conclusion**

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The overall impact to park operations under Alternatives A would be long-term, minor to moderate, and adverse. Alternatives B, C, and D would result in long-term, moderate, adverse impacts on park operations. For Alternatives A, B, C, and D the overall cumulative impact would be long-term, moderate, and adverse. Alternatives A, B, C, and D would contribute appreciable adverse increments to the cumulative impact on park operations.

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## **4.9 Summary of Impact Analysis**

### **4.9.1 Unavoidable Adverse Impacts**

The NPS is required to consider if the alternative actions would result in impacts that could not be fully mitigated or avoided (NEPA section 101(c) (ii)).

#### **Alternative A**

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Under Alternative A, there would be long-term, unavoidable, adverse impacts to vegetation, the white-tailed deer population, other wildlife and wildlife habitat, and special status species due to the continued increase in the deer population over time and the associated damage to park vegetation. There would be long-term, unavoidable, adverse effects to historic structures and archeological resources due to trampling and erosion. There would also be long-term, unavoidable, adverse impacts on visitor use and experience, because of the lack of vegetation and the associated wildlife and scenery which park visitors enjoy. There would be long-term, unavoidable, adverse impacts to socioeconomic resources and adjacent lands, as well as public safety, as the deer population would continue to grow or stabilize at a high density. This population would continue to inflict increasing damage on local properties and potentially lead to more deer-vehicle collisions. Unavoidable adverse impacts would continue on park operations, due to the demand on park staff related to continued deer monitoring and resource management.

#### **Alternative B**

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Over the life of the plan, Alternative B would include most of the unavoidable adverse impacts described for Alternative A, as the benefits of reproductive control would not be realized until much later. Unavoidable adverse impacts to some plant species, some historic structures, and some archeological resources could be mitigated, but not eliminated, by the use of rotational fencing, however.

Reproductive controls may have some unavoidable adverse impacts if the actions were visible or audible to park visitors. Reproductive controls may adversely impact deer population behavior. Providing interpretive materials may help mitigate some of this effect; however, reproductive control as proposed under this alternative would likely occur during relatively high visitor use periods and would require a substantial effort to treat the required number of deer. Unavoidable adverse impacts to park operations would remain relatively the same as Alternative A, as the fence construction and reproductive control implementation would be completed by a contractor or other federal employees.

### **Alternative C**

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Unavoidable adverse impacts for Alternative C would be greatly reduced compared to Alternatives A and B. The reduction in deer numbers would occur relatively rapidly and the park's vegetation would begin to recover within the life of the plan. This would mitigate adverse effects to vegetation, white-tailed deer population, other wildlife and wildlife habitat, special status species, historic structures, and archeological resources. Some wildlife that prefer more open habitat would be unavoidably impacted as the vegetation recovered. There may be some unavoidable adverse effects to visitors relating to the implementation of the lethal reduction. Conducting lethal reduction at night and providing interpretive materials would help mitigate some adverse effects. Unavoidable adverse impacts to operations and management would remain relatively the same as Alternative A, as the lethal reduction would be administered by a contractor or other federal employees.

### **Alternative D**

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Unavoidable adverse impacts for Alternative D would be greatly reduced compared to Alternatives A and B. The reduction in deer numbers would occur relatively rapidly and the park's vegetation would begin to recover within the life of the plan. This would mitigate adverse effects to vegetation, white-tailed deer population, other wildlife and wildlife habitat, and special status species, historic structures, and archeological resources. Some wildlife that prefer more open habitat would be unavoidably impacted as the vegetation recovered. There may be some unavoidable adverse effects to visitors relating to the implementation of the lethal reduction. Conducting lethal reduction at night and providing interpretive materials would help mitigate some adverse effects. Unavoidable adverse impacts to park operations and management would remain relatively the same as Alternative A, as the lethal reduction and reproductive controls would be administered by a contractor or other federal employees.

## **4.9.2 Sustainability and Long-Term Management**

In accordance with NEPA, and as further explained in NPS DO #12: "Conservation Planning, Environmental Impact Analysis, and Decision-making", consideration of long-term impacts and the effects of foreclosing future options should pervade any NEPA document. According to DO #12, and as defined by the World Commission on Environment and Development, "sustainable development is that which meets the needs of the present without compromising the ability of future generations to meet their needs." For each alternative considered in a NEPA document, considerations of sustainability must demonstrate the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. This is described below for each alternative.

The NPS must consider if the effects of the alternatives involve tradeoffs of the long-term productivity and sustainability of park resources for the immediate short-term use of those resources. It must also consider if the effects of the alternatives are sustainable over the long term without causing adverse environmental effects for future generations (NEPA section 102(c) (iv)).

### **Alternative A**

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Alternative A would trade any long-term productivity for short-term use of park resources. The deer population would continue to grow over time and use the park's vegetation at the expense of the long-term productivity and sustainability of the vegetation and other affected wildlife in the park, as well as the park's cultural landscapes. Impairment of the park's vegetation, deer herd health, other wildlife and wildlife habitat, and special status species would likely occur over the long term.

### **Alternative B**

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Alternative B would involve a similar trade for short-term use of park resources at the expense of long-term productivity for the duration of the plan, since the reproductive controls would not reduce the numbers of deer in the park over the life of the plan. The construction of the rotational fencing would involve short-term impacts related to their construction and visual impacts to visitors, but they would help preserve some of the park's long-term productivity. They would only protect 10-15% of the park's forested area (6% of the park) at any one time. This would meet the suggested need to protect a minimum of 10-15% of the park's forested area at any one time (NPS 2007i). Once the fencing is rotated, however, it is expected that much of the herbaceous and shrub layer would be lost to deer browsing. For this alternative to be truly sustainable, however, the reproductive control aspect must be continually managed and successful, and rotational fencing would need to be relocated to many areas of the park over time.

### **Alternative C**

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Alternative C would involve a long-term commitment of human resources and short-term impacts to the park's visitors and environment during deer removal actions, but with the result of long-term productivity of the park's vegetation and habitat and a sustainable use of the resources in the park. No impairment of park resources would occur, but it would require long-term management, including monitoring and adaptive management to protect park productivity.

### **Alternative D**

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Like Alternative C, Alternative D would involve a long-term commitment of human resources and short-term impacts to the park's visitors and environment during deer removal actions, but with the result of long-term productivity of the park's vegetation and habitat and a sustainable use of the resources in the park. Alternative D would require more resources focused on the reproductive control aspect, since it is experimental in a free-ranging population. No impairment of park resources would occur, but it would require long-term management, including monitoring and adaptive management to protect park productivity.

### **4.9.3 Irreversible or Irretrievable Commitments of Resources**

The NPS must consider if the impacts of the alternatives cannot be changed or are permanent (that is, the impacts are irreversible). The NPS must also consider if the impacts on park resources would mean that once gone, the resource could not be replaced; in other words, the resource could not be restored, replaced, or otherwise retrieved, (NEPA section 102(c) (v)).

#### **Alternative A**

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Under Alternative A, impacts to vegetation (particularly the forest understory) from continued overbrowsing by deer could result in irreversible impacts to Valley Forge NHP's forests and the surrounding landscape if no actions are taken to reduce the deer population. Invasive plants that are not palatable to deer would continue to exploit openings in the understory, and animal species that rely on native ground vegetation might not remain or return to Valley Forge NHP if the forest understory does not regenerate. Deer browsing has already resulted in the elimination or reduction of certain rare plant species at Valley Forge NHP. Even if fencing were used to protect some of the sensitive species, it would be impossible to identify all individual plants, and overbrowsing of new plants located outside the fenced areas could occur. In addition, the health of deer herd at Valley Forge NHP could suffer irretrievable adverse effects if no action is taken.

#### **Alternative B**

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Alternative B has the potential for irreversible impacts. If some areas of the park's forests are adversely affected by overbrowse to the point where no regeneration was occurring or invasive exotic plants take over some denuded areas before reproductive controls have had time to stabilize the deer population numbers. Rotational fencing would not cover the entire park; therefore, some of the irreversible impacts described for Alternative A would likely occur under Alternative B as well. Impairments to historic structures and archeological resources from continued trampling and erosion would be adverse and irreversible.

#### **Alternative C**

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Alternative C would have minimal potential for irreversible or irretrievable commitments of resources. Although deer would be removed through lethal reduction, the deer population would continue at a sustainable level. Because the population would be reduced relatively rapidly, there would be little chance that park vegetation (including special status species) or other species that are dependent upon forest understory and native ground cover would be irretrievably lost, since forest regeneration would begin within the life of the plan. Continuing damage to historic structures and archeological resources would cease relatively quickly.

#### **Alternative D**

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Like Alternative C, Alternative D would have minimal potential for irreversible or irretrievable commitments of resources. Although deer would be removed through lethal reduction, the deer population would continue at a sustainable level. Because the population would be reduced relatively rapidly, there would be little chance that park vegetation (including special status species) or other species that are dependent upon forest understory and native ground cover would be irretrievably lost, since forest regeneration would begin within the life of the plan. Continuing damage to historic structures and archeological resources would cease relatively quickly.

Table 14 Cumulative Impact Analysis Actions

| Impact Topic                                | Study Area   | Past Actions  | Current Actions   | Future Actions   | Alternative A Actions  | Alternative B Actions   | Alternative C Actions  | Alternative D Actions  |
|---|--|---|---|--|--|---|--|--|
| Vegetation and Special Status Plant Species | Spatial: Park boundary + 1,325 feet<br>Temporal: 1983+ | <p><b>Transportation Corridor Development</b></p> <ul style="list-style-type: none"><li>• Transportation corridor maintenance</li></ul> <p><b>Changes in Air Quality</b></p> <p><b>Natural Resource Management Activities</b></p> <ul style="list-style-type: none"><li>• Fencing of rare plant species</li><li>• Fencing of riparian areas</li><li>• Monitoring of forest plant communities</li><li>• Field Management Plan</li><li>• Pest Management</li><li>• Invasive Species Management</li><li>• Agricultural leasing</li></ul> <p><b>New Construction in the Park</b></p> <p><b>Land Acquisition</b></p> <p><b>Hazardous Material Response</b></p> <ul style="list-style-type: none"><li>• ARS</li><li>• Hazardous Waste site investigation</li></ul> <p><b>Activity Outside the Park Boundary</b></p> <ul style="list-style-type: none"><li>• Development outside the park boundary</li><li>• Legal hunting on adjacent properties</li></ul> <p><b>Inappropriate Visitor Use</b></p> <ul style="list-style-type: none"><li>• Social trails</li><li>• Accidental fires</li></ul> | <p><b>Transportation Corridor Development</b></p> <ul style="list-style-type: none"><li>• Transportation corridor maintenance</li></ul> <p><b>Changes in Air Quality</b></p> <p><b>Natural Resource Management Activities</b></p> <ul style="list-style-type: none"><li>• Fencing of rare plant species</li><li>• Fencing of riparian areas</li><li>• Monitoring of forest plant communities</li><li>• Field Management Plan</li><li>• Pest Management</li><li>• Invasive Species Management</li><li>• Agricultural leasing</li></ul> <p><b>New Construction in the Park</b></p> <p><b>Land Acquisition</b></p> <p><b>Hazardous Material Response</b></p> <ul style="list-style-type: none"><li>• ARS</li><li>• Hazardous Waste site investigation</li></ul> <p><b>Activity Outside the Park Boundary</b></p> <ul style="list-style-type: none"><li>• Development outside the park boundary</li><li>• Legal hunting on adjacent properties</li></ul> <p><b>Inappropriate Visitor Use</b></p> <ul style="list-style-type: none"><li>• Social trails</li><li>• Accidental fires</li></ul> | <p><b>Transportation Corridor Development</b></p> <ul style="list-style-type: none"><li>• Transportation corridor maintenance</li><li>• Increasing traffic volumes</li><li>• Improvements to PA Route 23</li><li>• Pennsylvania Turnpike corridor extension</li><li>• River Crossing Complex</li><li>• New trail connections</li></ul> <p><b>Changes in Air Quality</b></p> <p><b>Natural Resource Management Activities</b></p> <ul style="list-style-type: none"><li>• Fencing of rare plant species</li><li>• Fencing of riparian areas</li><li>• Monitoring of forest plant communities</li><li>• Field Management Plan</li><li>• Pest Management</li><li>• Invasive Species Management</li><li>• Valley Creek Restoration Plan</li><li>• Reforestation of Wagonseller and Fuller Fields</li><li>• Agricultural leasing</li></ul> <p><b>New Construction in the Park</b></p> <p><b>Land Acquisition</b></p> <p><b>Hazardous Material Response</b></p> <ul style="list-style-type: none"><li>• ARS</li><li>• Hazardous Waste site investigation</li></ul> | <ul style="list-style-type: none"><li>• Fencing special status species</li><li>• Monitoring and maintaining fenced plots</li><li>• Coordination with PGC</li><li>• No action taken to maintain deer population</li></ul> | <ul style="list-style-type: none"><li>• Fencing special status species</li><li>• Monitoring and maintaining fenced plots</li><li>• Coordination with PGC</li><li>• Installation and maintenance of rotational fencing</li><li>• Protecting 10-15% of the park’s forested area (4-6% of the park’s total area)</li><li>• Use of bait piles to deliver chemical reproductive control agents</li><li>• No control over the deer population within the life of the plan</li><li>• Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>• Fencing special status species</li><li>• Monitoring and maintaining fenced plots</li><li>• Coordination with PGC</li><li>• Direct reduction and maintenance of the deer population</li><li>• Actions associated with sharpshooting</li><li>• Limited surface disposal of deer carcasses</li><li>• Capture and euthanasia of deer</li><li>• Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>• Fencing special status species</li><li>• Monitoring and maintaining fenced plots</li><li>• Coordination with PGC</li><li>• Direct reduction and maintenance of the deer population</li><li>• Actions associated with sharpshooting and delivering chemical reproductive control agents</li><li>• Limited surface disposal of deer carcasses</li><li>• Capture and euthanasia of deer</li><li>• Implementation of the CWD Response Plan</li></ul> |

Table 14 Cumulative Impact Analysis Actions (continued)

| Impact Topic  | Study Area   | Past Actions  | Current Actions   | Future Actions   | Alternative A Actions   | Alternative B Actions   | Alternative C Actions   | Alternative D Actions   |
|---|--|---|---|--|---|---|---|---|
| Vegetation and Special Status Plant Species (continued) |  |   |   | <b>Activity Outside the Park Boundary</b> <ul style="list-style-type: none"><li>Commercial development at St. Gabes</li><li>Development outside the park boundary</li><li>Legal hunting on adjacent properties</li></ul> <b>Inappropriate Visitor Use</b> <ul style="list-style-type: none"><li>Social trails</li><li>Accidental fires</li><li>Illegal harvesting</li></ul> <b>Climate Change</b>  |   |   |   |   |
| White-tailed Deer Population                            | <b>Spatial:</b> Park boundary + 1,325 feet<br><b>Temporal:</b> 1983+ | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Transportation corridor maintenance</li></ul> <b>Natural Resource Management Activities</b> <ul style="list-style-type: none"><li>Fencing of rare plant species</li><li>Fencing of riparian areas</li><li>Monitoring of forest plant communities</li><li>Field Management Plan</li><li>Pest Management</li><li>Invasive Species Management</li><li>Agricultural leasing</li></ul> <b>Activity Outside the Park Boundary</b> <ul style="list-style-type: none"><li>Development outside the park boundary</li><li>Legal hunting on adjacent properties</li></ul> | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Transportation corridor maintenance</li></ul> <b>Natural Resource Management Activities</b> <ul style="list-style-type: none"><li>Fencing of rare plant species</li><li>Fencing of riparian areas</li><li>Monitoring of forest plant communities</li><li>Field Management Plan</li><li>Pest Management</li><li>Invasive Species Management</li><li>Agricultural leasing</li></ul> <b>Activity Outside the Park Boundary</b> <ul style="list-style-type: none"><li>Development outside the park boundary</li><li>Legal hunting on adjacent properties</li></ul> | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Transportation corridor maintenance</li><li>Increasing traffic volumes</li><li>Closing Gulph Rd.</li><li>Traffic calming</li><li>Pennsylvania Turnpike corridor</li><li>River Crossing Complex</li><li>New trail connections</li></ul> <b>Natural Resource Management Activities</b> <ul style="list-style-type: none"><li>Fencing of rare plant species</li><li>Fencing of riparian areas</li><li>Monitoring of forest plant communities</li><li>Field Management Plan</li><li>Pest Management</li><li>Invasive Species Management</li><li>Reforestation of Waggon seller and Fuller Fields</li><li>Agricultural leasing</li></ul> | <ul style="list-style-type: none"><li>Fencing special status species</li><li>Vegetation and deer population monitoring</li><li>Coordination with PGC</li><li>CWD surveillance</li><li>No action taken to maintain the deer population</li><li>No additional action taken to address CWD</li></ul> | <ul style="list-style-type: none"><li>Fencing special status species</li><li>Vegetation and deer population monitoring</li><li>Coordination with PGC</li><li>CWD surveillance</li><li>Use of rotational fencing</li><li>Implementation of chemical reproductive control</li><li>Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Fencing special status species</li><li>Vegetation and deer population monitoring</li><li>Coordination with PGC</li><li>CWD surveillance</li><li>Lethal reduction to reduce and maintain the deer population</li><li>Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Fencing special status species</li><li>Vegetation and deer population monitoring</li><li>Coordination with PGC</li><li>CWD surveillance</li><li>Lethal reduction and chemical reproductive control to reduce and maintain the deer population</li><li>Implementation of the CWD Response Plan</li></ul> |



Table 14 Cumulative Impact Analysis Actions (continued)

| Impact Topic  | Study Area   | Past Actions  | Current Actions   | Future Actions   | Alternative A Actions  | Alternative B Actions   | Alternative C Actions  | Alternative D Actions   |
|---|--|---|---|--|--|---|--|---|
| White-tailed Deer Population (continued)                            |  |   |   | <b>Cultural Resource Management Activities</b> <ul style="list-style-type: none"><li>Landscape plantings</li><li>Cultural landscape rehabilitation</li></ul> <b>Activity Outside the Park Boundary</b> <ul style="list-style-type: none"><li>Commercial development at St. Gabes</li><li>Development outside the park boundary</li><li>Legal hunting on adjacent properties</li></ul>  |  |   |  |   |
| Other Wildlife, Wildlife Habitat, and Special Status Animal Species | <b>Spatial:</b> Park boundary + 1,325 feet<br><b>Temporal:</b> 1983+ | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Transportation corridor maintenance</li></ul> <b>Natural Resource Management Activities</b> <ul style="list-style-type: none"><li>Fencing of rare plant species</li><li>Fencing of riparian areas</li><li>Monitoring of forest plant communities</li><li>Field Management Plan</li><li>Pest Management</li><li>Invasive Species Management</li><li>Agricultural leasing</li></ul> <b>Land Acquisition</b> <b>Activity Outside the Park Boundary</b> <ul style="list-style-type: none"><li>Development outside the park boundary</li><li>Legal hunting on adjacent properties</li></ul> | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Transportation corridor maintenance</li></ul> <b>Natural Resource Management Activities</b> <ul style="list-style-type: none"><li>Fencing of rare plant species</li><li>Fencing of riparian areas</li><li>Monitoring of forest plant communities</li><li>Field Management Plan</li><li>Pest Management</li><li>Invasive Species Management</li><li>Agricultural leasing</li></ul> <b>Land Acquisition</b> <b>Activity Outside the Park Boundary</b> <ul style="list-style-type: none"><li>Development outside the park boundary</li><li>Legal hunting on adjacent properties</li></ul> | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Transportation corridor maintenance</li><li>Increasing traffic volumes</li><li>Traffic calming</li><li>Closing Gulph Rd.</li><li>Pennsylvania Turnpike corridor</li><li>River Crossing Complex</li><li>New trail connections</li></ul> <b>Natural Resource Management Activities</b> <ul style="list-style-type: none"><li>Fencing of rare plant species</li><li>Fencing of riparian areas</li><li>Monitoring of forest plant communities</li><li>Field Management Plan</li><li>Pest Management</li><li>Invasive Species Management</li><li>Reforestation of Wagonseller and Fuller Fields</li><li>Agricultural leasing</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Coordination with PGC</li><li>CWD surveillance</li><li>Fencing of special status species</li><li>No action taken to maintain the deer population</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Coordination with PGC</li><li>CWD surveillance</li><li>Fencing of special status species</li><li>Construction and maintenance of rotational fencing</li><li>Preventing deer from browsing on 10-15% of the park's forested area (4-6% of the park's total area)</li><li>No immediate action to maintain the deer population</li><li>Implementation of CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Coordination with PGC</li><li>CWD surveillance</li><li>Fencing of special status species</li><li>Lethal reduction to reduce and maintain the deer population</li><li>Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Coordination with PGC</li><li>CWD surveillance</li><li>Fencing of special status species</li><li>Lethal reduction and chemical reproductive controls to reduce and maintain the deer population</li><li>Implementation of the CWD Response Plan</li></ul> |

Table 14 Cumulative Impact Analysis Actions (continued)

| Impact Topic  | Study Area                                | Past Actions  | Current Actions   | Future Actions   | Alternative A Actions  | Alternative B Actions   | Alternative C Actions  | Alternative D Actions   |
|---|---|---|---|--|--|---|--|---|
| Other Wildlife, Wildlife Habitat, and Special Status Animal Species (continued) |   |   |   | Land Acquisition<br>Cultural Resource Management Activities <ul style="list-style-type: none"><li>Landscape plantings</li><li>Cultural landscape rehabilitation</li></ul> Activity Outside the Park Boundary <ul style="list-style-type: none"><li>Commercial development at St. Gabes</li><li>Development outside the park boundary</li><li>Legal hunting on adjacent properties</li></ul> Climate Change   |  |   |  |   |
| Cultural Landscapes   | Spatial: Park boundary<br>Temporal: 1976+ | Transportation Corridor Development <ul style="list-style-type: none"><li>Transportation corridor maintenance</li></ul> Changes in Air Quality<br>Natural Resource Management Activities <ul style="list-style-type: none"><li>Fencing of rare plant species</li><li>Fencing of riparian areas</li><li>Monitoring of forest plant communities</li><li>Field Management Plan</li><li>Pest Management</li><li>Invasive Species Management</li><li>Agricultural leasing</li></ul> New Construction in the Park<br>Land Acquisition<br>Hazardous Material Response <ul style="list-style-type: none"><li>ARS</li><li>Hazardous Waste site investigation</li></ul> | Transportation Corridor Development <ul style="list-style-type: none"><li>Transportation corridor maintenance</li></ul> Changes in Air Quality<br>Natural Resource Management Activities <ul style="list-style-type: none"><li>Fencing of rare plant species</li><li>Fencing of riparian areas</li><li>Monitoring of forest plant communities</li><li>Field Management Plan</li><li>Pest Management</li><li>Invasive Species Management</li><li>Agricultural leasing</li></ul> New Construction in the Park<br>Land Acquisition<br>Hazardous Material Response <ul style="list-style-type: none"><li>ARS</li><li>Hazardous Waste site investigation</li></ul> | Changes in Air Quality<br>Natural Resource Management Activities <ul style="list-style-type: none"><li>Fencing of rare plant species</li><li>Fencing of riparian areas</li><li>Monitoring of forest plant communities</li><li>Field Management Plan</li><li>Pest Management</li><li>Invasive Species Management</li><li>Reforestation of Wagonseller and Fuller Fields</li></ul> New Construction in the Park<br>Cultural Resource Management Activities <ul style="list-style-type: none"><li>Landscape plantings</li><li>Cultural landscape rehabilitation</li></ul> Land Acquisition<br>Hazardous Material Response <ul style="list-style-type: none"><li>ARS</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with PGC</li><li>No action taken to maintain the deer population</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with PGC</li><li>Installation and maintenance of rotational fencing</li><li>Construction and maintenance of rotational fencing</li><li>Preventing deer from reaching 10-15% of the park's forested area (4-6% of the park's total area)</li><li>Implementation of reproductive control agents</li><li>Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with PGC</li><li>Lethal reduction to reduce and maintain the deer population</li><li>Actions associated with sharpshooting</li><li>Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with PGC</li><li>Lethal reduction and chemical reproductive controls to reduce and maintain the deer population</li><li>Actions associated with sharpshooting</li><li>Implementation of the CWD Response Plan</li></ul> |

Table 14 Cumulative Impact Analysis Actions (continued)

| Impact Topic                    | Study Area                                | Past Actions  | Current Actions  | Future Actions   | Alternative A Actions  | Alternative B Actions  | Alternative C Actions  | Alternative D Actions   |
|---------------------------------|---|---|--|--|--|--|--|---|
| Cultural Landscapes (continued) |   | Inappropriate Visitor Use <ul style="list-style-type: none"><li>Social trails</li></ul> Accidental fires  | Inappropriate Visitor Use <ul style="list-style-type: none"><li>Social trails</li></ul> Accidental fires   | Activity Outside the Park Boundary <ul style="list-style-type: none"><li>Commercial development at St. Gabes</li><li>Development outside the park boundary</li></ul> Inappropriate Visitor Use <ul style="list-style-type: none"><li>Social trails</li></ul> Accidental fires  |  |  |  |   |
| Historic Structures             | Spatial: Park boundary<br>Temporal: 1976+ | Cultural Resource Management Activities <ul style="list-style-type: none"><li>Preserve encampment period earthworks</li></ul> Inappropriate Visitor Use <ul style="list-style-type: none"><li>Social trails</li></ul>   | Cultural Resource Management Activities <ul style="list-style-type: none"><li>Preserve encampment period earthworks</li></ul> Inappropriate Visitor Use <ul style="list-style-type: none"><li>Social trails</li></ul>        | Cultural Resource Management Activities <ul style="list-style-type: none"><li>Preserve encampment period earthworks</li></ul> Inappropriate Visitor Use <ul style="list-style-type: none"><li>Social trails</li></ul>  | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with PGC</li><li>No action taken to maintain the deer population</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with PGC</li><li>Construction and maintenance of rotational fencing</li><li>Implementation of the CWD Response Plan</li></ul>  | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with PGC</li><li>Lethal reduction to reduce and maintain the deer population</li><li>Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with PGC</li><li>Lethal reduction and chemical reproductive control agents to reduce and maintain the deer population</li><li>Implementation of the CWD Response Plan</li></ul> |
| Archeological Resources         | Spatial: Park boundary<br>Temporal: 1976+ | Cultural Resource Management Activities <ul style="list-style-type: none"><li>Preserve encampment period earthworks</li></ul> New Construction in the Park<br>Land Acquisition<br>Inappropriate Visitor Use <ul style="list-style-type: none"><li>Social trails</li></ul> | Cultural Resource Management Activities <ul style="list-style-type: none"><li>Preserve encampment period earthworks</li></ul> New Construction in the Park<br>Land Acquisition<br>Inappropriate Visitor Use<br>Social trails | Cultural Resource Management Activities <ul style="list-style-type: none"><li>Preserve encampment period earthworks</li></ul> New Construction in the Park<br>Land Acquisition<br>Activity Outside the Park Boundary <ul style="list-style-type: none"><li>Commercial development at St. Gabes</li></ul> Inappropriate Visitor Use <ul style="list-style-type: none"><li>Social trails</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with PGC</li><li>No action taken to maintain the deer population</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with PGC</li><li>Construction of rotational fencing</li><li>Protection of 10-15% of the park’s forested area (4-6% of the park’s total area)</li><li>Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with PGC</li><li>Lethal reduction to reduce and maintain the deer population</li><li>Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with PGC</li><li>Lethal reduction and chemical reproductive controls to reduce and maintain the deer population</li><li>Implementation of the CWD Response Plan</li></ul>       |

Table 14 Cumulative Impact Analysis Actions (continued)

| Impact Topic               | Study Area                                | Past Actions   | Current Actions  | Future Actions  | Alternative A Actions   | Alternative B Actions  | Alternative C Actions   | Alternative D Actions  |
|----------------------------|---|--|--|---|---|--|---|--|
| Visitor Use and Experience | Spatial: Park boundary<br>Temporal: 1983+ | <p><b>Transportation Corridor Development</b></p> <ul style="list-style-type: none"><li>• Transportation corridor maintenance</li><li>• Increases in traffic volume</li></ul> <p><b>Changes in Air Quality</b></p> <p><b>Natural Resource Management Activities</b></p> <ul style="list-style-type: none"><li>• Field management plan</li><li>• Invasive species management</li><li>• Fencing of rare plant species</li><li>• Fencing of riparian areas</li><li>• Monitoring of forest plant communities</li></ul> <p><b>Hazardous Material Response</b></p> <ul style="list-style-type: none"><li>• ARS</li><li>• Hazardous Waste site investigation</li></ul> <p><b>New Construction in the Park</b></p> <p><b>Land Acquisition</b></p> <p><b>Activity Outside the Park Boundary</b></p> <ul style="list-style-type: none"><li>• Development outside the park boundary</li><li>• Legal hunting on adjacent properties</li></ul> <p><b>Inappropriate Visitor Use</b></p> <ul style="list-style-type: none"><li>• Accidental fires</li><li>• Social trails</li></ul> | <p><b>Transportation Corridor Development</b></p> <ul style="list-style-type: none"><li>• Transportation corridor maintenance</li><li>• Increases in traffic volume</li></ul> <p><b>Changes in Air Quality</b></p> <p><b>Natural Resource Management Activities</b></p> <ul style="list-style-type: none"><li>• Field management plan</li><li>• Invasive species management</li><li>• Fencing of rare plant species</li><li>• Fencing of riparian areas</li><li>• Monitoring of forest plant communities</li></ul> <p><b>Hazardous Material Response</b></p> <ul style="list-style-type: none"><li>• ARS</li><li>• Hazardous Waste site investigation</li></ul> <p><b>New Construction in the Park</b></p> <p><b>Land Acquisition</b></p> <p><b>Activity Outside the Park Boundary</b></p> <ul style="list-style-type: none"><li>• Development outside the park boundary</li><li>• Legal hunting on adjacent properties</li></ul> <p><b>Inappropriate Visitor Use</b></p> <ul style="list-style-type: none"><li>• Accidental fires</li><li>• Social trails</li></ul> | <p><b>Transportation Corridor Development</b></p> <ul style="list-style-type: none"><li>• Transportation corridor maintenance</li><li>• Increasing traffic volumes</li><li>• Traffic calming</li><li>• Improvements to PA Route 23</li><li>• Close Gulph Road</li><li>• Metro transit improvements</li><li>• Pennsylvania Turnpike corridor</li><li>• River Crossing Complex</li><li>• New trail connections</li></ul> <p><b>Changes in Air Quality</b></p> <p><b>Natural Resource Management Activities</b></p> <ul style="list-style-type: none"><li>• Field management plan</li><li>• Invasive species management</li><li>• Fencing of rare plant species</li><li>• Fencing of riparian areas</li><li>• Monitoring of forest plant communities</li><li>• Reforestation of Wagonseller and Fuller Fields</li></ul> <p><b>Cultural Resource Management Activities</b></p> <ul style="list-style-type: none"><li>• Landscape plantings</li><li>• Cultural landscape rehabilitation</li></ul> <p><b>Hazardous Material Response</b></p> <ul style="list-style-type: none"><li>• ARS</li><li>• Hazardous Waste site investigation</li></ul> | <ul style="list-style-type: none"><li>• Vegetation and deer population monitoring</li><li>• Fencing special status species</li><li>• Coordination with PGC</li><li>• Removal of roadkilled deer</li><li>• No action taken to maintain the deer population</li></ul> | <ul style="list-style-type: none"><li>• Vegetation and deer population monitoring</li><li>• Fencing special status species</li><li>• Coordination with PGC</li><li>• Removal of roadkilled deer</li><li>• Construction and maintenance of rotational fencing</li><li>• Implementation of chemical reproductive control agents</li><li>• Focused educational programs</li><li>• Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>• Vegetation and deer population monitoring</li><li>• Fencing special status species</li><li>• Coordination with PGC</li><li>• Removal of roadkilled deer</li><li>• Lethal reduction to reduce and maintain the deer population</li><li>• Implementation of capture and euthanasia</li><li>• Limited surface disposal of carcasses</li><li>• Focused educational programs</li><li>• Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>• Vegetation and deer population monitoring</li><li>• Fencing special status species</li><li>• Coordination with PGC</li><li>• Removal of roadkilled deer</li><li>• Lethal reduction and chemical reproductive controls to reduce and maintain the deer population</li><li>• Implementation of capture and euthanasia</li><li>• Limited surface disposal of carcasses</li><li>• Focused educational programs</li><li>• Implementation of the CWD Response Plan</li></ul> |

Table 14 Cumulative Impact Analysis Actions (continued)

| Impact Topic                               | Study Area  | Past Actions  | Current Actions  | Future Actions   | Alternative A Actions   | Alternative B Actions   | Alternative C Actions   | Alternative D Actions   |
|--|---|---|--|--|---|---|---|---|
| Visitor Use and Experience<br>(continued)  |   |   |  | <b>New Construction in the Park</b><br><b>Land Acquisition</b><br><b>Activity Outside the Park Boundary</b> <ul style="list-style-type: none"><li>Commercial development at St. Gabes</li><li>Development outside the park boundary</li><li>Legal hunting on adjacent properties</li></ul> <b>Inappropriate Visitor Use</b> <ul style="list-style-type: none"><li>Accidental fires</li></ul> <b>Social trails</b>  |   |   |   |   |
| Socioeconomic Resources and Adjacent Lands | <b>Spatial:</b> Park boundary + 1,325 feet<br><b>Temporal:</b> 1983+` | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Increases in traffic volume</li></ul> <b>Natural Resource Management Activities</b> <ul style="list-style-type: none"><li>Pest Management</li></ul> <b>Land Acquisition</b><br><b>Activity Outside the Park Boundary</b> <ul style="list-style-type: none"><li>Legal hunting on adjacent lands</li></ul> | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Increases in traffic volume</li></ul> <b>Activity Outside the Park Boundary</b> <ul style="list-style-type: none"><li>Legal hunting on adjacent lands</li></ul> | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Transportation corridor maintenance</li><li>Increasing traffic volumes</li><li>Traffic calming</li><li>Improvements to PA Route 23</li><li>Metro transit improvements</li><li>Close Gulph Road</li><li>Pennsylvania Turnpike corridor extension</li><li>River Crossing Complex</li></ul> <b>Land Acquisition</b><br><b>Activity Outside the Park Boundary</b> <ul style="list-style-type: none"><li>Commercial development at St. Gabes</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with the PGC</li><li>Removal of roadkilled deer</li><li>No action taken to maintain the deer population</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with the PGC</li><li>Removal of roadkilled deer</li><li>Construction and maintenance of rotational fencing</li><li>Preventing deer from reaching 10-15% of the park’s forested area (4-6% of the park’s total area)</li><li>Implementation of chemical reproductive control</li><li>Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with the PGC</li><li>Removal of roadkilled deer</li><li>Lethal reduction to reduce and maintain the deer population</li><li>Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Vegetation and deer population monitoring</li><li>Fencing special status species</li><li>Coordination with the PGC</li><li>Removal of roadkilled deer</li><li>Lethal reduction and chemical reproductive control to reduce and maintain the deer population</li><li>Implementation of the CWD Response Plan</li></ul> |

Table 14 Cumulative Impact Analysis Actions (continued)

| Impact Topic    | Study Area   | Past Actions  | Current Actions  | Future Actions  | Alternative A Actions  | Alternative B Actions   | Alternative C Actions   | Alternative D Actions   |
|-----------------|--|---|--|---|--|---|---|---|
| Public Safety   | Spatial: Park boundary + 1,325 feet<br>Temporal: 1983+ | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Increases in traffic volume</li></ul> <b>Hazardous Material Response</b> <ul style="list-style-type: none"><li>ARS</li><li>Hazardous Waste site investigation</li></ul> <b>Inappropriate Visitor Use</b> <ul style="list-style-type: none"><li>Accidental fires</li><li>Social trails</li></ul>  | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Increases in traffic volume</li></ul> <b>Hazardous Material Response</b> <ul style="list-style-type: none"><li>ARS</li><li>Hazardous Waste site investigation</li></ul> <b>Inappropriate Visitor Use</b> <ul style="list-style-type: none"><li>Accidental fires</li><li>Social trails</li></ul>   | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Increases in traffic volume</li><li>Traffic calming</li><li>Close Gulph Road</li></ul> <b>Hazardous Material Response</b> <ul style="list-style-type: none"><li>ARS</li><li>Hazardous Waste site investigation</li></ul> <b>Inappropriate Visitor Use</b> <ul style="list-style-type: none"><li>Accidental fires</li><li>Social trails</li></ul> | <ul style="list-style-type: none"><li>Fencing special status species</li><li>Vegetation and deer population monitoring</li><li>Coordination with the PGC</li><li>No action taken to maintain the deer population</li></ul>   | <ul style="list-style-type: none"><li>Fencing special status species</li><li>Vegetation and deer population monitoring</li><li>Coordination with the PGC</li><li>Construction and maintenance of rotational fencing</li><li>Implementation of reproductive control</li><li>Implementation of the CWD Response Plan</li></ul>  | <ul style="list-style-type: none"><li>Fencing special status species</li><li>Vegetation and deer population monitoring</li><li>Coordination with the PGC</li><li>Lethal reduction to reduce and maintain the deer population</li><li>Implementation of the CWD Response Plan</li></ul>                                    | <ul style="list-style-type: none"><li>Fencing special status species</li><li>Vegetation and deer population monitoring</li><li>Coordination with the PGC</li><li>Lethal reduction and chemical reproductive control to reduce and maintain the deer population</li><li>Implementation of the CWD Response Plan</li></ul>                                    |
| Park Operations | Spatial: Park boundary<br>Temporal: 1983+              | <b>Natural Resource Management Activities</b> <ul style="list-style-type: none"><li>Field Management Plan</li><li>Agricultural leasing</li><li>Fencing of rare plant species</li><li>Fencing of riparian areas</li><li>Monitoring of forest plant communities</li><li>Invasive plant management</li></ul> <b>New Construction in the Park</b> <b>Land Acquisition</b> <b>Hazardous Material Response</b> <ul style="list-style-type: none"><li>ARS</li><li>Hazardous Waste site investigation</li></ul> <b>Inappropriate Visitor Use</b> <ul style="list-style-type: none"><li>Accidental fires</li><li>Social trails</li></ul> | <b>Natural Resource Management Activities</b> <ul style="list-style-type: none"><li>Field Management Plan</li><li>Invasive plant management</li><li>Fencing of rare plant species</li><li>Fencing of riparian areas</li><li>Monitoring of forest plant communities</li></ul> <b>New Construction in the Park</b> <b>Hazardous Material Response</b> <ul style="list-style-type: none"><li>ARS</li><li>Hazardous Waste site investigation</li></ul> <b>Inappropriate Visitor Use</b> <ul style="list-style-type: none"><li>Accidental fires</li><li>Social trails</li></ul> | <b>Transportation Corridor Development</b> <ul style="list-style-type: none"><li>Transportation corridor maintenance</li><li>Increasing traffic volumes</li><li>Close Gulph Road</li><li>Improvements to PA Route 23</li><li>Pennsylvania Turnpike corridor extension</li><li>River Crossing Complex</li><li>New trail connections</li></ul>  | <ul style="list-style-type: none"><li>Fencing special status species</li><li>Vegetation and deer population monitoring</li><li>Coordination with PGC</li><li>Maintained staffing of the park's natural resource management division</li><li>Implementation of the CWD Response Plan</li><li>Monitoring deer management costs</li></ul> | <ul style="list-style-type: none"><li>Fencing special status species</li><li>Vegetation and deer population monitoring</li><li>Coordination with PGC</li><li>Construction and maintenance of rotational fencing</li><li>Implementing chemical reproductive control</li><li>Increased educational programs</li><li>Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Fencing special status species</li><li>Vegetation and deer population monitoring</li><li>Coordination with PGC</li><li>Lethal reduction to reduce and maintain the deer population</li><li>Increased educational programs</li><li>Implementation of the CWD Response Plan</li></ul> | <ul style="list-style-type: none"><li>Fencing special status species</li><li>Vegetation and deer population monitoring</li><li>Coordination with PGC</li><li>Lethal reduction and chemical reproductive control to reduce and maintain the deer population</li><li>Increased educational programs</li><li>Implementation of the CWD Response Plan</li></ul> |

Table 14 Cumulative Impact Analysis Actions (continued)

| Impact Topic                   | Study Area | Past Actions | Current Actions | Future Actions   | Alternative A Actions | Alternative B Actions | Alternative C Actions | Alternative D Actions |
|--------------------------------|------------|--------------|-----------------|--|-----------------------|-----------------------|-----------------------|-----------------------|
| Park Operations<br>(continued) |            |              |                 | <div>Natural Resource Management Activities<ul style="list-style-type: none"><li>Fencing of rare plant species</li><li>Fencing of riparian areas</li><li>Monitoring of forest plant communities</li><li>Field Management Plan</li><li>Pest Management</li><li>Invasive Species Management</li><li>Valley Creek Restoration Plan</li><li>Reforestation of Wagonseller and Fuller Fields</li><li>Stream bank collapse</li></ul></div> <div>Cultural Resource Management Activities<ul style="list-style-type: none"><li>Landscape plantings</li><li>Cultural landscape rehabilitation</li></ul></div> <div>New Construction in the Park</div> <div>Land Acquisition</div> <div>Hazardous Material Response<ul style="list-style-type: none"><li>ARS</li><li>Hazardous Waste site investigation</li></ul></div> <div>Inappropriate Visitor Use<ul style="list-style-type: none"><li>Accidental fires</li></ul></div> <div>Social trails</div> |                       |                       |                       |                       |

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