Chapter 4

USFWS

The Marsh Master is a versatile tool for mowing in wet areas on the refuge.

Environmental Consequences

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Introduction

This chapter describes the foreseeable environmental consequences we predict will result from implementing the refuge management alternatives in chapter 3. Specifically, we predict the effects of implementing the management actions and strategies for each of the three alternatives: alternative A, "Current Management," which is the status quo, and serves as the baseline for comparing alternative B, "The Service-Preferred alternative," and alternative C. When detailed scientific information is available, we present analytic comparisons among the alternatives and their anticipated consequences, which we describe as "impacts" or "effects." In the absence of detailed information, we base our comparisons on our professional judgment and experience.

Our discussion focuses on the impacts associated with the goals and issues in chapter 1, "The Purpose and Need for Action," and includes the direct, indirect, short-term, beneficial and adverse effects likely to occur during this plan's 15-year span. Beyond that 15-year span, we speculate more in describing the direct, indirect, and cumulative effects. Table 4.10 compares in side-by-side summaries the effects we predict for each alternative. Finally, this chapter identifies any irreversible and irretrievable commitment of resources and the relationship between short-term uses of the environment and its long-term productivity.

As required by the Council on Environmental Quality (CEQ) and U.S. Fish and Wildlife Service regulations implementing the National Environmental Policy Act (NEPA), we assessed the importance of the effects of our alternatives based on their context and intensity. Their context ranges from site-specific to broad regional impacts. Although the refuge composes only a small percentage of the contexts of the large ecosystems around it, we developed all of the alternatives to contribute to achieving our conservation goals in those larger contexts. The species and habitat actions we propose are consistent with the state, regional, and watershed conservation plans identified in chapter 1. At varying levels, each alternative would contribute positively to larger, landscape-scale conservation.

We evaluated the intensity of those impacts based on their expected degree or percentage of the change in resources from their current conditions:

Impact Contexts at the Wallkill River Refuge

Vernal Pool	0.001 to 0.1 acre
Parking Lot	0.1 acre
Moist Soil Management Units	50 acres
Wallkill River Refuge	7,500 acres (11.6 mi^2)
Wallkill River Watershed (N.Y. and N.J.)	502,400 acres (785 mi^2)
in N.J. (upper reaches)	133,120 acres (208 mi^2)
Sussex County, N.J.	333,440 acres (521 mi^2)
Partners in Flight (Landbird) Conservation Plan Physiographic Region 17—Northern Ridge and Valley)	11,272,400 acres (17,613 mi^2)

- the frequency and duration of the effect,
- the sensitivity of the resource to such an effect,
- the natural resiliency of the resource to recover from such an effect, and
- the potential for preventing or mitigating such an effect.

The duration of the effects varies, from those that would occur only once, briefly, within the 15-year planning horizon—for example, the effects of parking lot construction—and those that would occur every day during one season of the year—for example, the effects of hunting or fishing.

Certain types of the actions in chapter 3 do not require additional NEPA analysis, because they do not have significant individual or cumulative effects on the human environment. NEPA categorically excludes them from further analysis or review, and we do not describe their consequences further in this chapter. They include but are not limited to the following:

- conducting environmental education and interpretation programs (unless major construction is involved)
- conducting research, inventorying resources, and collecting other resource information
- operating and maintaining existing infrastructure and facilities (unless major renovation is involved)
- recurring, routine management activities and improvements
- constructing small projects (e.g., fences, berms, small water control structures, interpretative kiosks, developing access for routine management purposes)
- planting vegetation
- reintroducing native plants and animals
- making minor changes in amounts or types of public use
- issuing new or revised management plans when only minor changes are planned, and
- enforcing laws and Service policies.

We organized this chapter by major resource headings. Under each heading, we discuss the resource context and the types of benefits and adverse impacts of the management actions we evaluated. Then we discuss the beneficial and adverse effects that would occur regardless of which alternative our Regional Director selects and, finally, the beneficial and adverse effects of each of the alternatives.

Effects on Air Quality

Chapter 2, "Description of the Affected Environment," presents the status of air quality in the region of the refuge. Overall air quality in the region of the refuge is currently good, with the following exceptions. The U.S. Environmental Protection Agency (USEPA 2006) reports that Sussex County is one of 51 counties in the N.Y.–N.J. region in non-attainment for the criteria (8-hour) air pollutant ozone. Sussex County is in attainment for all other criteria air pollutants, although the adjacent Passaic and Morris counties to the east are in non-attainment for particulate matter (PM 2.5), and the adjacent Warren County is in non-attainment for sulfur dioxide (SO_2). Sussex County also contributes to levels of a number of the 188 EPA-monitored hazardous air pollutants (HAPS), at an estimated 2.9 million pounds of emissions from all sources in the county (1999). More than 1 million pounds came from on-road mobile sources: automobiles, trucks, buses, and motorcycles.

We evaluated the management actions the alternatives propose for their potential to help improve air quality locally, in the region, and globally. The benefits we considered included the

- potential to adopt energy efficient practices to reduce the refuge's contribution to emissions
- potential of refuge land acquisition and protection to limit the growth of development thereby limiting emission sources and reducing losses of natural vegetation
- potential of refuge forest management activities to contribute to carbon sequestration and reduce greenhouse gases

The potential adverse air quality effects of the Wallkill River management alternatives that we evaluated included increases in pollutants from

- setting prescribed fires to manage grasslands
- applying herbicides to control invasive plants
- blowing dust from construction sites, roads, and trails
- increasing emissions from vehicles and equipment
- increasing air emissions from new or upgraded building facilities

Air Quality Impacts that Would Not Vary by Alternative

Regardless of which management alternative our Regional Director selects, refuge management activities should not adversely affect regional air quality. None of the alternatives would violate EPA standards; all three would comply with the Clean Air Act.

Sussex County does have a number of criteria pollutants and hazardous air pollution sources (EPA 2006), but no major stationary or mobile sources of air pollutants are present at the refuge, and our management alternatives would create none. On the contrary, the Service limits the uses of the refuge to compatible, wildlife-oriented, consumptive and non-consumptive uses, and thus, curtails anthropogenic sources of emissions by maintaining forested and non-forested wetlands, grasslands, and early successional sites in natural vegetative cover. Therefore, in analyzing the impacts on air quality, we considered only how Service actions at the refuge might affect criteria air pollutants, visibility, and global warming to a minimal degree, focusing instead on the potential for localized air quality impacts or improvement.

None of the proposed management alternatives would affect visibility due to emission haze at the nearest Class I airshed, the Edwin B. Forsythe National Wildlife Refuge. In all the alternatives, the management actions and public uses at the refuge would contribute a negligible increment to the Sussex County air emission levels overall, and it is highly unlikely that air emissions from the county would reach that Class I area. Brigantine lies 70 miles south of the refuge, and the prevailing wind patterns from the west generally move air emissions toward the N.Y.–Conn. metropolitan area, well north of Brigantine.

Wildfires are not a substantial concern at the refuge, because they occur infrequently, and the rapid local response quickly limits their extent. The refuge is relatively isolated from major forested tracts by the residential and

agricultural lands around it, and community fire protection is good. Although we would conduct prescribed burns to manage grassland and other habitat in alternatives A and B, and to control invasive plants in all the alternatives, we would monitor and control the burning carefully to keep the risk of wildfire extremely low.

In all the alternatives, we would use the herbicide glyphosate to control invasive plants, particularly at bog turtle sites. Glyphosate is a non-volatile compound we would apply only with ground equipment, thereby virtually eliminating the likelihood of any measurable airborne particulates. Glyphosate is not a risk to human or wildlife health, because of its low toxicity to vertebrates and strong affinity for soils that renders it biologically unavailable soon after application. Nevertheless, we will take all precautions with respect to wind conditions, time of day, and proper equipment to ensure that we expose only target plants to the chemical.

We will make responsible energy use fundamental in the development and operation of our lands and facilities, as well as in contractor and commercial visitor services. The energy management process will emphasize energy awareness, energy conservation, and energy efficiency, as well as the use of renewable energy resources, including bio-based fuels. We will reduce energy use substantially below the recommended standards through responsive design, such as day lighting, solar, geothermal, and photovoltaic techniques. When feasible and appropriate, we will promote renewable energy sources. For example, when the opportunity arises, we will consider using alternative sources of energy, such as solar or wind power in Service-owned buildings. Whenever we retire a piece of motorized of equipment, we will upgrade to 4-stroke equipment, if available.

Impacts of Alternative A—Current Management

Benefits

Continuing benefits to air quality under alternative A would derive from maintaining the natural vegetation on more than 5,065 acres of currently owned land, and up to 2,021 acres of additional, newly purchased land within the refuge acquisition boundary. The air quality benefits are twofold. Natural vegetation serves to filter air pollutants (see text box), and maintaining the refuge lands and acquiring additional land precludes their development and the introduction of attendant sources of pollutant emissions. Trees also serve as long-term carbon "sinks" that reduce atmospheric carbon. In alternative A, we would adopt energy-efficient practices as feasible, and some benefit would accrue from our acquisition of nearly 800 acres of additional forestland, in terms of maintaining their contribution to carbon sequestration. However, our purchasing land only within the current refuge acquisition boundary would limit that beneficial effect more than in alternatives B and C, which would substantially expand the forested land base we protect.

Biological Air Filtration

Biological air filtration by vegetation occurs in three processes: deposition on leaves, branches, and trunks, adsorption by those same surfaces and uptake by leaves through the stomata. Deposition is the most important for particulate removal, while sorption and uptake are most important for the removal of gases. Sorption and deposition are primarily physical processes affected by the amount of plant surface and the physical and chemical nature of those surfaces. (Whitlow and Reaves 2006)

Adverse Impacts

Localized, temporary adverse effects on air quality and visibility could result from the prescribed burns that we would conduct under alternative A to maintain or restore more than 600 acres of refuge grasslands and for other management purposes.

In February 2002, we completed an environmental assessment (EA) and Fire Management Plan for our prescribed fire program. All of the alternatives in this draft CCP/EA incorporate the decision in that Fire EA. Alternative A proposes prescribed fires to maintain grasslands, enhance habitats for threatened and endangered species, or control invasive plant species. The current Fire Management Plan proposes burning annually between 0 acres and 30 acres; the future Habitat Management Plan will continue that proposal. Since 2002, we have conducted two prescribed burns on 60 acres, mostly on grassland. We estimate that the size of the burn program would increase slightly (0 acres to 60 acres annually) as we acquire additional land and develop a Habitat Management Plan. In alternative A, we would implement the following planned projects over the next 15 years, with the annual maximum acreage indicated below, using prescribed fire

- 60 acres/year for enhancing or maintenance of wildlife and plant species populations
- 30 acres/year to preserve threatened and endangered species and promote biological diversity
- 25 acres/year for invasive plant control

Visibility and clean air are important natural resource values on the refuge, and we would fully consider protecting them in our fire management planning and operations. We would comply with all applicable federal, state, and local air pollution requirements, as specified in section 118 of the Clean Air Act (42 U.S.C. 7418). Our Fire Management Handbook provides further guidance (USFWS 2001b). The plan stipulates the required conditions for burning prescribed fires to control their size, minimize or eliminate their impacts on visibility, and reduce their potential for releasing particulates and pollutants into the air. All of those required conditions aim at minimizing smoke emissions and following Best Available Control Technology.

The following measures would minimize the effects of prescribed fires on air quality

- We would permit burning only if the existing wind speed, wind direction, and atmospheric conditions do not create nuisance smoke conditions.
- The Annual Prescribed Fire Plan would identify and address smoke-sensitive areas. The direction of the selected wind vector would transport smoke and other particulate emissions away from sensitive areas.
- Burning would be conducted only when visibility exceeds 2 miles and the fire weather forecast indicates the presence of an unstable air mass, mixing heights are greater than 1,500 feet, and ventilation rates (mixing height × transport wind speed) are 7,500 or greater, with a recommended minimum transport wind speed of 5 mph. A daily spot forecast is required, which we would obtain from the National Weather Service.
- No burning would occur if any government agency has issued an air pollution health advisory, alert, warning, or emergency for the area surrounding the refuge.
- We would use backing and flanking fires when possible to minimize particulate emissions.

- We would keep media sources informed of fire and smoke dispersal conditions throughout any fire.

Although our prescribed fire program would cause short-term adverse effects on air quality, the pollution-filtering benefits that derive from maintaining those areas in natural vegetation conditions would last in perpetuity. The carbon emissions from all the prescribed burns at the refuge would constitute a negligible increment in greenhouse gas emissions.

Trail maintenance and parking lot construction would cause negligible short-term, localized effects from dust and vehicle and equipment exhausts. Operating the refuge facilities would continue to contribute slightly in local stationary source emissions. The projected increase in levels of annual refuge use (table 4.1) of more than 34,000 visits would also increase vehicle emissions slightly on the refuge in the long-term. Those would be virtually no localized increases on the refuge, compared to the current off-refuge contributions to pollutant levels and likely increases in air emissions from land development in the Wallkill River valley during the next 15 years. The benefits of maintaining the refuge in natural vegetation would more than offset them. Consequently, the emissions from sources on the refuge would not cause cumulative effects on air quality.

Table 4.1. Estimated refuge visits by alternative.

	Actual Refuge Visits	Annual Refuge Visits Estimated by Alternative for the Next 15 years		
Visitor Activity	2005	Alt A (2005 + 10%)	Alt B (2005 + 15%)	Alt C (2005 - 5%)
Consumptive Uses				
Fishing	625	685	720	595
Hunting: Deer and Turkey	6,560	7,210	7,545	6,230
Hunting: Migratory birds	970	1,060	1,110	925
Hunting: Other birds	110	160	130	105
Non-Consumptive Uses				
Boating/Water Use	1,500	1,650	1,720	1,425
Nature trails/other wildlife observation/ office visits	21,320	23,430	24,520	20,250
Total annual refuge visits	31,085	34,195	35,745	29,530

Impacts of Alternative B—The Service-Preferred Alternative

Benefits

In alternative B, expanding the refuge land base outside the current acquisition boundary would increase the refuge to more than 16,638 acres, more than doubling the area of undeveloped land we would manage for a variety of habitats benefiting wildlife. That expanded land base will help stem increases nearby in development, and locally reduce the long-term potential for air emissions from additional homes, businesses, vehicles, and equipment.

We would upgrade our refuge maintenance operations to include energy-efficient vehicles and equipment. Additional carbon sequestration benefits would derive from the increase to more than 6,000 acres in total refuge forested acreage proposed in alternative B.

Adverse Impacts
Prescribed burning would cause impacts similar to those described in alternative A. They would increase because of the increase in managed acreage. The size of the burn program would increase by 10 acres to 20 acres annually as we acquire additional land and develop a Habitat Management Plan. Alternative B would implement the following planned projects, with the annual maximum acreage indicated, using prescribed fire over the next 15 years:

100 acres/year for enhancing or maintenance of wildlife and plant species populations

50 acres/year to preserve threatened and endangered species and promote biological diversity

50 acres/year for invasive plant control.

New trail, boardwalk, and parking lot construction (see text box) would cause short-term, localized effects from dust and from the exhaust of construction vehicles and other equipment. The operation of the refuge headquarters and other facilities would continue to contribute slightly to the ambient levels of local, stationary source emissions.

The projected levels of annual refuge use (more than 35,000 visits) would increase slightly the vehicle emissions on and near the refuge in the long-term. Precluding development in the expansion area and preventing the introduction of the attendant emission sources would more than likely compensate for the contribution of cumulative effects on local and regional air quality.

Alternative B Proposed Construction Projects

1. Boardwalk and barrier-free fishing platform and canoe/kayak access site at Bassett's Bridge for disabled anglers. The platform will be built on wetlands adjacent to the river so that visitors can put a boat directly into the river from the platform. There will be access for non-motorized boats or boats with small engines that can be carried separately from the boat.
2. Fishing and canoe access on Route 565 (Glenwood Road) where the bridge crosses the river after the intersection with Scenic Lakes Road with a 10-car parking lot on a 30-foot-long boardwalk and a 20-square-foot floating dock where people could put non-motorized boats, or small engine boats, into the river.
3. Barrier-free fishing and canoe access at Scenic Lakes Road at the south end of the refuge by converting the grassy parking area into a gravel parking lot that would accommodate up to 10 cars, a comfort station for visitors, gated with an electric gate to avoid nighttime use and the accompanying law enforcement problems, a boardwalk about 3 feet wide and 30 feet long leading to a floating platform where people could launch boats.
4. Wood Duck Nature trail extension—0.75 miles with a footbridge over the Wallkill River.
5. Photography blind on the Liberty Loop Trail. The blind probably would be located on a high spot on one of the dikes overlooking the impoundments. Visitors would have to be able to walk to it; it would not be located near a parking area.
6. Former Lehigh and New England railroad bed opened to foot access from Kelly Road up to Bassett's Bridge to create the .75-mile Timberdoodle Trail and the extension of the Timberdoodle Trail north to connect with the Liberty Loop Trail.
7. Railroad bed south of Judge Beach Road acquired for use by the public as a nature trail for wildlife observation, wildlife photography, environmental education and interpretation.
8. In Papakating Creek Focus Area, work with partners to open the rail bed as a rail-trail, or multi-use trail for non-motorized vehicles. People currently use this trail for horseback riding, ATVing and other illegal or legal uses.
9. Fishing and canoe/boating access where Papakating Creek intersects Route 23, Route 565 (two places), and Ross's Road and a parking area and boardwalk, where appropriate, leading to a platform that can be used by disabled anglers for fishing or that can serve as a boat launch site. Also, provide up to three interpretive pullouts off major roads with a small parking lot and interpretive signage.
10. Trail to connect the Papakating Creek Focus area to High Point State Park wherever feasible. Work with NJ Forest and Parks.

Impacts of Alternative C

Benefits

As in alternative B, we would expand the refuge land base in alternative C outside the current acquisition boundary. We would manage the total expanded refuge of 14,691 acres for natural vegetation, including the current refuge boundary, and including the restoration of 5,474 acres of floodplain forest and about 4,287 acres of upland forest. As in alternative B, this approximate doubling of the size of the refuge will tend to stem increases nearby in residential and other development, thus reducing locally the long-term potential for air emissions from homes, businesses, vehicles and equipment. Over the long term—50+ years—the predominance of more mature stands would improve the health, diversity, and resilience of the forest to disturbance, disease and insect outbreaks, thus maintaining an important carbon "sink."

Adverse Impacts

Alternative C would reduce the impacts of burning. We would not burn any prescribed fires for grassland management, but would allow the refuge grasslands to succeed to scrub-shrub and forested habitat. The impacts of prescribed burning to control invasive species or manage bog turtle habitat would resemble those in alternative B.

We project a 5 percent decrease in annual refuge visits, which would decrease slightly the vehicle emissions on and near the refuge in the long-term. In addition, precluding development in the expansion area would compensate to some degree any contribution to cumulative effects on local and regional air quality.

Effects on Water Quality

Serious concerns about the water quality in the Wallkill River watershed have surfaced, notably, recent findings of elevated levels of arsenic, phosphorus, zinc, and fecal coliform resulting from point and non-point sources outside the refuge. Although the Service has communicated with the NJDEP about addressing those concerns, we have no authority to deal directly with their sources. We expect the state to take appropriate steps to address those problems, and we hope that water quality will improve in the long-term.

We evaluated and compared the management actions each alternative proposes based on their potential to help maintain and improve the water quality of the Wallkill River and the refuge wetlands in the watershed. We evaluated the benefits of actions that would protect or restore floodplain function, as influenced by vegetation and hydrology, to restore wetlands and their role in filtering water pollutants, and otherwise to maintain or improve water quality.

- Land acquisition and protection would provide watershed benefits by precluding development and maintaining native vegetation
- retention of floodplain buffer
- emergent wetlands projects
- restoration of hydrology at bog turtle sites
- improvements in local hydrology through ditch plugging or other measures
- control of impoundment water levels at all seasons to benefit waterfowl and other birds
- improved water quality monitoring for early problem identification
- improved cooperation of other landowners in watershed to influence water quality

We evaluated and compared the impacts of the management actions with the potential to cause adverse effects to hydrology and water quality, including:

- use of herbicides to manage grasslands or invasive species
- grazing livestock to manage bog turtle sites and grasslands
- refuge construction projects
- changes in recreational use that might lead to contamination with petroleum products

Impacts That Would Not Vary by Alternative

Regardless of which refuge management alternative we implement, we would cause no major adverse impacts on water quality; rather, managing the refuge and collaborating with local communities would continue to benefit water quality.

Benefits

Service actions at the refuge would not affect pollution levels from point and non-point sources. However, the refuge will continue to benefit water quality in the Wallkill River watershed by limiting development in that part of the watershed and acting as a buffer against non-point-source pollution in the surrounding landscape. The existing and restored wetlands adjacent to the river will filter water moving into the river and help improve water quality.

Adverse Impacts

Contaminants from routine operations

In managing the refuge, we would closely monitor and mitigate all of our routine activities that have some potential to result in the chemical contamination of water directly through leakage or spills or indirectly through soil runoff. Those include the control of weeds and insects around structures, the use of chemicals for de-icing roads and walkways, and the use of soaps and detergents for cleaning vehicles and equipment. Refuge staff will take the following precautions to minimize the potential for those chemicals and petroleum products to become a water quality problem:

- We will pour or mix chemicals or petroleum products no closer than 25 feet from surface water and over a non-porous surface material.
- We will train all staff in spill prevention and spill response.

Invasive plant control with herbicides

Regardless of the alternative selected, we would use glyphosate, the active ingredient in the brand-name pesticide Rodeo®, as one method to prevent the establishment and spread of invasive wetland plants, in particular, purple loosestrife and *Phragmites*. Our regional contaminants specialist, who is responsible for upholding federal standards for water quality and soil protection, reviewed our proposals and approved our use of chemical herbicides.

Some potential exists for the concentration of herbicides to build up over time in river sediments, backwaters and wetland habitats. That potential depends on the balance between the input and removal of herbicides from an aquatic system. Inputs may occur through direct application, water inflow, or re-suspension and diffusion from the sediment layer. Removal from the system may occur through outflow, degradation, volatilization, and settling or diffusion into the underlying sediment (Neitsch et al. 2001).

The rate of herbicide degradation is an important consideration for assessing the effects of any herbicide on aquatic systems. Glyphosate degrades with a reported half-life in water from 3.5 to 70 days, depending on the rate of transfer to the sediment layer and testing source (SERA 1996). Based on its relatively short half-life and the large water volume of the river and wetlands, we do not expect any discernible effects to result from herbicide treatments.

Impacts of Alternative A—Current Management

Benefits

Land acquisition and protection and site restoration

We now manage 5,106 acres, or about 4 percent of the 133,120 acres that compose the upper reaches of the Wallkill River watershed in New Jersey. Under alternative A, we expect to acquire or protect up to 27 acres of open water and 2,021 acres of additional upland, floodplain forest, wetland, and other land within the acquisition boundary. Therefore, we expect some minimal increase in benefits for water quality, because we would prohibit development or other activities that would introduce water pollutants on an additional 1 percent of the watershed.

Other measures will also facilitate maintaining or restoring wetlands and improving water quality. Those would include restoring 25 acres of adjacent cool season grassland at Bassett's Bridge and allowing natural hydrology to maintain the nearby wetland.

Adverse Impacts

Under alternative A, the level of risk of herbicide contamination of open water and wetland habitats used in invasive plant control would be minimal. We would mitigate any potential risk by properly applying the herbicide and using only glyphosate. In some formulations, such as the one in the brand-name formula Rodeo®, glyphosate is not a problem aquatic contaminant, because it does not contain the toxic adjuvant found in other formulations, such as in the brand-name formula Roundup. Also, it quickly adsorbs to suspended soil particles in water, rapidly making it biologically unavailable.

In alternative A, fishing and hunting as well as non-consumptive uses, including hiking, wildlife photography, canoeing and kayaking, would increase by 10 percent. That presents an increased potential for the contamination of the Wallkill River through the runoff of petroleum products from parking areas and through litter.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits

In addition to the benefits in alternative A, expanding the refuge by 9,550 acres in alternative B would provide substantial additional watershed benefits, because we would prohibit clearing for development and prevent its attendant water quality impacts on about 13 percent of the upper reaches of the Wallkill River watershed.

The restoration of hydrology for bog turtle habitat at the pond near headquarters may have short-term adverse effects in minor erosion and sedimentation. However, once completed, the restored hydrology would be of long-term benefit to the bog turtle and to the natural flow of rivulets into the river.

The benefits of wetland restoration for water quality would be substantially greater in this alternative than in alternative A. Alternative B proposes to restore as much as 2,108 acres of wetlands, compared to just 1,216 acres in alternative A. We would make a substantial effort to identify locations where we could improve hydrology by ditch-plugging or other localized measures. Furthermore, cooperating to develop monitoring, restoration, acquisition, and

protection directly related to improving floodplain and wetland function to enhance water quality should also add substantially to improvements in water quality, working with our New Jersey Field Office and Ecological Service Program, the Wallkill River Watershed Coordinator, the Wallkill River Watershed Management Group; Trout Unlimited; the Trust for Public Land, and N.J. Green Acres.

Other specific measures we would implement under alternative B that also would help us maintain or improve water quality include finalizing our memorandum of understanding (MOU) with the Sussex County Division of Mosquito Control to ensure that operations have minimal impacts on refuge wildlife, evaluating waterways within the refuge for excessive erosion, and developing restoration plans if needed, and developing a restoration demonstration site.

Adverse Impacts
Under alternative B, we would likely increase the acreage treated with herbicide for invasive plant control, so there would be a minor increased risk for herbicide contamination of open water and wetland habitats. At the same time, those lands would no longer have their current regimen of applications of household and agricultural fertilizers and chemicals. In all cases, the Service would follow the same measures outlined in alternative A to minimize the potential for these effects.

Under alternative B, fishing and hunting activities as well as non-consumptive uses, including hiking, photographing wildlife, canoeing and kayaking would increase by 15 percent. That represents a potential slight increase over alternative A for contaminating the Wallkill River through the runoff of petroleum products from parking areas.

Impacts of Alternative C

Benefits
Alternative C would likely provide greater long-term benefits for water quality than either alternative A or B. As in alternative B, expanding the refuge by up to 7,609 acres would provide benefits by limiting land clearing and changes in local hydrology that otherwise might affect those areas. That would enhance our ability to restore the natural hydrologic regimen of the Wallkill River system, because the Adjoining North Focus Area buffers the river in southern New York, and the Papakating Creek Focus Area buffers the entire Papakating Creek, a major tributary of the Wallkill River.

As discussed in alternative B, we would collaborate with local communities to improve water quality. In alternative C, the removal of all drainage or impounding characteristics of ditches, dikes, and other water control structures not essential to protect private property or refuge infrastructure would restore natural hydrology extensively across the refuge. We would restore the hydrology of the 335 acres of moist soil management units by removing the water control structures and allowing those areas to flood naturally.

Adverse Impacts
We would continue to control invasive plants and maintain bog turtle habitat with herbicides and prescribed fire, which would have some minimal potential to affect water quality as discussed above. However, we would allow grasslands to succeed to forested habitat, which would eliminate use of herbicides and burning for grassland maintenance.

Effects on Socioeconomics

The analysis of socioeconomic impacts is an analytical process by which we can evaluate the range of management goals and objectives in the three alternatives

in terms of their consequences for the local community and its quality of life. Assessing socioeconomic impacts is an integral part of the refuge planning process, and helps to ensure that the management of the refuge is compatible with the needs and concerns of the communities affected in Sussex and Orange counties.

The intent of this assessment is to estimate the potential regional effects associated with the three proposed alternatives. For the purposes of refuge planning, the impact analysis provides a mechanism for the identification, comparison and evaluation of the effects of current management practices and the two proposed alternatives developed for the future management of the refuge. This section begins with a brief characterization of the regional setting, and proceeds to identify the effects common to all the alternatives, followed by a discussion of the effects that are specific to each.

Sources of Impact

The assessment of potential effects on the socioeconomic environment identifies those elements of the environment that are susceptible to change and may be affected by any of the proposed alternatives. Specific characteristics of these alternatives, such as changes in proposed public use or access to the refuge or changes to budget and staffing for the refuge, can be important sources of potential impact for the user base of the refuge and the surrounding communities in Sussex and Orange counties. This section identifies the changes, or absence of change in specific conditions within the refuge, which may contribute to an impact on the regional setting or the local communities. Sources common to all alternatives include the

- Potential effect of haying and grazing activity on the local agricultural economy;
- Open space concerns with respect to clearing large grassland parcels;
- Possible change in compatible uses;
- Potential for disturbance of neighboring properties based on hours of public access;
- Overall benefit of revenue sharing payments; and
- Potential human health effects associated with activities such as mosquito control.

In addition to the aspects that are present in all three alternatives, some are unique to a specific alternative or common to only two of the three. Table 4.2 identifies those elements that might be considered specific to each of the proposed alternatives, which have the potential to affect the socioeconomic condition of the local communities around the refuge.

Of the sources of potential impact in table 4.2, we do not expect most of the anticipated changes to have a measurable or noticeable effect on the regional socioeconomic condition. However, changes in public use opportunities potentially affecting refuge visitation and visitor spending in the surrounding local communities, changes in land use potentially affecting local open space needs and land values, and changes in overall refuge management would potentially affect the area around the refuge.

Table 4.2. Sources of impact by alternative.

Alternative	Sources of Impact
Alterative A - Current Management	■ Overall public use and access remains unchanged (hunting, wildlife observation/ photography, educational/interpretative programs) ■ Anticipated visitor increase of 10 percent over 2005 levels ■ Additional access to recreation areas and new parking opportunities at access points ■ Enhanced hunting opportunities to also include barrier free hunting ■ Limitations on hunting opportunity attributable to non-stocking policy ■ Potential impact of residential development—loss of habitat surrounding the refuge ■ Grassland/open space preservation and maintenance (530 total acres) ■ Conversion of newly acquired agricultural land to native grassland ■ Budget/staffing considerations ■ Water quality improvement partnerships ■ Public events
Alternative B—The Service-Preferred Alternative	■ Increased public use opportunities (focused on qualitative improvement) ■ Anticipated visitor increase of 15 percent over 2005 levels ■ Expanded hunting opportunities ■ Increased wildlife viewing opportunities ■ Increased fishing access and parking ■ Introduction of paid parking permits ■ Increased grassland/open space conservation ■ Increased privately owned grassland acreage ■ Addition of one staff position (visitor services specialist) ■ Addition of one staff position (private lands biologist) ■ Water quality improvement partnerships ■ Public events (on-site and in surrounding communities) ■ Increased interpretative program and educational opportunities
Alternative C - Biological Integrity/ Ecosystem Health	■ Limited public use opportunities ■ Anticipated visitor decrease of 5 percent from 2005 levels ■ Hunting opportunities limited to deer and geese ■ No change in access for fishing over Current Management ■ Existing viewing opportunities maintained ■ Addition of one staff position (law enforcement officer) ■ Water quality improvement partnerships

Socioeconomic Effects of the Alternatives

We expect none of the three alternatives for the Wallkill CCP to alter substantially the regional community's demographic characteristics. As a result, no impacts would be associated with changes in the character or demographic composition of the community. Irrespective of the alternative implemented, we would expect the sources of effects common to all alternatives to exert the same

influence on the socioeconomic environment. Because they do not differ among the alternatives, we identified those effects in the previous section, but the following analysis will not develop them further.

Refuge Visitation
Individual spending associated with recreational and other visits to the refuge can have an important influence on the local economy of the surrounding region. Public interest in natural areas such as the refuge as a source of recreational opportunity is increasing. Visitor consumption patterns usually include a broad range of goods and services, such as food, accommodation, supplies, rental equipment, permits and fees. Visitor spending can generate benefits throughout the local economy. A recent report produced for the USFWS, titled "Banking on Nature, 2004," (Caudill and Henderson 2005) estimates that annual visitation to wildlife refuges during fiscal year 2002 resulted in $809 million in sales of goods and services in the local economies surrounding the refuge. Table 4.3 presents the changes we expect in annual visitation rates for the refuge under each of the proposed alternatives.

Table 4.3. Annual refuge visitation by alternative (this table is almost identical to table 4.1).

Activity	2005	Alt A (2005 + 10%)	Alt B (2005 + 15%)	Alt C (2005 - 5%)
Consumptive Uses				
Fishing	625	685	720	595
Hunting: Deer and Turkey	6,560	7,210	7,545	6,230
Hunting: Migratory birds	970	1,060	1,110	925
Hunting: Other birds	110	160	130	105
Non-Consumptive Uses				
Boating/Water Use	1,500	1,650	1,720	1,425
Nature trails/other wildlife observation/ office visits	21,320	23,430	24,520	20,250
Total annual refuge visits	31,085	34,195	35,745	29,530

Revenue Sharing and Land Use
Similar to other federal agencies that have acquired land in local jurisdictions to accomplish their mission, the Service provides payment in lieu of taxes or PILT payments to counties in which federal ownership of land has removed it from the tax base. Service acquisition removes land from the tax base, but under the provisions of the Revenue Sharing Act, or 16 U.S.C. 715s, annual payments that meet or exceed the taxes on that land in private ownership can offset those tax losses by counties or other local government units. Revenue sharing payments to counties for land purchased are based on three formulas, whichever is greatest: three-quarters of 1 percent of the market value; 25 percent of the net receipts generated from the sales of commodities or leases for public accommodations or facilities; or 75 cents per acre. Beginning in fiscal year 1976, refuge receipts nationwide were insufficient to make the county payments, so the federal government reduced the payments accordingly. For recent years, actual payments were about 40 percent of authorized levels.

Since 1992, the refuge has been acquiring land at an average rate of about 408 acres per year. As of September 30, 2005, the refuge had acquired a total of 4,746 acres at an average per-acre price of $4,268, or a total of $20,256,600 (USFWS 2006). In 2005, the Service made payments totaling $73,933 to four local jurisdictions: Vernon, N.J., Wantage, N.Y., Hardyston, N.J., and Warwick, N.Y. Those payments represent a small but perceptible portion of the

annual revenues for those jurisdictions. Table 4.4 shows the payments to the three Sussex County jurisdictions in New Jersey and their relationship to the annual budgets for 2005. We were unable to show the relationship between the 2005 refuge revenue payment to Warwick, NY ($1,283), and that town's total revenues for 2005, because the figures for total revenue were unavailable.

Table 4.4. Refuge Revenue Sharing Payments as percent of 2005 municipal budgets.

Municipality	2005 Anticipated Municipal Budget Revenues	2005 Refuge Revenue Sharing Payment	Revenue Sharing Portion of Municipal Budget
Vernon, N.J.	$20,298,935 (1)	$51,552	0.25%
Wantage, N.J.	$3,892,070 (2)	$19,515	0.50%
Hardyston, N.J.	$7,305,540 (3)	$1,583	0.02%

(Hardyston Township 2006; Vernon Township 2006; Wantage Township 2006)

In addition to providing revenue to local governmental entities, the land acquired by the refuge contributes in preserving open space in both Sussex and Orange counties.

As urban sprawl spreads westward across northern New Jersey, the preservation of open space has become a major concern for Sussex county. Projections for the next decade show the county growing from its current population of 153,150 at a rate slightly greater than 1 percent per year. Within the county approximately one-third (111,170 acres) of its land is preserved as open space. Various state and federal agencies, including the Service, own or control the land. Local governments have developed several goals for the preservation of open land (Sussex County 2002). These include

- Protecting the quantity and quality of water resources;
- Protecting and preserving surface water bodies and their access;
- Managing growth to preserve scenic vistas and maintain the character of the community;
- Protecting plant and wildlife habitat;
- Protecting and enhancing sites with cultural or historic value;
- Safeguarding threatened and endangered species habitat;
- Providing opportunities for active recreation (such as organized youth sports and other facility-based recreation);
- Providing opportunities for passive recreation (resource-based recreation, such as hiking, bird watching, fishing, other activities reliant on natural resources);
- Connecting land areas for greenway or trail development;
- Adding to publicly owned park land; and
- Promoting tourism activities.

Impacts of Alternative A—Current Management

Under alternative A, current planned or approved management activities for the refuge would remain in place, and we would expect them to continue into the future. Overall, public uses and access to the refuge would remain unchanged.

We expect planned additional access to recreation sites as well as the introduction of additional parking opportunities to contribute to an overall increase in annual visitation. We also expect the enhanced hunting opportunities, including barrier-free hunting, to increase visitation levels for the refuge. Hunters from outside the local area also contribute to the local economy by staying at local hotels and eating in local restaurants. Providing opportunities for waterfowl- and deer-hunting helps preserve the cultural heritage of the Wallkill area, where people have hunted for generations.

Using spending rates provided by Caudill and Henderson for Region 5 and specific to the several visitor activities available in the refuge, the 10-percent increase in annual visitation anticipated under this alternative could be estimated (table 4.3). Because the data for the distribution between resident and non-resident visitors was unavailable for this refuge, we estimated the breakdown based on data for other refuges in New Jersey and neighboring states in Region 5. On that basis, we projected annual visitation at 60 percent local or resident visitation and 40 percent non-resident visitation. We expect the additional visitor days anticipated under this alternative to produce an increase in annual visitor spending of $77,313. By this same method, we estimated direct visitor spending for 2005 at $774, 596. The total of visitor spending we anticipate under alternative A would be $851,909. Table 4.5, below, estimates the levels of visitor use by type of use for each of the three proposed alternatives.

Table 4.5. Visitor spending—Alternative A.

Activity	Visitor Days, 2005	Per Person, Per day spending - Region 5*	Total Visitor Spending by Recreation Type, 2005	Additional Visitor Days, Alt A	Additional Visitor Spending, Alt A	Total Visitor Spending, by Recreation Type, Alt A
Consumptive Use						
Fishing	625	$21.26	$13,287.50	60	$1,275.60	$14,563.10
Hunting: Deer and Turkey	6,560	$27.06	$177,513.60	650	$17,589.00	$195,102.60
Hunting: Migratory birds	970	$33.40	$32,398.00	90	$3,006.00	$35,404.00
Hunting: Other birds	110	$21.34	$2,347.40	50	$1,067.00	$3,414.40
Non-Consumptive Uses	22,820	$24.06	$549,049.20	2,260	$54,375.60	$603,424.80
Total	31,085		$774,595.70	3,110	$77,313.20	$851,908.90

**Based on an assumed 60/40 split between residential and non-residential users.*

Both counties in the surrounding region are experiencing development pressures from expanding populations and their proximity to major metropolitan areas. Planning for Sussex is especially concerned with the preservation of open space in the county. The land acquired for the refuge contributes to the local community by preserving existing open space and facilitating community planning goals related to resource-based recreation and natural resources.

A number of the objectives in alternative A support the requirements identified in the Sussex County Open Space Plan. Among those, our intention to continue to acquire privately held acres within the currently approved refuge boundary. That would support county plans to protect and enhance open space. Although we expect that removing this land from the tax base may have some adverse impact on county revenues, the potential revenue generated by the Refuge Revenue Sharing Program would offset some of that effect. Land adjacent to areas acquired by the refuge also may experience an increase in value.

Wallkill refuge staffing has diminished substantially from 6.5 full-time equivalent employees (FTEs) in 2002 to two in 2006. Due to the fiscal climate in fiscal year 2004, we combined the Wallkill River refuge in a complex with the Great Swamp National Wildlife Refuge to save money by sharing resources. As staffing positions at the Wallkill River refuge became vacant, the Service chose to apply funding for those positions elsewhere. Subsequently, we eliminated every position except the biologist position from the refuge staffing chart. Instead, the Great Swamp refuge will provide all the services necessary to maintain the refuge.

Impacts of Alternative B—The Service-Preferred Alternative

The Service-preferred alternative would focus the management of the refuge on protecting areas with high ecological value. Implementing alternative B would also result in several beneficial effects for the communities near the refuge and in the region. We expect public use of the refuge to increase, thereby increasing the number of visitor days spent in the area and, correspondingly, the level of visitor spending in the region. Also of importance to the local communities surrounding the refuge is the objective of adding 9,550 acres to the refuge boundary, substantially affecting local land use and ownership, as well as extending protection over a large land area and furthering the goals of the Sussex County Open Space Plan. Fully funding the approved staffing level of seven and adding two additional positions would also make a small but important contribution to employment and income in the local community.

Many of the goals and objectives of this alternative reflect the specific needs and issues identified as part of the Sussex County open space and recreation planning process (Sussex County 2002). The establishment of partnerships to improve water quality (objective 2.2) also corresponds to a key element of the Sussex County plan. Measures implemented to enhance ecological communities and improve habitat (goal 1), specifically by managing for grassland (objective 1.3) and forested habitats on the refuge (objective 1.4) contribute to the overall quality of the scenic environment of the area and maintain its character. Also in support of the goals of the Sussex County plan are the efforts to reduce invasive species and nuisance wildlife (see “Common to All Alternatives”).

Our strategies in objective 3.6 to identify cultural resources on the refuge and provide enhanced research and interpretative opportunities support the Sussex County plan to enhance and protect cultural sites. Similarly, we expect the enhanced environmental education and interpretative programming opportunities in the fourth goal of this alternative to support local county concerns about recreation and civic involvement in environmental conservation.

The overall focus of this alternative is to enhance and improve the quality of existing programs on the refuge. We expect it to increase the public use of the refuge. Increasing opportunities for hunting, as well as improving refuge trails and interpretation programs, would likely increase the attractiveness of the refuge as a recreation site for the public, resulting in an increase in the number of days visitors spend on the refuge and in the surrounding communities. Our estimates for this alternative predict a 15 percent increase in the number of refuge visits each year. We expect the additional visitor days to increase visitor spending in the local economy each year above the $116,062 spent in 2005. We expect the total annual visitor spending associated with this alternative to

contribute $890,657 to the local economy. Table 4.6 presents the visitor-spending data for alternative B.

Table 4.6. Visitor spending—Alternative B.

Activity	Visitor Days, 2005	Per Person, Per day spending - Region 5*	Total Visitor Spending by Recreation Type, 2005	Additional Visitor Days, Alt B	Additional Visitor Spending, Alt B	Total Visitor Spending, by Recreation Type, Alt B
Consumptive Use						
Fishing	625	$21.26	$13,287.50	95	$2,019.70	$15,307.20
Hunting: Deer and Turkey	6,560	$27.06	$177,513.60	985	$26,654.10	$204,167.70
Hunting: Migratory birds	970	$33.40	$32,398.00	140	$4,676.00	$37,074.00
Hunting: Other birds	110	$21.34	$2,347.40	20	$426.80	$2,774.20
Non-Consumptive Uses	22,820	$24.06	$549,049.20	3,420	$82,285.20	$631,334.40
Total	31,085		$774,595.70	4,660	$116,061.80	$890,657.50

**Based on an assumed 60/40 split between residential and non-residential users.*

Implementing the habitat protection and refuge viability components of this alternative includes adding 9,550 acres to the current, approved boundary. Although our acquiring that acreage, which is mostly in private ownership, would approximately double the size of the land area held by the refuge, it represents only about 3 percent of the total acreage in Sussex County. Our acquiring the land would remove it from the tax base of the jurisdictions in which it is located. However, under the Refuge Revenue Sharing Act, payments from the federal government to local jurisdictions would at least partially offset that loss.

Based on an estimated average price per acre of $4,268 for land already purchased for the refuge, adding 9,550 acres would result in an annual payment of $305,728 to jurisdictions containing refuge land, assuming Congress fully funds the federal payment. The current 41-percent level of funding probably would reduce the actual payment to $125,348. That would represent substantial revenue benefit for local jurisdictions, as would the reduced requirement for them to provide public services for the acreage we purchased.

However, the projected revenue sharing payments to local jurisdictions would not be sufficient to offset completely the lost revenue that would result from the withdrawal of 9,550 acres from local tax base. Although the projected refuge revenue sharing payments are approximately double the current payments, local jurisdictions still would experience a measurable, negative effect on local tax revenues under this alternative.

We might also expect the expansion of the refuge to stimulate an increase in the desirability of neighboring private lands, because it would preclude development, and owners would know adjacent lands were protected and not subject to uncontrolled development. Therefore, we might expect a resulting increase in the market value of adjacent, privately held lands. Additional non-monetary benefit may accrue from protecting scenic vistas and retaining the setting and character of land withdrawn from development and no longer subject to increasing growth pressures.

The direct employment of refuge staff has provided a small beneficial effect for the local economy; however, we have never been able to staff the refuge fully at the approved level of seven FTEs. As of fiscal year 2006, the refuge employed two full-time staff. For this alternative, we propose a staff of five: a Refuge Manager, Private Lands Biologist, Visitor Services Specialist, maintenance worker, and biologist. Since the only currently approved staffing position is the biologist position, this would be an increase of four staff from alternative A. This would represent an increase in refuge employment and contribute four additional FTE jobs as direct employment to the local economy. The funding for those positions is independent of the current refuge budget.

In summary, much of what is implemented under this alternative would have a beneficial effect on the socioeconomic condition of the surrounding local communities in terms of increased visitation and visitor spending, increased protection of open space, and a small but important contribution in direct employment to the local economy. The goals and objectives of this alternative would not conflict with the issues and requirements identified in the Sussex County open space plan and, in many instances, would provide beneficial support in achieving its goals and objectives.

Impacts of Alternative C

Implementing alternative C would involve restoring the refuge to its historic condition, reestablishing the historic plant community and the natural hydrologic regime of the Wallkill River system. Opportunities for public use of the refuge in the immediate future would remain essentially, as they are at present, but we expect them to decrease substantially in the future. Restricted access to the interior of the refuge would affect hunting opportunities and the swamp-dominated landscape would restrict trail use and wildlife viewing activity. As a result, we expect the rates of annual visitation at the refuge to decrease by 5 percent. A corresponding decrease in annual visitor spending of approximately $38,196 from the level in 2005 would have a minor but adverse effect on the economy of the local communities surrounding the refuge. Overall, we expect the refuge to generate $736,399 in direct visitor spending in the local economy (see table 4.7).

Table 4.7. Visitor spending—Alternative C.

Activity	Visitor Days, 2005	Per Person, Per day spending - Region 5*	Total Visitor Spending by Recreation Type, 2005	Additional Visitor Days, Alt C	Reduction in Visitor Days, Alt C	Reduction in Visitor Spending, Alt C	Total Visitor Spending, by Recreation Type, Alt C
Consumptive Use							
Fishing	625	$21.26	$13,287.50	595	-30	-$637	$12,649
Hunting: Deer and Turkey	6,560	$27.06	$177,513.60	6,230	-330	-$8,929	$168,583
Hunting: Migratory birds	970	$33.40	$32,398.00	925	-45	-$1,503	$30,895
Hunting: Other birds	110	$21.34	$2,347.40	105	-5	-$106	$2,240
Non-Consumptive Uses	22,820	$24.06	$549,049.20	21,697	-1123	-$27,019	$522,029
Total	31,085		$774,595.70	29,552	-1533	-$38,196.68	$736,399.02

**Based on an assumed 60/40 split between residential and non-residential users.*

Expanding the refuge by 7,609 acres (or 150 percent of its current size) would result in withdrawing that acreage from the local tax base. These 7,609 acres represent 2.3 percent of the total land area of Sussex County. Federal revenue sharing payments may compensate for the taxes that this land currently generates. Based on an average per-acre price of $4,268 estimated under alternative C, the addition of 7,609 acres would result in an annual payment of $243,564 to jurisdictions containing refuge land, assuming that Congress fully funded the federal payment. The current 41 percent level of funding probably would reduce the actual payment to $99,861. As in alternative B, that payment would represent a beneficial contribution to the revenues of local governments, as well as potentially increasing the market value of surrounding land because of the increased intrinsic value of land protected by the refuge.

In general, the socioeconomic impacts associated with this alternative would be beneficial, although not to the same extent as those in alternative B. Non-monetary benefit would be associated with the restoration of the historic character and setting of the community. However, that may not increase its attractiveness as a recreation destination for visitors. We expect a small but adverse effect on the local economy from the potential decrease in visitor spending associated with alternative C.

Effects on Soils

Soils are crucial for plant productivity at the refuge, and must be protected to sustain the variety of wetland, floodplain, and upland habitats that will meet our habitat and species management goals. With the exception of the Glacial Soils property, the soils of the refuge are productive and in good condition, with no substantive erosion, compaction, or contamination problems.

We evaluated and compared the management actions proposed for each of the alternatives based on their potential to benefit or adversely affect upland soils and soils of the refuge floodplains, riparian areas, and moist soil management units. We compared the benefits of actions that would protect the soils from erosion, compaction, or contamination, or that would restore eroded, compacted, or contaminated soils, including the

- extent to which refuge land acquisition and protection under the alternative would limit the growth of nearby development, thereby reducing the loss of forest vegetation to human disturbance and potential soil impacts;
- extent to which the alternative would replace private management on acquired expansion lands with Service management that would improve soil protection; and the
- potential for site acquisition, closure, and restoration of access roads and trails to provide opportunities to restore soils.

The potential adverse soil effects of the alternatives we evaluated included the impacts from

- burning prescribed fires;
- grazing to maintain bog turtle sites and grassland;
- constructing parking facilities, access roads, and interpretive trails; and
- providing refuge visitor activities and hunt programs.

Impacts that Would Not Vary by Alternative

Benefits

The soils of the refuge are now in good condition, and would remain so under all management alternatives. We will continue to maintain the refuge protective vegetative cover that minimizes soil losses through erosion. All the land the Service now owns or would purchase within the refuge acquisition boundary would remain under Service management, thereby eliminating the potential for the soil impacts of development or other use. We will continue to prohibit recreational activities such as ATVs or mountain bikes that would damage soils on the refuge. Hiking trails, boat launch sites, wildlife observation areas, parking areas and other high-use areas would be well maintained to keep impacts on the soil to a minimum. We will note and correct any erosion problems during routine refuge monitoring.

Regardless of which CCP alternative we select, we will continue to use best management practices in all activities that might affect refuge soils to ensure that we maintain soil productivity. Site conditions, including soil composition, condition and hydrology, will be the ultimate determinant of the wildlife management potential for any particular site on the refuge. No site would be managed in a manner inconsistent with its recognized potential.

In general, no soil from off-site will be brought onto the refuge, although cut-and-fill may occur on a project. We will make every effort not to alter soil conditions on adjacent private lands by filling drainage ditches that originate on private land and still function to drain that land. Whenever feasible, we will restore soil on degraded sites to natural topographic and hydrologic conditions, and will return them to native vegetation as quickly as feasible.

Adverse Impacts

There is a potential for adverse impacts from the management tools we propose to use at varying scales under all alternatives to help maintain, enhance or create wildlife habitat. These tools include replanting with native species, prescribed burning, haying/mowing, hydro-axing, grazing, and applying herbicides and biological control agents. Trail, boat launch, parking lot or other construction projects could affect the soils in the upland areas and in the Wallkill River floodplain. Only the management actions taken to enhance those more intensively managed areas for waterfowl, shorebirds, and other species or remove the dikes and restore those areas to their natural floodplain status under alternative C would affect soils in the moist soil management units.

Replanting with Native Species

Replanting may cause the short-term disturbance, compaction, and localized erosion of soil, depending on site conditions and methods of site preparation. The use of best management practices would minimize those effects. In the long-term, establishing native species would help restore and maintain soil productivity at those sites.

A prescribed burn at the refuge helped reestablish warm season grasses.

USFWS

Prescribed Fire

We would use prescribed fire in all alternatives for controlling invasive plants and, in alternatives A and B, for managing grassland as well. We would conduct all prescribed burns under a strict prescription and in optimal weather conditions to minimize concerns about smoke and the risk of wildfire. We would maintain all fires within their prescriptions to minimize the degradation of resources, although impacts could occur in small areas.

Prescribed fire elevates surface temperatures; mineralizes detritus, litter and standing dead material; volatilizes some nutrients

and organic matter; alters the water-holding capacity of soil; and alters its populations of micro- and macro-fauna (Barbour et al. 1999).

The effects on organic matter depend on the intensity and duration of the fire. Intense, long-duration fires consume more organic matter than brief, low-intensity fires. Nitrogen compounds volatilize and are lost at temperatures of 100–200°C; in contrast, calcium, sodium, and magnesium usually are deposited on the soil surface and recycled. At temperatures of 200–300°C, large amounts of organic substances are lost, which can reduce the cation exchange and moisture-holding capacity of soils.

Fire usually elevates soil pH, because of cation release; that effect is particularly evident in acidic soils. Fire may enhance soil microbial nitrogen fixation, due to the mineralization of nutrients and elevated pH levels in soils (Barbour et al. 1999).

The removal of litter and duff may initially facilitate water infiltration; nevertheless, the loss of litter and blackened soils also mediate evaporation. That results in an overall reduction in the water-holding capacity of soil. There is little change in water repellency with cool fires (below 176°C); moderately hot fires increase water repellence (176–204°C). Extremely hot fires (above 204°C) volatilize hydrophobic substances and destroy soil water repellence (Debano et al. 1998). After moderately intense fires, runoff may increase due to lowered infiltration, and erosion may result.

Fire usually reduces fungi, but increase soil bacteria. It may remove soil and litter pathogens. Fire often destroys nitrifying bacteria. Legumes and other nitrogen-fixing plants often must recover nitrogen losses due to volatilization, as the recovery of nitrifying bacteria is slow (Barbour et al. 1999).

We will burn small-scale prescribed fires on confined areas, in short durations and low to moderate intensities. They also consume only part of the duff/litter layer, and rarely transfer major amounts of heat into the soils. We would use prescribed fires to remove litter and light fuels and avoid adverse effects of severe, hot wildfires on soil resources.

Considering all the potential methods of treatment, we expect negligible direct or indirect impacts on upland soils, as the effects are limited due to short duration and low to moderate intensity, and confined to the project area. We expect none of the proposed actions to affect adversely the soils or water quality over the long-term.

Haying, Mowing, and Hydro-Axing
Haying, mowing, and hydro-axing affect soils by rutting and compaction and, depending on the soil conditions and vegetation ground cover, by removing soil-protective vegetation. Tracked equipment is not used in haying and mowing operations, and the operations are not done when the soil is saturated. We would conduct those operations on agricultural sites that are tilled to incorporate organic matter and aerated to maintain good soil conditions.

In hydro-axing, wide rubber tires distribute the equipment weight to help minimize compaction. Hydro-axing may be done at sites with saturated soils, particularly at bog turtle sites, but we will take precautions to minimize soil disturbance.

Grazing
The New Jersey Bog Turtle Project (NJDEP 2006) summarizes the use of grazing to benefit bog turtles.

> "Grazing in bog turtle habitats has been demonstrated to retard natural succession, control invasion by fast-growing invasive species, augment hydrological regimes through reducing above-ground vegetative matter and breaking up peat accumulation, create microhabitats for bog turtles in the form of footprints, and encourage the growth of hummocky vegetation that bog turtles use for nesting (Herman 1999). In the Kittatinny Valley of Sussex and Warren counties, 107 of 108 bog turtle sites either are grazed or were grazed recently. It has been theorized that livestock are the contemporary analogs of the elk, bison, and mastodons that grazed pre-colonial fens and swamps (Lee and Norden 1996)."

Grazing can degrade soils where grazing pressure is high because of the removal of protective vegetation and compaction by hooves. Grazing at the refuge would continue, with only a few individual animals, and we will routinely monitor grazed sites to minimize any possibility that such impacts would occur.

Grazing can either promote or reduce the abundance of weeds at a particular site. By itself, grazing rarely, if ever, completely eradicates invasive plants. However, when grazing treatments combine with other control techniques, such as herbicides or biocontrol, they can reduce severe infestations and eliminate small ones. Grazing animals may be particularly useful in areas where herbicides cannot be applied (e.g., near water) or are prohibitively expensive (e.g., large infestations). Animals also can be part of a restoration program, by breaking up the soil and incorporating the seeds of desirable native plants.

However, when not properly controlled, grazing or other actions of grazing animals (e.g., wallowing, pawing up soil) can cause major damage to a system and promote the spread and survival of invasive weeds. Overgrazing can reduce native plant cover, disturb soils, weaken native communities, and allow exotic weeds to invade. In addition, animals that move from pasture to pasture can spread invasive plant seeds.

In general, the specific weed and desirable native plants will determine the number and species of animal grazers and the duration and frequency of grazing. Our Habitat Management Plan for the refuge, a step-down plan from this CCP, will discuss grazing in more detail. In the meantime, we should develop a grazing plan in situations where prescribed grazing is desirable, and should tailor that plan to fit the specifics of the site.

Herbicides

We would apply the herbicide glyphosate, formulated as Roundup® or Rodeo®, to control invasive plants under all alternatives. Glyphosate would not adversely affect the soils at the sites. Studies have shown that once Roundup reaches the soil, it strongly adsorbs to soil particles. With its half-life of 20 to 40 days, glyphosate degrades readily in soil (Weber 1991). Field and field simulation studies on glyphosate found no direct effect on basal soil respiration, microbial activity, or microbial biomass when glyphosate was applied at a rate of 5 kg/ha (SERA 1996), which is three times greater than the application rate proposed for treating invasive species on open land at the refuge. Therefore, no impact on soils would result from the application of glyphosate to wildlife plantings or ecological restoration sites.

Soil Microflora

The manufacturer of glyphosate, Monsanto (2002) states that the effects of glyphosate on microflora have been extensively studied by both Monsanto and independent investigators and that the results of these investigations provide compelling evidence that applications of glyphosate according to label directions for the use of Roundup, Accord®, and Rodeo herbicides do not have a negative

impact upon microflora. Experiments on glyphosate-treated and untreated soils revealed no major difference in their microbial population or types or the degradation of sucrose (Rueppel et al. 1977). The degradation of cellulose, starch, protein and leaf litter in soils treated with glyphosate was essentially the same as that in untreated soils. Studies also found that soil residues of glyphosate did not affect nitrogen fixation and nitrification.

Beneficial Fungi
The presence of glyphosate is unlikely to affect the beneficial mychorrizal fungi, which help plants absorb water and nutrients, because the herbicide binds tightly to soil particles and is not available for uptake. Studies in laboratories that grew mycorrhyzia in agar cultures show the effects of glyphosate on the fungi. In one study where an effect was seen (Estok et al. 1989), the authors point out that agar represents a very different condition than would be seen in the environment, and caution that agar would increase the uptake of herbicide. The weight of evidence from several studies (Monsanto 2002) shows that actual use rates do not produce concentrations that would adversely affect fungi.

Earthworms
The manufacturer, Monsanto, indicated that it has conducted several studies, which demonstrate that glyphosate and Roundup® herbicide are harmless to earthworms at concentrations greatly exceeding what the normal application of the product would produce. In those studies, earthworms were exposed to Roundup or glyphosate for 14 days. The herbicide material was incorporated into the soil to ensure exposure under test conditions. (Under normal use conditions, the herbicide would remain on or near the surface). There was no mortality at the highest test concentration of 5,000 parts per million (ppm). No adverse effect of any kind was seen with a Roundup concentration of 500 ppm. Concentrations in the soil immediately after application depend on the amount of material intercepted by target plant material, and are typically less than 1 ppm. Those studies were submitted to European authorities in support of glyphosate registration. They were conducted according to established Good Laboratory Practices, and were reviewed by the toxicologists of several governmental regulatory agencies around the world.

Earthworms are important components of agricultural ecosystems, and the impact of agricultural practices has been extensively reviewed by other scientific, ecological and agricultural organizations. In the *Biology and Ecology of Earthworms* (1996), Edwards and Bohlen examine the effect on earthworms of many agricultural products. The authors rank products using a scale of zero (relatively non-toxic) to three (extremely toxic). Glyphosate ranks zero.

Impacts of Alternative A—Current Management

Benefits
Alternative A would be the least desirable alternative in terms of potential benefits for soils from the acquisition of an additional 2,021 acres of land, because our purchases would be limited to land within the current refuge acquisition boundary, in contrast to alternatives B and C, which substantially expand the protected land base (see text box).

Land Protected by Wallkill River Refuge CCP Alternatives

Alternative A—An additional 2,021 acres within current refuge acquisition boundary

Alternative B—An additional 9,550 acres, plus the current acquisition boundary

Alternative C—An additional 7,609 acres, plus the current acquisition boundary

Adverse Impacts
We do not anticipate any major adverse impacts on refuge soils from continuing

current management. The refuge staff will continue to use prescribed burns periodically on grassland areas to maintain grasslands, enhance habitats for threatened and endangered species, or control invasive plant species. The staff and cooperative farmers will continue to hay, mow or graze 633 acres of grasslands to maintain natural grassland conditions and support nesting for grassland-dependent birds.

We would employ best management practices to minimize short-term, localized impacts on soil in constructing the new river access and parking facilities. That should eliminate any potential for major cumulative effects. We expect visitation under alternative A to increase by 10 percent (see table 4.1 in the section on "Air Quality"), so visitor activities that might affect soils, such as hiking off designated trails, fishing along the riverbanks or up tributaries, or launching canoes and kayaks would pose a minimally higher concern than at present.

The hunt programs for migratory birds, turkey, deer, woodcock and resident geese can cause some soil compaction. With hunter density estimated to be an average of one hunter per 1,000 acres throughout the hunting season, impacts will be minimal. Refuge regulations would not permit the use of ATVs on the refuge. Vehicles would be confined to existing roads and parking lots. Snowshoeing and cross-country skiing, which occur when the ground is frozen and snow-covered, would cause no or minimal impact.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits

From a watershed perspective, alternative B would be the most beneficial in terms of the total land area protected and resulting reduced potential for soils impacts. Under alternative B, we would expand the current refuge acquisition boundary by 9,550 acres, thereby reducing the potential for residential and related development on those lands. This should substantially reduce the long-term potential for soil impacts from home, road, storm-water management, and other infrastructure development on these lands as well as effects from other economic or recreational uses that would also have attendant soil impacts.

We would apply Best Management Practices on expansion lands in terms of measures to restore any sites with eroded soils and protect the soil with an appropriate native plant cover.

Adverse Impacts

We would increase total annual burning to manage grasslands, invasive plants and bog turtle habitat as needed but this would be distributed over a much larger land area so impacts should be comparable to alternative A, that is, minimal and localized. We would use other management methods and equipment that may lead to localized soil compaction and the short-term loss of soil from erosion, but would employ best management practices to ensure that no long-term, major soil problems—such as unchecked gully erosion—result.

The hunt programs for migratory birds, turkey, deer, woodcock and resident geese cause some trampling of vegetation. The impacts on vegetation should be minor, particularly because hunt seasons generally occur in the winter, when most vegetation is dormant. We estimate hunter density at an average of one hunter per 1,000 acres throughout the hunting season. Refuge-regulations would not permit the use of ATVs. Vehicles would be restricted to existing roads and parking lots.

Under this alternative, we would expand hunting by opening the refuge to bear hunting. We would also open hunting in the proposed expansion area. We still do

not anticipate any adverse impacts on soils because we predict hunter densities would remain the same as alternative A (one hunter per 1,000 acres). If anything, since we will be almost doubling the amount of acreage open to hunters, hunter densities could be even lower, depending on how many new hunters would apply for permits due to newly opened lands. The number of hunters may increase slightly when we open the refuge to bear hunting. However, most hunters who currently obtain a deer hunt permit also obtain a turkey hunt permit and a migratory bird-hunting permit. Therefore, we predict almost the same number of hunters will apply for permits, only they will be able to hunt bear.

Impacts of Alternative C

Benefits

Alternative C may be almost as beneficial from a watershed perspective as alternative B. Although we would not acquire as much expansion land under alternative C, we would manage all refuge lands to achieve a mature forest cover similar to what the environment at Wallkill may have comprised before European settlement. This canopy of upland and floodplain forest would be highly protective of the refuge soils. We would do no burning of grassland areas to maintain that habitat type so there would be no short-term soil impacts from that source.

Adverse Impacts

Similar to alternative B, we would continue to burn up to 50 acres a year to manage invasive plants and bog turtle habitat as needed and would use other methods and equipment that may lead to soil compaction and soil losses from erosion. These impacts would be minimal, short-term and localized where they occur at all. As with the other alternatives, our use of soil best management practices would ensure no major, long-term soil impacts would occur.

Under this alternative, we would allow hunting of deer and resident goose only. We would also allow hunting in the Wallkill Adjoining North and Papakating Creek focus areas. As in alternatives A and B, we would expect hunter densities to remain at one hunter per 1,000 acres, even in the expansion areas. That density may decrease slightly because of the removal of turkey and migratory bird hunting.

Effects on Emergent and Non-Forested Wetlands

The Service currently manages about 2,400 acres of emergent marsh, open water, wet meadow, scrub-shrub wetland, and calcareous fen habitats including 335 acres of moist soil units, at the refuge, which support a wide diversity of wildlife species. Calcareous fens are of singular importance because their continuous groundwater seepage and open vegetation create habitat suitable for the endangered bog turtle as well as supporting an assemblage of plant species unique to this wetland type. The moist soil units at Liberty Marsh provide spring and fall migratory waterfowl and shorebird habitat, and wintering raptor foraging habitat.

We evaluated the benefits and adverse impacts of the management actions under the three CCP alternatives on these wetlands. We considered the benefits from

- acquiring land thereby precluding land development; acquisition emphasis on wetlands
- maintaining a forested floodplain corridor
- restoring the small pond
- restoring bog turtle habitat

- treating invasive species
- controlling nuisance species
- managing to benefit other federal-and state listed plants and unique plant communities

We considered the potential adverse impacts of

- wetlands habitat management activities
- upland habitat management activities
- visitor facility and trail construction and maintenance
- public consumptive and non-consumptive refuge uses

Impacts That Would Not Vary by Alternative

Benefits

The seasonally flooded forests along the Wallkill River and associated emergent wetlands of the refuge provide habitat for a broad array of vertebrate and invertebrate species representing a major component of the refuge biodiversity and serve as a critical buffer for the Wallkill River from the impacts of nearby human activities and development. Regardless of the management alternative we select, we would continue to conserve these wetlands and the wildlife they support. By managing beaver and muskrat populations through trapping, the refuge can maintain the water levels necessary to support migratory birds at the appropriate seasons.

Adverse Impacts

The refuge would continue to support consumptive human uses, such as fishing, that may affect these wetlands but those impacts should be minimal. Law enforcement issues related to fishing include illegal taking of fish, littering, trespassing and fires. Discarded fishing line and other fishing litter can entangle migratory birds and mammals, and cause injury and death (Gregory 1991). Litter also affects the visual experience of refuge visitors (Marion and Lime 1986). In addition, anglers could inadvertently introduce non-native species to the environment by using them as bait. Finally, anglers may disturb other wildlife by walking through refuge habitats to access fishing sites. We believe that, with the proper management, fishing will not result in any short- or long-term impacts that will adversely affect the purpose of the refuge or the mission of the Refuge System.

Hunting can cause disturbance to vegetation because of trampling. As mentioned above in the soils section, we do not expect hunter density to exceed one hunter per 1,000 acres in any of the alternatives. Given that predicted density, and the refuge regulations limiting vehicles to existing roads and parking lots, trampling of vegetation would be minimal. In addition, most hunt seasons occur during the winter months, when vegetation is dormant.

Impacts of Alternative A—Current Management

Benefits

Continued management of the refuge wetlands in alternative A would continue to conserve the values discussed above, though improvements in management and acquisition and protection of additional wetland acreage would be limited. We would manage 693 acres of emergent wetlands including 335 acres of created seasonal wetlands (moist soil units) at Liberty Marsh, to provide spring and fall migratory waterfowl and shorebird habitat, and wintering raptor foraging habitat. We would purchase an additional 523 acres of emergent and non-forested

wetland within the current refuge acquisition boundary. Wetlands would also benefit under alternative A by the wetlands restoration and maintenance measures noted in the "Water Quality" section. Those include the survey of wetland resources, GIS mapping of drainage ditches, impoundments, farmed lands, dikes, excavations, tertiary roads, and berms affecting flow; annually surveying vernal pool and associated amphibian populations and secretive marshbirds on the refuge; annually maintaining 25 acres of adjacent cool season grassland at Bassett's Bridge, and allowing natural hydrology to maintain the nearby wetland.

Adverse Effects
In alternative A, the direct impacts on the emergent wetlands and forested floodplains currently managed by the Service would be negligible. We would maintain the current acreage and purchase and manage additional acreage when it is available within the refuge acquisition boundary from willing landowners. We would not alter those habitats by cutting, filling, or other means to achieve any other Service goals.

These wetlands and floodplains may be at some minimal risk of indirect effects from Service activities in upland areas that drain into them from leaks or spill accidents involving chemicals or petroleum products in refuge management operations. Our leak and spill prevention and emergency clean-up procedures should ensure that such occurrences are rare, and are addressed immediately, limiting those short-term effects to the immediate location.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits
We would increase benefits substantially for non-forested wetlands and wetland dependant species under alternative B as compared to alternative A. First, we would expand our ownership and management of non-forested wetlands, and would seek to convert additional areas to moist soil management units. We would more than double our non-forested wetland acreage to manage a total of 3,324 acres of non-forested wetlands along the Wallkill River, and expand the muskrat-trapping program on the refuge, as needed, where sensitive refuge habitats or adjacent landowners are impacted.

Adverse Effects
The direct impacts on the emergent wetlands and forested floodplains the Service manages would be negligible under alternative B. The impacts of building boating access and parking facilities would be short-term, localized turbidity and some minimal loss of wetlands plants, but no substantial habitat alteration or degradation would occur.

As in alternative A, leak and spill prevention and emergency clean-up procedures should ensure that such occurrences are rare, are addressed immediately, and their effects limited to the immediate location.

Impacts of Alternative C

Benefits
In the short term, benefits would resemble those in alternative B, with the acquisition of wetlands in the current boundary and in expansion lands. Over the long-term, diminished priority public use opportunities, with the exception of fishing, and reduced access to much of the interior of the refuge would benefit those wetland habitats by diminishing the risk of damage from human activities.

Adverse Impacts
In alternative C, the direct impacts on the emergent wetlands and forested floodplains on current or expansion lands would be minimal.

Effects on Forested and Upland Vegetation

The forested, scrub-shrub, and grassland habitats of the refuge provide diverse habitat components to support breeding birds and other wildlife. We evaluated the benefits and adverse impacts of the management actions under the three alternatives on forested and upland habitats. We considered the benefits from

- acquiring and conserving forested and upland areas
- allowing natural succession in existing deciduous forested areas
- maintaining and restoring grassland habitat
- allowing natural succession on existing grassland areas
- continuing partnerships to maintain early-successional habitat
- hunting deer

We considered the potential for adverse impacts from

- mowing, cooperative haying, burning prescribed fires, applying herbicides, and grazing livestock to maintain grassland, and
- allowing natural succession to deplete or eliminate grassland or scrub-shrub habitats

Impacts That Would Not Vary by Alternative

Benefits

Regardless of the alternative, we will continue to acquire land from willing sellers within the current refuge boundary, and may acquire as much as 356 acres of forested wetland and forested upland habitat, 23 acres of grassland, and 100 acres of scrub-shrub land. That would expand the conservation of those habitats and benefit the wildlife species that depend on them.

USFWS

Grassland habitats are examined for their usefulness to grassland birds.

Whenever practicable, we will replace non-native plant species with native species to restore the ecological integrity of the refuge.

In all the alternatives, we will offer a deer hunt program. As we attempt to strengthen the integrity of the bottomland hardwood forests on the refuge, controlling the deer population is imperative. When deer are overpopulated, they overbrowse their habitat, which changes the forest structure and plant composition. Overbrowsing can stunt the growth of young tree seedlings (1–9 years old). Failure to control the deer population would have negative impacts on forested habitats and, therefore, on future resident and non-resident wildlife populations as well as the purpose of the refuge.

Adverse Impacts

Regardless of the alternative, we will use certain tools to help maintain, enhance or create wildlife habitat

- replanting with native species
- burning prescribed fires
- haying/mowing
- grazing
- hydroaxing
- applying herbicides
- employing biological control agents

The section on "soils" previously discussed the impacts of those methods. The alternatives vary in terms of the extent and frequency of those management practices.

Impacts of Alternative A—Current Management

Benefits
In alternative A, benefits would be limited to the acquisition and protection of land within the current refuge boundary. Maintaining bog turtle habitats and grassland would continue as priorities.

Scrub-shrub Habitat
In alternative A, the Service would manage up to 999 acres of scrub-shrub habitat in patches of 2 acres or more, thereby benefiting wildlife that depends on that type of habitat.

Grassland Habitats
Continuing to manage up to 632 acres of grasslands on the refuge will help sustain its role in contributing to maintaining grasslands in the region overall and to the biodiversity that type represents.

Forested Communities
Acquiring 795 acres of additional forested wetland and upland within the current refuge boundary and affording them long-term Service management and conservation would benefit the habitat. That would protect up to 3,658 acres of forest within the current acquisition boundary from development or another use that might eliminate or degrade the ecological value of the habitat.

Adverse Impacts
A minimal level of risk of loss or damage to forested and upland vegetation would continue with use of the habitat management methods described above, particularly the use of prescribed fire to maintain grassland. The Service will adhere to detailed burn plans to ensure that those risks remain low. We take strict precautions in applying herbicides to ensure that they affect only the targeted plants.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits
The benefits for forested and upland habitats would accrue primarily from Service acquisition and management of those types on expansion lands.

Scrub-shrub Habitat: In alternative B, benefits to scrub-shrub habitat would increase substantially, as this alternative proposes to manage a total of 1,708 acres of scrub-shrub habitat compared with the 999 acres in alternative A. We would allow about 169 acres of the habitat on current refuge land to succeed to forested habitat, leaving 730 acres of scrub-shrub habitat, but would manage an additional 978 acres by acquiring and conserving that type in the four expansion areas.

Grassland Habitat
Grassland would continue as a major priority in alternative B. The benefits for grassland habitat would increase with our management of 590 acres of grassland habitat within the current refuge boundary and up to an additional 791 acres in the four areas of expansion.

Forested Communities
In alternative B, the benefits for forested wetland and upland habitat would also increase substantially through Service management of 9,760 acres of those types in current refuge and expansion land.

Adverse Impacts
Scrub-shrub Habitat: The use of accepted management practices such as mechanical control, prescribed fire, livestock grazing, and herbicides to maintain fields that will stay as shrub-scrub habitat would carry the potential for causing the impacts of the methods discussed previously. That potential would increase because the total refuge acreage managed with those treatments would increase from about 999 acres under alternative A to 1,708 acres under alternative B. Any potential for short-term adverse effects would likely be more than offset by the protection afforded those habitats by Service management.

Grassland Habitat
We would not maintain in grassland the fields smaller than 100 acres that we managed formerly across the refuge, unless we needed them to support an administrative or priority public use. Those fields would likely revert to shrub habitat over the next 15 years. We might consider their loss to succession adverse to the overall objective of maintaining that cover type, but that impact would be negligible when considered in the context of the more focused management of grasslands in larger areas in this alternative.

We would follow best management practices for prescribed burns, haying and mowing, and other practices that could affect grassland soils and cause localized habitat damage. Long-term management to promote the habitat would offset any localized, short-term, adverse effects.

Forested Communities
Some localized tree cutting may be required to implement the river access and parking area improvements under alternative B, but those would be negligible compared to the total acreage of forested habitat protected under this alternative.

Impacts of Alternative C

Benefits
Scrub-shrub Habitat
In alternative C, scrub-shrub habitat would benefit through its continued conservation on the refuge. We would manage an area of 719 acres in the current boundary and more than 769 acres in the expansion area.

Grassland Habitat
Compared with alternatives A and B, alternative C would reduce the benefits for grasslands. Although 224 acres of grassland may grow on the refuge as the result of natural disturbances, we would manage none of the land in the current refuge boundary or in the expansion areas to sustain grassland habitat.

Forested Communities
Of the three alternatives, alternative C would provide the greatest benefits for forested habitat. Forested wetlands and upland forests would increase in the near term under alternative C by our acquiring land in the current boundary and in expansion areas and, in the longer-term, by allowing earlier vegetation to succeed into forest. The result under this alternative: eventually, 11,258 acres would be forested.

Adverse Impacts

Scrub-shrub Habitat

Under alternative C, we would continue to conserve scrub-shrub habitat, which would maintain the diversity of the habitats we manage and the benefits for forest-, scrub-shrub-, and grassland-dependent species on the refuge.

Grassland Habitat

Grassland habitats throughout the refuge would diminish as they change to later successional vegetation. Although grasslands may continue as a varying component due to natural disturbance of the refuge, its contribution to sustaining grassland habitats in the region would diminish accordingly.

Forested Communities

In alternative C, allowing natural succession to proceed unimpeded may affect the diversity of the refuge forest community, because it may lead to dominance by one or a few species, which may limit the diversity of forest-dependent fauna on the refuge.

Effects on Endangered and Threatened Species

Among our highest priorities on the refuge are the preservation, enhancement, restoration and management of bog turtle habitat and researching and monitoring populations of the bog turtle. Although more than 50 sites recently surveyed within the refuge acquisition boundary appear to provide habitat suitable for bog turtles, we know of only two sites where turtles are present. One is on refuge land, the other on private land within the current refuge boundary. Fundamental in achieving our goals at the refuge is working toward the recovery of the bog turtle by preventing their loss from poaching, maintaining and enhancing their habitat where conditions are suitable, and expanding the turtle population to other sites.

Also important are efforts to help in the recovery of three other federal-listed species—the Mitchell's satyr butterfly, dwarf wedge mussel, and Indiana bat—that are known to occur in the area, and for which the refuge appears to provide suitable habitat.

Edward Henry/USFWS

The use of ground penetrating radar was used to look for bog turtles on the refuge.

We evaluated the management actions we propose in the alternatives for their potential to benefit the endangered and threatened species by protecting them or their potential habitat. The benefits we considered included

- protecting bog turtles and habitat components at the currently inhabited bog turtle site on the refuge
- acquiring, protecting, and enhancing bog turtle sites within the acquisition boundary and in the proposed expansion areas
- constructing or restoring habitat projects that might enhance the suitability of refuge habitats for the Mitchell's satyr butterfly, dwarf wedge mussel, and Indiana bat

The potential adverse effects of the Wallkill River management alternatives that we evaluated included impacts from

- vegetation management methods that may affect bog turtles or their habitats
- vegetation management methods that may affect the potential for successful recovery efforts for Mitchell's Satyr butterfly, dwarf wedge mussel, and Indiana bats
- recreation facilities construction projects that might affect species habitats, and

- public activities on the refuge that might damage habitat or disturb the species

In addition to evaluating the effects of our proposed actions on bog turtles, we are working with our New Jersey Field Office to conduct an intra-Service section 7 consultation on all actions related to bog turtles in this draft CCP/EA.

Impacts that Would Not Vary by Alternative

Benefits

Bog Turtle

Regardless of which refuge management alternative we select, we will continue to monitor and protect bog turtles on the refuge. We will also map, monitor, and protect bog turtle habitat to meet species recovery goals, and will seek to acquire additional habitat within the refuge acquisition boundary.

We will continue to protect and maintain the viability of the Bog Turtle Population Analysis Sites (PAS) within the acquisition boundary. We will map continuous, contiguous, suitable nesting and hibernating bog turtle habitat within the refuge acquisition boundary, store the information in a GIS database, and monitor and map any changes (Recovery Plan task 1.1.1). We will also identify and map the watersheds or wetland ecosystems associated with those bog turtle sites and incorporate the information into a GIS database (Recovery Plan task 1.1.2).

We will monitor the status of and threats to populations and habitat, including changes in hydrology, encroachment of development, successional changes, and the introduction and spread of invasive native or exotic plants. We will monitor population trends and detect signs of recruitment and reproduction, seasonal movements, and home range (Recovery Plan task 3.5) and, each year, coordinate with the Bog Turtle Recovery Team, the states (NYSDEC and NJDEP), and our conservation partners to ensure that we employ the best available science in our management decisions.

We will continue our efforts to acquire the one known bog turtle site on private land within the current refuge boundary. We will protect bog turtles from illegal poaching by routine site monitoring visits.

Mitchell's Satyr Butterfly, Dwarf Wedge Mussel, and Indiana Bat

Regardless of which management alternative we select, our continued protection and management of refuge land would ensure that many or all of the habitat components those species require would be conserved for the future and available to aid in recovery with the application of appropriate management techniques. If we find the Mitchell's satyr butterfly, dwarf wedge mussel, Indiana bat, or other federal-listed species on the refuge during the 15-year implementation of this plan, we would immediately institute steps to protect the specific habitat at the location it is found and consider what measures are feasible to further protect and promote the species recovery on the refuge.

Adverse Impacts

Regardless of the alternative, we will continue to employ a range of management tools to achieve our objectives in managing for the recovery of federal-listed species. We will use these tools only when and where necessary, and only with the proper training and focused application to avoid adverse impacts.

Bog Turtle

To control invasive plants and set back succession, we will use biological control agents, girdle red maple stems of 4 inches dbh or more, graze goats or other livestock, mow, use a hydroax, other mechanical mulching, or hand-pull vegetation.

The biological agents we would use to control invasive plants would be species-specific, and so, would affect only the targeted, unwanted vegetation. They would have no affect on desired plant species at bog turtle sites, such as tussock sedge. We would continue to evaluate the success of biological control agents on purple loosestrife by monitoring plant damage to ensure that the control we use is effective and well targeted.

Girdling red maple stems would open the tree canopy. We would not attempt to remove red maple from the refuge on a larger scale, so this method would cause no changes in forest composition.

Within 5 years of the approval of this CCP, we would begin a study to determine the effectiveness of livestock grazing on the bog turtle site to control invasive plant species while maintaining the fluid mud substrate preferred by bog turtles. Our observations of grazing livestock at our occupied bog turtle site indicate that grazing does two things. It checks natural plant succession just as the other vegetation control methods do, and the movement of the grazing animals tends to keep the unique microenvironments of the bog turtle's seepages in good condition by keeping the small, deep mud holes between sedge plants open and moist. We would keep the number of grazing animals at a minimum to mitigate the damage to the plants and minimize the nutrient loading from manure.

The foot traffic of refuge staff monitoring bog turtles and their habitat and managing vegetation would not cause adverse effects at those sites. We would keep foot traffic and equipment hauling to a minimum to protect the seep vegetation. We would not drive vehicles, ORVs, or heavy equipment on turtle sites.

Foot traffic from cross-country skiers and hunters would likely not affect bog turtles adversely, because they generally hibernate from late September through April, when most of the skiing, showshoeing and hunting seasons occur.

We would carefully plan all refuge management actions that we might employ in nearby or upgradient habitats to ensure that we do not inadvertently alter their hydrology and cover characteristics. We would continue to employ outreach to private landowners with land near or upgradient of the bog turtle sites to ensure that they know about our program, and to encourage them to help us protect the turtles and their habitat.

Mitchell's Satyr Butterfly, Dwarf Wedge Mussel, and Indiana Bat
Regardless of which alternative we select, our routine refuge management activities would have no substantial, adverse impacts on those species. To our knowledge, they are not present on the refuge. In addition, none of the alternatives is likely to affect adversely their potential habitat. Even if we do not pursue species recovery by managing suitable habitat, our general refuge management would continue to maintain habitat components important to major portions of the species' life cycles.

Mosquito control conducted by the State of New Jersey may pose some risk to these species if certain techniques are used and any of the species are, in fact, present. Because our memorandum of understanding with the Sussex County Office of Mosquito Control does not allow the use of insecticides (adulticides) to control adult mosquitoes on the refuge, there would be no effects to Mitchell's satyr butterfly or to the adult stages of the insect prey base of any Indiana bats that might forage on the refuge in the future. Should public health concerns make it necessary to conduct mosquito control on the refuge in the future, the Service would coordinate with the State of New Jersey to ensure that we take all measures to reduce the potential for harm to these species, if present.

We would use bacillus thuringiensis (Bt), a biological agent, for control. Many think Bt to be a selective mosquito control treatment in freshwater wetlands. However, there may be some effects to chironomids, commonly known as midges, under normal operating conditions. Chironomids are frequently one of the most common aquatic invertebrates within a wetland. They are closely related to mosquitoes, but are non-biting. Chironomids are a very important food resource for numerous other aquatic organisms, as well as being an important food for shorebirds and waterfowl. Repeating treatments at longer intervals may give the non-target community time to recover in case there are any effects (Mulla et al. 1979). In addition, chironomids were the most abundant group in the freshwater wetlands of that study (Hershey et al. 1998). Therefore, at the level of treatment proposed, we expect the adverse impacts on non-target organisms to be negligible or nonexistent.

Impacts of Alternative A—Current Management

Benefits

Bog Turtle

Bog turtles would continue to benefit under alternative A, because we would continue our baseline level of bog turtle management at the refuge—the minimum level of protection and management we would continue to maintain for the next 15 years, to ensure that the refuge continues to contribute to the survival and recovery of the species. We would manage and maintain the one known bog turtle site on refuge-owned land following the recommendations in the Bog Turtle Recovery Plan to prevent any loss, alteration or fragmentation of its highly specialized wetland habitat on the refuge (USFWS 2001).

We would monitor the status of and threats to the known bog turtle site, and would control invasive plants and set back succession using biological control agents, girdling red maple stems, grazing cows, goats or other livestock, and mowing or using hydroaxes. We will also continually monitor the known bog turtle site to prevent the illegal collection of individual animals that become part of the illegal wildlife trade (USFWS 2001).

Mitchell's Satyr Butterfly, Dwarf Wedge Mussel and Indiana Bat

Although those species do not occur on the refuge, the management actions in alternative A would improve the likelihood that they may inhabit the refuge in the future. The management strategies we would continue for bog turtles would indirectly benefit Mitchell's satyr butterfly, since those species use the same habitat. For the dwarf wedge mussel, we would institute measures to promote the recovery of this species. Efforts to protect and manage our refuge wetlands, floodplain forests, and upland habitats under alternative A would indirectly benefit the Indiana Bat by improving habitat for that species. All three of these species would benefit from acquiring additional lands in the current acquisition boundary.

Adverse Impacts

We would take particular care to ensure that continuing Service actions at the refuge under alternative A would not cause adverse affects on the bog turtle. The bog turtle would continue to be one of the primary management focuses at the refuge so we would consider carefully all the activities at bog turtle sites before proceeding, and would conduct them only if we judged them not harmful to the turtle or its habitat. We would carefully monitor the sites to identify any changes in habitat, such as a loss of soil saturation, growth of invasive species, or excessive growth of tree canopy that would indicate a loss of habitat quality for supporting the species. We would continue to prohibit the public from entering the sites, and be particularly vigilant to prevent illegal takings.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits
In general, endangered and threatened species should benefit most under alternative B. In addition to specific actions we propose to protect or enhance habitats and promote recovery, we plan to encourage protection of endangered and threatened species through development of an educational awareness program.

Bog Turtle
We would expand our habitat protection measures and related management efforts under alternative B and thereby substantially increase benefits to bog turtles as compared to alternative A. The primary impetus for refuge expansion under alternative B is to acquire additional bog turtle habitat in the Papakating Creek area. Acquiring that habitat would allow us to implement a markedly improved plan to support a major effort to recover bog turtles there. Under the plan, we would protect and enhance occupied bog turtle habitat, field survey all suitable refuge habitat for bog turtles, and implement the actions needed to sustain and improve that habitat. Further, we would identify currently suitable but unoccupied bog turtle habitat and create additional habitat by manipulating red maple swamps, simulating the beaver pond flooding regime sequence, or restoring the natural hydrology at the refuge headquarters pond, and we would reintroduce the species wherever feasible. That would support the goals and objectives in the recovery plan for bog turtles.

Mitchell's Satyr Butterfly, Indiana Bat and Dwarf Wedge Mussel
Alternative B would provide increased benefits to these three species, which have been found on or near the refuge in the past, because the refuge expansion lands contain habitats those species prefer. The Papakating Creek Focus Area contains potential habitat for the dwarf wedge mussel. We would determine the feasibility of re-establishing its populations within the species' historic range and, if feasible, introduce the species into such areas. We would begin surveys for the Mitchell's satyr butterfly and the Indiana bat in appropriate habitats on all Service-owned land.

Adverse Impacts
Our management activities under alternative B would produce no adverse impacts on bog turtles or any potential future populations of the other endangered and threatened species. The construction projects we plan would have small-scale, localized effects that either would not affect at all or would cause negligible effects on the habitats those species prefer. Although we propose to allow dog walking on the Liberty Loop Trail in this alternative, no bog turtle sites are near the Liberty Loop trail, where dogs might disturb them.

Bog Turtle
Habitat management techniques.—We would employ the same set of techniques to control invasive plants and retard succession to maintain bog turtle habitat as previously discussed. Those would not cause any substantive adverse impacts on the bog turtles at occupied sites or on the important components of suitable bog turtle habitat.

Construction projects.—Because bog turtle habitats are a major focus of habitat protection and management at the refuge, we would not undertake a public recreation facility or other construction project that would adversely affect their habitat. That would also tend to eliminate the possibility of adverse effects on potential Mitchell's satyr butterfly habitat. Our trail projects would not involve major habitat clearing, because we would continue to make use of old railroad

beds that, to a large degree, have continued to be cleared for bird surveys and other purposes. We would continue to monitor and control carefully, as necessary, public access and activities on the refuge.

Mitchell's Satyr Butterfly, Dwarf Wedge Mussel and Indiana Bat
Precautions described above related to protection of bog turtle habitat would also protect potential Mitchell's Satyr butterfly habitat components and the butterflies themselves if they should be found on the refuge in the future. Minor construction projects for boating access to the Wallkill River would not affect dwarf wedge mussels, if they were found on the refuge, because little or no disturbance of the river bottom would result from placing the boardwalk and platforms. Tree cutting in floodplain forests would affect potential roost trees for Indiana bats, and we should evaluate that management activity if bats are found on the refuge.

Impacts of alternative C
Benefits
Bog Turtle
We would expand refuge lands and continue to protect bog turtles and their habitats under alternative C making the benefits intermediate between the two other alternatives. We would maintain the habitat at known bog turtle sites and protect them from invasive species, such as purple loosestrife. That would include tagging to protect turtles from poaching, but would create no additional bog turtle habitat for further reintroductions.

Mitchell's Satyr Butterfly, Dwarf Wedge Mussel, Indiana Bat
Alternative C would benefit all three species more than alternative A, by expanding the refuge land base to include the habitat types conducive to those species.

Adverse Impacts
Bog Turtle
Under alternative C, we would remove cattle from the refuge, and would permit no other livestock for habitat management. However, cattle hooves may be one of the cheapest, most effective tools for maintaining the mud holes between tussocks sedges microhabitats that bog turtles prefer, so eliminating livestock as a management tool may diminish our capability of maintaining turtle habitats on multiple sites.

Mitchell's Satyr Butterfly, Dwarf Wedge Mussel, Indiana Bat, or other Federal-listed Species
Under alternative C, we would not direct management at locating those species on the refuge or in locating and enhancing suitable habitat to aid in species recovery. Nevertheless, the protection and management of refuge land would ensure that many or all of the habitat components required by those species would be conserved for the future and available to aid in recovery with the application of appropriate management techniques.

If we find the Mitchell's satyr butterfly, dwarf wedge mussel, Indiana bat, or other federal-listed species on the refuge during the 15-year implementation of this plan, we would immediately begin steps to protect the specific habitat elements at the location, and consider what measures are feasible to further protect and promote the species recovery on the refuge.

Effects on Landbirds

Over 225 species of birds have been recorded as using the refuge; 122 are documented as breeding here. The refuge provides especially valuable habitat for wintering raptors, grassland birds, and marsh birds. It is also an important site for shrub land-dependent birds and forest-interior songbirds. Further, the refuge provides nesting, resting, and feeding habitat for numerous birds on lists of rare and declining species.

USFWS

Golden winged warblers are a species of importance at the refuge.

Impacts That Would Not Vary by Alternative

Benefits

Protecting and managing current refuge land and acquiring land from willing sellers within the current refuge boundary generally would benefit forest, shrubland, and wetland birds that use the refuge to breed or winter, or that visit the refuge during migration. Protecting that habitat is particularly important in this part of the PIF Physiographic Area 17, because the refuge helps to maintain the continuity of the natural habitats in the narrow portion of Area 17 that transitions from eastern New York State to the mountains of Pennsylvania.

Adverse Impacts

Regardless of the alternative selected, breeding, wintering, and migrating birds may be adversely affected by management methods, such as prescribed burning or use of herbicides to control invasive plants or to maintain or restore bog turtle habitat or by construction projects. Those methods would displace birds from treated locations and could damage or destroy any active nests that are present. The impacts would be minor, short-term, and highly localized, with no threats to

Partners in Flight Landbird Conservation Plan

Physiographic Region-17

Northern Ridge and Valley

The Partners in Flight Landbird Conservation Plan Physiographic Region 17 is part of Bird Conservation Region 28, the Appalachian Mountains region. The Northern Ridge and Valley extends from southeastern Pennsylvania, through northwestern New Jersey and southeastern New York nearly to the base of the Adirondack Mountains. It includes portions of several major river valleys, including the Hudson, Delaware, and Susquehanna Rivers. Ecologically, this is a transitional area, with forested ridges grading from primarily oak-hickory forests in the south to northern hardwood forests further north. Pine-oak woodlands, barrens, and hemlock ravine forests are also important along ridges, whereas bottomland and riparian forests are important in the valleys, which are now largely cleared for agricultural and urban development. Roughly, 55% of the physiographic area is forested today, most of it at higher elevations. About 40% of the area is in agricultural production, primarily a mixture of dairy pastureland and corn. Over 200,000 ha is state forestland in PA and NJ; other important public lands include High Point State Park (NJ) and Wallkill River National Wildlife Refuge. (PIF, 2003).

NOTE: Other Bird Conservation Plans for BCR-28 include for Landbird—the Southern Blue Ridge, Allegheny Plateau, Ohio Hills plans; for waterbirds—the Southeast U.S plan; for waterfowl—the Atlantic Coast Joint Venture Waterfowl Implementation Plan; and for all birds the Appalachian Mountain Bird Conservation Initiative Concept Plan.

bird populations in terms of adult mortality or breeding success. The methods would improve treated habitats over the long-term, and that would benefit bird populations.

Visitors to the refuge for educational programs or other non-consumptive uses may affect landbirds, primarily through temporary disturbance. On-site activities by teachers and students using trails and environmental education sites may cause other low-level impacts, such as trampling or removing vegetation, vegetation, and littering. If the disturbance of habitat or wildlife persists, we will restrict or discontinue the activity.

The placement of kiosks may affect small areas of vegetation. We will place the kiosks to minimize disturbance. By providing additional interpretive and educational brochures and increasing our involvement with groups in the area, we may increase public knowledge of the refuge and its resources. That awareness and knowledge may improve the willingness of the public to support refuge programs and resources and comply with its regulations.

The impacts of wildlife observation and photography will be minimal. They may include disturbing wildlife, removing or trampling plants, littering, vandalizing, or entering into closed areas. We will remove some vegetation to place the observation platforms and photo blinds. If the disturbance of habitat or wildlife persists, we will restrict or discontinue the activity. Wildlife will expend little energy in leaving areas of disturbance. The impacts of cross-country skiing and snowshoeing will be minimal, because those will occur during the winter, when many species are less active or not present at all on the refuge.

For songbirds, Gutzwiller et al. (1994) found that low levels of human intrusion altered the singing behavior of some species. Some studies have found that some bird species habituate to repeated intrusion; frequently disturbed individuals of some species have been found to vocalize more aggressively, have higher body masses, or tend to remain in place longer (Cairns and McLaren 1980). Disturbance may affect the reproductive fitness of males by hampering territory defense, male attraction and other reproductory functions of song (Arrese 1987). Disturbance, which leads to reduced singing activity, would make males rely more heavily on physical deterrents, which are time- and energy-consuming in defending territories (Ewald and Carpenter 1978).

Travel routes can disturb wildlife outside the immediate trail corridor (Miller et al. 2001). Miller et al. (1998) found bird abundance and nesting activities (including nest success) increased as distance from a recreational trail increased in both grassland and forested habitats. Bird communities in this study apparently were affected by the presence of recreational trails, whereas “generalists” (e.g., American robins) were found near trails, and “specialist” species (i.e. grasshopper sparrows) were found farther from the trails. Nest predation also was found to be greater near trails (Miller et. al 1998).

Disturbance can cause shifts in habitat use, the abandonment of habitat, and can increase energy demands on affected wildlife (Knight and Cole 1991). Flight in response to disturbance can lower nesting productivity and cause disease and death. Hammitt and Cole (1998) conclude that the frequent presence of humans in “wildland” areas can dramatically change the normal behavior of wildlife, mostly through “unintentional harassment.”

Seasonal sensitivities can compound the effects of disturbance on wildlife. Examples include regularly flushing birds during nesting. The Delaware Natural Heritage Program, Division of Fish and Wildlife, and the Department of Natural

Resources and Environmental Control completed a document on the "The Effects of Recreation on Birds: A Literature Review" in April 1999 (Bennett and Zuelke 1999). We refer to the following information from that document:

> "Several studies have examined the effects of recreationists on birds using shallow-water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981; Burger 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers & Smith 1995, 1997; Burger & Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreation activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers & Smith 1997; Burger & Gochfeld 1998). The findings these studies report appear in summary below in terms of visitor activity and avian response to disturbance.
>
> - Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981; Klein et al. 1995; Burger & Gochfeld 1998).
>
> - Distance: Disturbance increased with decreased distance between visitors and (Burger 1986), though exact measurements were not reported.
>
> - Approach Angle: Visitors directly approaching birds on foot caused more disturbance than did visitors driving by in vehicles, stopping vehicles near birds, or stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger & Gochfeld 1981; Burger et al. 1995; Knight & Cole 1995a; Rodgers & Smith 1995, 1997).
>
> - Type and Speed of Activity: Joggers and landscapers caused birds to flush more than anglers, clammers, sunbathers, and some pedestrians, possibly because the former groups move quickly (joggers) or create more noise (landscapers). The latter groups tend to move more slowly or stay in one place for longer periods, and thus birds likely perceive these activities as less threatening (Burger 1981, 1986; Burger et al. 1995; Knight and Cole 1995a). Alternatively, birds may tolerate passing by with unabated speed whereas if the activity stops or slacks birds may flush (Burger et al. 1995).
>
> - Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986; Klein 1993; Burger & Gochfeld 1998), though noise was not correlated with visitor group size (Burger & Gochfeld 1998)."

We would take all necessary measures to mitigate those effects, particularly where group educational activities are involved. Activities will take place in areas where minimal impact will result. We will evaluate the sites and programs periodically to assess whether they are meeting the objectives, and to prevent site degradation. If evidence of unacceptable adverse impacts appears, we will rotate the activities to secondary sites, or curtail or discontinue them. We will post and enforce refuge regulations, and establish, post, and enforce closed areas. The known presence of a threatened or endangered species will preclude the use of an area until the refuge manager determines otherwise.

We will issue special use permits to organizations conducting environmental education and interpretation or wildlife observation and photography tours on the refuge. We may charge a fee for those permits. We will monitor the areas

involved to evaluate the impacts on the resource. If adverse impacts appear, we may move an activity to secondary locations, curtail it, or discontinue it. The special use permit will address any specific conditions that may apply, depending on the activity requested.

All photographers must follow refuge regulations. Photographers in closed areas must follow the conditions outlined in the special use permit, which normally include the notification of refuge personnel each time any activity takes place in closed areas. The use of a closed area should be restricted to inside blinds to reduce the disturbance of wildlife. No baits or scents may be used. At the end of each session, the permittee must remove the blind, and remove all litter daily. The patrol of public use areas by law enforcement should continue to minimize that type of violation.

Cross-country skiing and snowshoeing trails must be monitored to make sure that conditions do not impose adverse effects on populations of wildlife, especially threatened or endangered species, or their habitats. If we found that those species were using habitat near the trails, we may close or reroute them to ensure the protection of that habitat.

Impacts of Alternative A—Current Management

Benefits

In alternative A, continuing to manage our current lands and acquire habitat within the refuge boundary would benefit refuge bird species by managing for, and ensuring the long-term protection of, 7,086 acres of grassland, scrub-shrub, wetland and forested habitats.

Adverse Impacts

Management practices such as haying, mowing, prescribed burning and hydroaxing to manage for grassland or control invasive plants would produce short-term, localized impacts on bird habitat and the temporarily displace some birds. Trail maintenance and parking lot construction would also cause negligible, short-term, localized effects of disturbance. Parking lot construction would also remove a small amount of habitat that would provide cover and food for land birds, but that would be negligible in terms of what the refuge provides otherwise for those species. The impacts of visitor disturbance may increase minimally, due to a general increase in refuge visitation of 10 percent.

We currently allow no hunting on Service-owned land in the State of New York; however, as we acquire additional land in that state, we may consider opening it for hunting, under regulatory requirements.

Under alternative A, the refuge is open to a spring and fall turkey and woodcock hunt, according to state seasons. Our hunt seasons consist of these dates (based on the 2006-2007 New Jersey state seasons): spring turkey, April 16–May 25; fall turkey, Oct. 29–Nov. 3; and woodcock, Oct. 19–Nov. 11.

By the mid-1800s, turkeys had disappeared from New Jersey due to changing habitat and over-harvesting for food (http://www.nj.gov/dep/fgw/turkey_info.htm). Division biologists, in cooperation with the *NJ Chapter of the National Wild Turkey Federation*, reintroduced wild turkeys in 1977 by releasing 22 birds. In 1979, biologists and technicians began to live-trap and relocate birds to establish populations throughout the state. By 1981, the population was able to support a spring hunting season, and in December 1997, a limited fall season began. Wild turkeys now abound throughout the state, wherever there is suitable habitat. The estimated state population is between 20,000 and 23,000, with an annual harvest of more than 3,000 statewide. The refuge sells approximately 130 turkey permits

per year, with an average of about 10 turkeys harvested per year, representing only 0.0005 percent of the total state population.

The refuge is also open to woodcock hunting during the state open season. New Jersey has two woodcock hunting zones, north and south of Route 70, respectively. Of the 3,794 woodcock taken during the 2005–2006 hunt season, North Zone hunters took 65 percent (2,450), South Zone hunters took 19 percent (711), and hunters that pursued woodcock in both zones took 17 percent (632). No specific figures are available for how many woodcock were taken on the refuge.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits
Continuing to manage our current lands and acquire habitat within the refuge boundary and the four expansion areas proposed in alternative B would make this alternative the most generally beneficial for virtually all refuge bird species, by managing for and ensuring the protection of 16,637 acres of grassland, shrubland, wetland and forested habitat over the long-term.

Adverse Impacts
Management methods used to maintain or restore habitats or prevent encroachment of invasive species may affect individual birds by temporarily displacing them and the short-term loss of their specific habitat. Those effects would be short-term and highly localized, and should not affect any species populations. We would not employ these management measures during the major part of the nesting season, when the majority of the birds are building nests, incubating eggs, or feeding nestlings, so the adverse impacts on bird reproduction would not occur. Habitat improvements, particularly the control of invasive plants, would benefit birds over the long-term.

USFWS

Purple loosestrife is one of the most aggressive invasive species on the refuge.

The array of construction projects alternative B proposes would cause a greater degree of disturbance to land birds, and remove more acreage from natural habitat than in alternative A. Visitor disturbance would also increase, because of the projected 15-percent increase in visitation and the increased access from new and improved refuge amenities. However, the greatly expanded protection of those birds on newly acquired refuge lands would more than offset those effects.

In alternative B, we would continue to open the refuge to hunting for spring and fall turkey and for woodcock, as in alternative A, and we would allow hunting on most of the lands in the proposed acquisition area when we acquire them in fee. Because that would approximately double the area open for hunting on the refuge, we predict a harvest twice the total of animals harvested in alternative A. Specifically, we predict an average of 20 turkeys and twice as many woodcock would be harvested on the refuge annually, making this alternative the one with the most adverse impact on upland game bird species.

In alternative B, we propose to allow dog walking on the Liberty Loop Trail. We would require that all dogs be leashed, to minimize impacts on land birds and other wildlife.

Impacts of Alternative C

Benefits
The refuge expansion proposed under alternative C generally would benefit the cerulean warbler and Louisiana water thrush, and other forested floodplain and riparian forest-dependent bird species by managing for and ensuring the long-term protection of those habitats. This alternative would not open the refuge to upland bird hunting. Therefore, this alternative has the least impact on populations of upland game birds.

Adverse Impacts
This alternative C would adversely affect grassland birds, because we would not maintain their habitat on the refuge, but rather, allow it to progress through

natural stages of vegetative succession, ultimately to mature forest. Except for a few pairs on naturally disturbed sites or local grassed areas maintained for other reasons that may appear from time to time, breeding grassland birds would likely disappear from the refuge. The success of those birds then would depend on the conservation of grassland habitats elsewhere in BCR-28.

Effects on Waterfowl

The refuge provides high quality waterfowl habitat that is a priority focus area for waterfowl management in New Jersey. Nineteen waterfowl species have been recorded on the refuge. Breeding waterfowl include the Canada goose, wood duck, American black duck, mallard, hooded merganser, and common merganser. refuge wetlands are particularly important to migratory American black ducks. Waterfowl using the two major migration corridors the refuge straddles rest and feed in the extensive wetlands along the Wallkill River, especially when it floods in the spring.

With the cooperation of Ducks Unlimited, the Service restored, enhanced, and now manages 335 acres of seasonal wetlands adjacent to the Liberty Loop Trail. That improved habitat for thousands of migrant ducks and geese as well as a wide diversity of other wetland-dependent wildlife. The refuge first opened for migratory bird hunting in 2000, and reported 970 waterfowl hunter visits for fiscal year 2005.

Purple loosestrife and Phragmites have taken over many refuge wetlands, degrading habitat for breeding and migrating waterfowl. The mute swan outcompetes native waterfowl and marshbirds for food resources and nesting areas and, in feeding, damages wetland ecosystems. Feeding and spawning common carp (*Cyprinus carpio*) can have an adverse effect on aquatic plants and increase water turbidity.

We evaluated the management actions the alternatives propose for their potential to benefit waterfowl or their habitat. The benefits we considered included the

- acquisition and protection of wetlands within the acquisition boundary and in proposed expansion areas
- restoration projects on refuge wetlands and hydrology that would enhance refuge habitats for breeding or migrating waterfowl
- control measures that would reduce problems associated with mute swans on the refuge.

The potential adverse effects of the Wallkill River management alternatives that we evaluated included impacts from

- construction projects that might affect species habitats
- public activities on the refuge that might damage habitat or disturb the species.

Impacts That Would Not Vary by Alternative

Benefits
Regardless of which alternative we select, our continued protection and management of refuge lands, particularly the forested floodplain of the Wallkill River and related naturally occurring wetlands will benefit migratory and breeding waterfowl. Those areas will remain undeveloped in the long-term, thereby sustaining a reserve of breeding and migratory habitats along the Wallkill River corridor that otherwise would likely be intensively developed.

Adverse Impacts

Water quality affects the aquatic invertebrates, plants, and fish on which breeding and migrating waterfowl depend. The water quality of the Wallkill River and tributaries will continue to reflect the level of point and non-point source pollution and the effectiveness of pollution controls in the different communities of the watershed. The refuge will continue to serve as a filter for pollutants, and the Service will continue to collaborate with agencies that address water pollution, but we would not directly control any major upstream sources.

All of the alternatives include refuge activities to protect and restore bog turtle habitat: grazing to maintain the fluid mud substrate preferred by bog turtles, hydroaxing to remove trees and shrubs, and the prescribed burning of invasive plants may cause minor, short-term water quality impacts, such as increased turbidity and elevated nutrient levels. Those effects would not likely add measurably to the general turbidity and nutrient levels in the Wallkill River or its associated wetlands.

Fishing causes disturbance of the wildlife that use the ponds and the river, including waterfowl and shorebirds. McNeil et al. (1992) found that many waterfowl species avoid disturbance by feeding at night instead of during the day. Klein (1989) found migratory dabbling ducks to be the most sensitive to disturbance and migrant ducks to be more sensitive when they first arrived, in the late fall, than later in winter. Discarded fishing line and other fishing litter can entangle migratory birds and cause injury and death (Gregory 1991). Fishing with lead sinkers at the refuge pond may result in the lead poisoning waterfowl and wading birds. Proper management actions, including education, law enforcement, and a prohibition on lead sinkers for pond anglers, would ensure no short- or long-term affects on waterfowl from public fishing at the refuge.

We will monitor the use of motorized and non-motorized watercraft at the refuge to ensure that it will not have an adverse impact on wildlife habitat or the management of migratory birds and other wildlife species. The disturbance of wildlife may arise from the noise of boat motors, their proximity to wildlife, their speed, and time of operation. Maintenance activities on the river to improve its navigability could disturb wildlife habitats and nursery habitats for fish. Litter from inappropriate use could affect the quality of the visitor experience and, in some cases, threaten wildlife and wildlife habitats. Bank erosion and vegetational damage are possible at boat launch sites.

We are responsible for ensuring that all of the activities on the refuge occur in a manner that is consistent with its purposes. We will review all of the areas of the rivers within and adjacent to the refuge and determine the maximum allowable speed. Since the river is small, sinuous, and often clogged with navigational hazards, in no case will the speed limit exceed 25 mph. We will respect the speed restrictions imposed by the towns that border the rivers.

All of the provisions of 50 CFR §§27.31 and 27.32 will be imposed as well. They include the requirement that "No operator or person in charge of any boat shall operate or knowingly permit any other person to operate a boat in a reckless manner, or in a manner so as to endanger or be likely to endanger any person, property or wildlife."

Boaters will use only the established trails and other areas open to the public, and not venture into closed areas. All boats can be launched only from designated launch sites: Route 565, Bassett's Bridge, and Oil City Road.

The cross-country skiing and snowshoeing trails must be monitored to make sure that conditions do not pose adverse effects on populations of wildlife, especially threatened or endangered species, or their habitats. If we found such species using habitat near the trails, we would close or reroute them to ensure habitat protection.

Impacts of Alternative A—Current Management

Benefits

Under alternative A, migratory waterfowl would continue as a priority at the refuge, and would continue to benefit from Service maintenance of the refuge, and from our specific waterfowl conservation measures, including management of the 335 acres of moist soil units at Liberty Marsh. Some minor benefits would accrue to migratory waterfowl from our acquiring as much as 523 acres of non-forested wetlands and 27 acres of open water within the current acquisition boundary.

Adverse Impacts

Increasing refuge visitation in alternative A may result in a minimal increase in the disturbance of waterfowl by humans near trails, at river crossings, or in watercraft. Because most visitors understand the protection the refuge affords, those incidents should remain rare. We will continue to provide educational materials and adequate signage.

Under alternative A, the refuge allows waterfowl hunting on Service-owned lands in New Jersey during state seasons. Our migratory bird permit consists of these species and seasons:

Canada Goose	Sept. 1–Sept. 30
Rails and Gallinule	Sept. 1–Nov. 8
Snipe	Sept. 16–Dec. 30
Regular Waterfowl	Oct. 14–Nov. 4, 14–Dec. 30
Winter Canada Goose	Jan. 22–Feb. 15

The state uses population data and other tools to determine the appropriate seasons and bag limits for each species of waterfowl. Because the refuge follows state regulations, we may reasonably conclude that, although individual birds are harvested during the hunt, the overall population does not suffer major adverse impacts. Furthermore, we close parts of the refuge, such as the Liberty Marsh area, to waterfowl hunting to provide a safe haven for waterfowl during the hunting season.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits

Among the three alternatives, alternative B would provide the greatest benefits for migratory and breeding waterfowl. We would continue to manage 1,420 acres of non-forested wetland within the current acquisition boundary, and 1,904 acres within the proposed expansion area. Managing those areas as non-forested wetlands would benefit migrating waterfowl by ensuring the long-term protection of that habitat, a priority purpose of the refuge.

Allowing the seasonally flooded areas of the refuge to succeed to forest would be of long-term benefit to wood duck (see table 4.8), hooded merganser and common merganser, because the number of natural nest cavities would likely increase. Areas that are continuously flooded naturally or by impoundments created by beavers would benefit both breeding and migrating waterfowl.

Table 4.8. Wood duck (*Aix sponsa*) requirements and limiting factors.

Survival Need	Species-Specific Requirement
Food—Young	Insects, aquatic invertebrates, small fish, and other high-protein animal material Aquatic plants such as algae, watermeal, watershield, sago pondweed, and duckweed
Food—Adult	Seeds of oaks, bald cypress, hickory, sweet gum, beech, button bush, arrow-arum, bur-reed, wild rice, and other mast-producing plants Aquatic insects and other invertebrates Aquatic plants and seeds
Nesting Cover	Natural tree cavities or artificial nesting boxes in deciduous woodlands in close proximity to rivers, wetlands, and other suitable aquatic habitats used for brood rearing
Brood-Rearing Cover	Shallow water for foraging on invertebrates and aquatic plants that contain some protective cover from predators. A ratio of 50 percent to 75 percent cover to 25 percent to 50 percent open water is preferred
Winter Cover	Bottomland hardwood wetlands with an abundance of partially submerged downed timber, shrubs, and woody debris
Water	Water requirements are met where wetlands suitable as brood-rearing and wintering habitat exist
Interspersion	Prefer a complex of forested wetland habitats that include live forest, green-tree reservoirs, rivers, oxbows, riparian corridors, beaver ponds, shrub-scrub and robust emergent herbaceous wetlands
Minimum Habitat Size	At least 10 acres of wetland or other aquatic habitat should be available in a contiguous unit or in isolated parcels separated by no more than 100 feet of upland in close proximity to nesting habitat

Source: Anonymous. No date. Wood Duck (Aix sponsa). U.S. Department of Agriculture, Natural Resources Conservation Service, Madison, MS, and Wildlife Habitat Council, Silver Spring, MD. Fish and Wildlife Habitat Management Leaflet. Jamestown, ND: Northern Prairie Wildlife Research Center Online. *http://www.npwrc.usgs.gov/resource/birds/ woodduck/woodduck.htm (Version 16AUG99).*

As in alternative A, we would implement measures to control mute swans, including the removal of adults and the addling of eggs, which would reduce those aggressive, non-indigenous birds and benefit other waterfowl and wetland-breeding birds.

Adverse Impacts
Increasing refuge visitation under alternative B may result in some minor increase in the disturbance of waterfowl by humans near trails, at river crossings, or in watercraft. Because most visitors understand the protection the refuge affords, those incidents should remain rare. We will continue to provide educational materials and adequate signage.

Currently, we allow no hunting on Service-owned lands in the State of New York. However, as we acquire additional lands in that state, we may consider opening them for hunting, based on state regulatory requirements.

As in alternative A, we would allow waterfowl hunting on Service-owned lands in alternative B. Because we propose to expand the refuge by 9,550 acres in this alternative, potentially more lands would be open to hunting than in alternative A. However, the expanded boundary would also provide additional habitat for waterfowl to rest and feed outside the hunting seasons. We predict that the additional number of birds that benefit from an increase in the number of acres we protect would offset the additional number of birds taken in

alternative B. Because the state uses scientific methods to set seasons and bag limits for waterfowl hunting, we do not believe that hunting on the refuge would be detrimental to local or regional populations of waterfowl.

Although we propose to allow dog walking on the Liberty Loop Trail in alternative B, we would require that all dogs be leashed in order to minimize impacts on waterfowl.

Impacts of Alternative C

Benefits
Our long-term management of 523 acres within the current refuge boundary and 559 acres of emergent wetlands in the Papakating Creek and Adjoining North focus areas would benefit migrating waterfowl, but somewhat less than in alternative B. Allowing the seasonally flooded areas of the refuge to succeed to forest would provide long-term benefit for wood duck, hooded merganser and common merganser, because the number of natural nest cavities would likely increase. Areas that are continuously flooded naturally or by beaver-created impoundments would benefit both breeding and migrating waterfowl.

As in alternative B, the measures we would use to control mute swans, including the removal of adults and the addling of eggs, would reduce those aggressive, non-indigenous birds and benefit other waterfowl and wetland-breeding birds.

Because we would not allow waterfowl hunting in this alternative, except for resident Canada geese, it provides the most benefit for waterfowl in terms of providing a refuge free from hunting.

Adverse Impacts
The actions that would adversely affect waterfowl under alternative C include the removal of all water control structures associated with the 335 acres of moist soil management units, which would eliminate our direct management of those areas for the benefit of migrating waterfowl. Either we would allow beavers to maintain those areas, or allow them to revert through succession to natural floodplain environments, which would flood in the same cycles as the other floodplain acreage on the refuge. Their value in supporting migrating waterfowl would likely diminish under beaver management, or would greatly diminish under reversion to floodplain forest. The breeding productivity of the wood duck, hooded merganser, and common merganser at the refuge would also likely diminish through the removal of all nest boxes.

Other than resident Canada geese, no additional waterfowl species would suffer adverse impacts from hunting. Many consider resident Canada geese a nuisance species in many areas, littering parks and golf courses with their feces and eating crops from agricultural fields. Opening the refuge to hunting for that species will help control the resident Canada goose population in the state.

Effects on Shorebirds, Wading, and Waterbirds

We evaluated the management actions we propose in the alternatives for their potential to benefit shorebirds, wading, and waterbirds or their habitat. The benefits we considered included

- acquiring and protecting wetlands within the acquisition boundary and proposed expansion areas
- sustaining or increasing forested floodplains that provide breeding habitat for herons
- restoring refuge hydrology and wetlands that would enhance refuge habitats for breeding or migratory waterfowl

The Wallkill River management alternatives that we evaluated included the potential adverse effects of the

- construction projects that might affect species habitats
- public activities on the refuge that might damage habitat or disturb the species

Impacts that Would Not Vary by Alternative

Benefits
Regardless of alternative selected, the refuge will continue to provide habitat for breeding and migrating shorebirds, wading and waterbirds, although the distribution and acreage of habitat types would vary among the alternatives.

Adverse Impacts
Visitors using the refuge for consumptive and non-consumptive wildlife-dependent uses would continue to cause some minor level of disturbance of those birds at locations where those habitats are near trails or river access points are on the refuge. The uses include hunting, fishing, observing and photographing wildlife, cross-country skiing and snowshoeing.

In studying the effects of human visitation on waterbirds at the J.N. "Ding" Darling National Wildlife Refuge, Klein (1989) found resident waterbirds to be less sensitive to disturbance than migrants were; she also found that sensitivity varied according to species and individuals within species. Ardeids were quite tolerant of people, but were disturbed as they took terrestrial prey; great blue herons, tricolored herons, great egrets, and little blue herons were disturbed to the point of flight more than other birds. Kushlan (1978) found that the need of these birds to move frequently while feeding might disrupt interspecific and intraspecific relationships. In addition, Batten (1977) and Burger (1981) found that wading birds were extremely sensitive to disturbance in the northeastern U.S. Klein (1993) found that as the intensity of the disturbance increased, the avoidance response by the birds increased; she also found out-of-vehicle activity to be more disruptive than vehicular traffic. Freddy et al. (1986) and Vaske (1983) also found the latter to be true. Klein (1989) found gulls and sandpipers to be apparently insensitive to human disturbance; Burger (1981) found the same to be true for various gull species.

However, none of the encounters at the refuge would constitute to any degree a substantial adverse impact on species survival or reproduction. Furthermore, hunting, cross-country skiing and snowshoeing all take place at a time of the year when most of those birds are absent from the refuge.

In addition to causing disturbance, visitors who are fishing may introduce litter and lead sinkers that may harm these birds. The impacts would resemble those discussed above for other refuge users. To prevent lead poisoning the wading birds that use the pond, no lead sinkers will be permitted.

Impacts of Alternative A—Current Management

Benefits
Acquiring and protecting 523 acres of additional non-forested wetlands habitat under alternative A would benefit shorebirds, wading and waterbirds by ensuring that those habitats remain available for the long term.

Adverse Impacts
A 10 percent increase in refuge visitation would elevate the potential for impacts on wetlands and the disturbance of shorebirds, wading and waterbirds. The potential for disturbance from refuge projects would be negligible. Except for developing a parking area at the Wallkill River on Route 565, we plan no construction projects under alternative A.

Under alternative A, we would allow migratory bird hunting, which includes hunting for some species of shorebirds, waterbirds, and wading birds. As we mentioned in the "Waterfowl" section, the Service permits hunting according to state seasons and bag limits. The state uses scientific methods to set seasons and bag limits, to ensure that hunting will not adversely affect local or regional populations.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits

Our management of 3,324 acres of non-forested emergent wetlands would substantively benefit shorebirds, wading, and waterbirds, as well as migrating waterfowl, under alternative B. Areas that are continuously flooded naturally or by beaver-created impoundments would also benefit those species.

USFWS

Wood duck boxes provide nesting habitat for this important species.

Under alternative B, we would implement measures to control mute swans, including the removal of adults and the addling of eggs to reduce those aggressive, non-indigenous birds and benefit other waterfowl and wetland-breeding birds.

Adverse Impacts

Alternative B poses the highest, albeit minimal, risk of visitors affecting wetlands and disturbing shorebirds, wading and waterbirds, because refuge visitation would increase by 15 percent. In addition, alternative B potentially offers the most opportunities for waterfowl hunting, because the refuge boundaries would expand the most in this alternative. Depending on how many acres of land the Service owns, that could result in the largest take of individual shorebirds, wading birds or waterbirds. However, by following state seasons and limits, we would ensure no major adverse impacts on local or regional populations.

Although we propose to allow dog walking on the Liberty Loop Trail in alternative B, we would require that all dogs be leashed, to minimize the impacts on waterfowl.

Impacts of Alternative C

Benefits

Acquiring 523 acres within the current refuge boundary and 559 acres of non-forested emergent wetlands in the Papakating Creek and Adjoining North focus areas would benefit shorebirds, wading, and waterbirds as well as migrating waterfowl, but to a lesser extent than alternative B. Areas that are continuously flooded naturally or by impoundments created by beavers would benefit those species. Allowing the seasonally flooded areas of the refuge to succeed to forest would be of long-term benefit to herons, because ultimately, those areas may provide breeding habitat.

As in alternative B, the measures we would implement to control mute swans, including the removal of adults and the addling of eggs, would reduce those aggressive, non-indigenous birds and benefit other waterfowl and wetland-breeding birds.

This alternative provides no hunting for shorebirds, wading birds or waterbirds. Therefore, it provides the most benefit for those birds during the state hunting seasons.

Adverse Impacts
As was the case for waterfowl, the actions in alternative C that would adversely affect shorebirds, wading and waterbirds include eliminating the management of the 335 acres of moist soil management units. Either we would allow beavers to maintain those areas, or we would allow them to revert through natural succession to floodplain environments that would flood in the same cycles as other floodplain acreage on the refuge. Their value in supporting those birds would likely diminish under beaver management, or would greatly diminish under reversion to floodplain forest.

Allowing natural succession on all refuge grassland areas would likely affect American woodcocks adversely, because those open habitats are important components of their breeding cycle.

Effects on Fisheries

The Wallkill River provides an excellent warmwater fishery for largemouth bass, pickerel, perch, sunfish, and bullhead. Although some of the streams that enter the river have native brook trout populations, the stocking of brown trout by the state stops near Hamburg, N.J., where the river changes from a primarily gravelly bottom to a siltier bottom.

The segments of the Wallkill River that run through the refuge are classified as non-trout waters. However, the upper stretches of several tributaries are considered trout maintenance waters (i.e., capable of supporting stocked trout). Three river tributaries (Franklin Pond Creek, Sparta Glen Brook, and a tributary to the Wallkill in Ogdensburg) support naturally reproducing populations of brook trout (*Salvelinus fontinalis*). Franklin Pond Creek also supports reproducing brown trout (*Salmo trutta*).

We compared the management actions in the alternatives based on their potential to benefit or adversely affect the refuge fishery, including actions to help maintain and improve the water quality of the Wallkill River, the refuge wetlands, and the watershed. We evaluated the benefits of actions that would benefit the fishery by protecting or restoring floodplain functions influenced by vegetation and hydrology, and to otherwise maintain or improve water quality

- acquiring and protecting land that would provide watershed benefits by precluding development and maintaining native vegetation
- retaining floodplain buffer
- protecting or restoring emergent wetlands
- restoring hydrology at bog turtle sites
- improving local hydrology by ditch-plugging or other measures
- controlling impoundment water levels at all seasons to benefit waterfowl and other birds
- improving water quality monitoring for early problem identification, and
- improving cooperation with other landowners to influence water quality in the watershed.

We compared the impacts of these refuge management actions with the potential to cause adverse effects on the fishery by altering refuge hydrology or degrading water quality

- applying herbicides to manage grasslands or invasive species
- grazing livestock to manage bog turtle sites and grasslands
- constructing refuge projects (parking lot), and
- changing recreational use that might lead to contamination by petroleum products.

Impacts That Would Not Vary by Alternative

Benefits
Regardless of which management alternative we select, the Wallkill River fisheries will continue to benefit from Service protection of the part of the watershed that provides good cover, food, and breeding habitat.

Adverse Impacts
Under all the alternatives, prescribed burning, grazing, and hydroaxing to maintain bog turtle habitat may cause short-term, minimal, localized increases in turbidity. Controlling invasive plants with herbicides would not affect fisheries, because the formulation of glyphosate herbicide we would use is not toxic to fish or invertebrates, and quickly adsorbs to suspended and bottom sediments. The malathion insecticide the State of New Jersey uses to control mosquitoes would be toxic to fish and invertebrates. The Service will coordinate any mosquito control with the state to minimize the risks of exposing aquatic species.

Bait-trapping, stocking and fishing competitions would not be permitted. A law enforcement presence would be required to prevent the illegal taking of fish, littering, trespassing, or setting fires.

Impacts of Alternative A—Current Management

Benefits
Acquiring up to 523 acres of additional, non-forested wetland, would result in a total of 1,216 acres of that habitat type within the current acquisition boundary, and would minimally increase the benefits for the Wallkill River fishery.

Adverse Impacts
Because of elevated levels of pollutants, the effects of water quality on aquatic species in the Wallkill River watershed are a concern. Those may increase as the development of land in the watershed lands continues. Over the long-term, the risk of water quality problems that might affect those habitats would be somewhat higher under this alternative than under alternatives B and C, because additional watershed land conservation by the Service would be limited to acquisition within the current refuge boundary.

We will continue to allow fishing as a compatible refuge use, from anywhere along the shoreline accessible by boat, from fishing access points, and at the pond stocked with native fish near the refuge headquarters. Refuge visitors who boat and fish may cause localized, minor, short-term impacts by disturbing the bottom substrate in shallow water or causing minor spills or leaks of petroleum products. In addition, discarded items such as fishing line, lures, and plastic containers present a risk for waterfowl and other birds. Brochures and signage would notify those visitors of proper precautions, including retrieving broken line and lures and carrying out all trash.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits
Expanding refuge ownership and management of wetlands and open water habitat and instituting water quality collaborating and fishing enhancement measures should substantially increase benefits to the refuge fishery under alternative B. Habitat management gains would result in a total of 3,324 acres

of non-forested wetlands within the current and expanded refuge boundaries. We described the effects of collaborating to improve water quality under alternative B in the "Water Quality" section. Measures to enhance fishing include the creel/user census, signage with fishing regulations, additional parking for fishing access, and fishing access in the expansion areas and for persons with disabilities.

Adverse Impacts
Increased access will help accommodate demand for recreational fishing and fishing pressure in the watershed that is likely to increase with increasing visitation and increasing population, and to comply with the Americans with Disabilities Act (ADA). That increased pressure may cause decreases in fish populations of warm water sport fish such as bass. Warm water fisheries are relatively robust, and can absorb a substantial amount of pressure before they begin to degrade. Maintaining adequate cover and diverse aquatic biota, as we designed the refuge habitat-management goals and objectives to do, should ensure the sustainability of the fishery in the long-term.

As in alternative A, refuge visitors who boat and fish may cause localized, minor, short-term impacts by disturbing the bottom substrate in shallow water or causing minor spills or leaks of petroleum products. In addition, discarded items such as fishing line and lures and plastic containers present a risk for waterfowl and other birds. Brochures and signage would notify those visitors of proper precautions, including retrieving broken line and lures and carrying out all trash.

Impacts of Alternative C

Benefits
Alternative C would likely provide benefits to the refuge fishery similar to those in alternative B. Refuge expansion, in terms of protecting additional wetlands and open water habitat, would be lower than alternative B. However, we expect refuge visitation to reduce by 5 percent, rather than increase by 15 percent, a 20-percent difference that is likely to reflect a lower level of fishing pressure and habitat disturbance compared to alternative B.

Adverse Impacts
Adverse impacts would resemble those discussed in alternatives A and B.

Effects on Mammals

The refuge is important regionally in providing large, unfragmented patches of habitat that bobcat and black bear require, and meeting that habitat requirement will remain a Service priority. Other mammals at the refuge—white-tailed deer, muskrat, and woodchuck—are important concerns because they directly affect the ability of the refuge to sustain other wildlife species, or prey on priority bird species, such as wood duck.

We evaluated the alternatives with respect to the degree to which they met the requirements for sustaining or enhancing populations of bobcat, bear and other desirable species, and the degree to which they afforded management measures and opportunities to reduce adverse effects from deer and other mammals.

Impacts That Would Not Vary by Alternative

Benefits
Regardless of which alternative we select, we would continue to provide a natural landscape with required habitats and a refuge from hunting and trapping pressure elsewhere in the region for the game mammal and furbearer species found here. We would also seek to acquire additional lands that, in the long-term, would meet habitat requirements from willing sellers within the current refuge boundary under all the alternatives.

Many landowners regularly suffer property damage by deer. For example, farmers may suffer crop damage, and residential homeowners may suffer ornamental and garden damage. Furthermore, the transmission of Lyme disease becomes a major issue with large numbers of deer. Starvation of individuals is a possibility when deer numbers are high as food supplies dwindle in bad weather, and deer-vehicle collisions become more common and problematic. Heavily browsed vegetation leaves less food and cover habitat for Neotropical migratory birds, a trust resource that the refuge is charged with protecting. Controlled deer hunting keeps the deer population within the carrying capacity of its habitat.

Adverse Impacts
Habitat management activities, such as mowing and using prescribed fire, would likely result in the inadvertent take of individual small mammals, such as mice, moles, and shrews, and cause the temporary disturbance or displacement of others. However, that would cause no major mortality or loss in local populations, because those actions occur on a rotational basis, meaning no major habitat components would change completely in any one year.

Furbearer management through trapping is a useful tool in maintaining the balance on the refuge between furbearers and habitat. High populations of predators can decrease the nesting success of ground-nesting migratory birds, thus compromising one purpose of the refuge. Furbearer populations, with local exceptions, are stable or increasing on refuge lands. The furbearer management program on the refuge does not have any appreciable negative impacts on furbearer populations.

The impacts of furbearer management can be either direct or indirect, and may have negative, neutral, or positive impacts on refuge resources. The indirect impacts may include displacing migratory birds during the pair bonding/nesting season or destroying their nests by trampling them. The direct impacts may include the catch of target and non-target species that are predators on migratory birds or nests, or the removal of species that induce habitat change (e.g., beavers).

Because of the temporal separation of trapping activities from breeding wildlife using the refuge, the indirect impacts of trappers on those resources would be negligible. The trappers using the refuge in early March may disturb individual, early nesting waterfowl on occasion, and cause their temporary displacement from specific, limited areas. Those impacts are occasional, temporary, and isolated in small geographic areas.

The anticipated direct impacts of trapping on wildife would be a reduction of the furbearer population in those areas surplus furbearers inhabit. The removal of excess furbearers from those areas would maintain furbearer populations at levels compatible with the habitat and with refuge objectives, minimize damage to facilities and wildlife habitat, minimize competition with or interaction among wildlife populations and species that conflict with refuge objectives, and minimize the threats of disease in wildlife and humans.

This trapping program would not cause the take of non-target species. The traps will be set around specific areas of targeted species activity to reduce the risk of taking species other than those targeted. The experience of the trappers and the selection of the appropriate trap size will reduce non-target captures (Northeast Furbearer Resources Technical Committee 1996, Boggess et. al 1990).

A national program operating under the guidance of the Fur Resources Technical Subcommittee of the International Association of Fish and Wildlife Agencies

(IAFWA 1998) systematically improves the welfare of animals in trapping through trap testing and developing "Best Management Practices (BMPs) for Trapping Furbearers in the United States." The refuge would cooperate with and contribute to the development and implementation of those BMPs by practicing an integrated, comprehensive approach to furbearer management whenever possible.

Management trapping to remove or eliminate individual depredating mammals, such as feral cats, foxes, raccoons, muskrats, or beavers, also could result in losses in some non-target species (e.g., mink, otter). The town typically removes feral cats from the refuge. No feral dogs are managed and, if present, their numbers are low.

Mammals at the refuge would continue to undergo some minimal level of human disturbance from refuge staff and from visitors, regardless of the alternative. The disturbance of non-target species is likely to occur during hunting seasons. The impacts of allowing hunting may include the disturbance of non-target species in the course of tracking prey, trampling vegetation, creating unauthorized trails, littering, or vandalism and subsequent erosion. The noise of shotguns could cause some disturbance as well.

The direct mortality of deer in hunting would continue, regardless of which alternative is chosen, because we permit deer hunting in all the alternatives. We do not expect deer hunting on the refuge to have a noticeable effect on the local or regional deer population, because deer are abundant in most areas of the northeast, including northern New Jersey. Nevertheless, we will continue to adhere to state seasons, which account for species populations and trends, so no long-term threat to deer populations would arise.

We would review the refuge hunt program annually to ensure that we are achieving our management goals, and to affirm that the hunt program is providing a safe, high quality hunting experience for its participants. We would adjust the dates, bag limits or number of hunters per day each year as needed to achieve balanced wildlife populations within the carrying capacities of the refuge. Members of the public who consider deer hunting unacceptable would continue to have the opportunity to voice their concerns.

Dogs generally are not compatible with managing for wildlife values at the refuge. We will not allow pursuit hounds in support of hunting on the refuge. Hunting areas are small enough that pursuit hounds and the game they are chasing could easily run off the refuge and onto private land. We would continue to allow dog walking only on the Appalachian Trail, which coincides with part of the Liberty Loop Trail. A leash requirement minimizes the impacts on mammals.

Impacts of Alternative A—Current Management

Benefits
Mammalian species would continue to benefit as we continue to manage refuge habitats for the benefit of wildlife under alternative A and as we seek to acquire up to 2,021 additional acres within the current refuge boundary.

Wetland restoration work and sustaining a forested floodplain buffer would continue to provide valuable wildlife corridors, especially for larger mammals moving through the area.

Adverse Impacts
The potential adverse impacts noted above for all the alternatives would pertain to alternative A. Mowing, haying, and prescribed burning would continue to

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Bear management on the refuge is a controversial subject that includes relocation efforts.

result occasionally in the injury or inadvertent take of individual small mammals in grassland management units.

The increased visitation under alternative A will minimally increase the likelihood of humans or wildlife encountering other mammals. Those encounters are unlikely to result in harm to the mammal involved, because most would quickly leave the location. However, those encounters may cause a negative reaction in the visitors. Educational programs, brochures, and signage should keep these problematic encounters a rarity.

Hunter harvest of deer, during state seasons, on Service-owned lands in New Jersey would continue under this alternative. Our deer hunt seasons consist of these dates (based on 2006-07 New Jersey state seasons).

Deer:	
Fall Bow	Sept. 9–Sept. 29
Permit Bow	Oct. 28–Dec. 23 and Dec. 26–Dec. 31
Permit Muzzleloader	Nov. 27, 28 and Dec. 11, 12, 16-23, 26-31 & Jan. 1–5
Six-Day Firearm	Dec. 4–9
Permit Shotgun	Dec. 13–15 and Jan. 6–13
Winter Bow	Jan. 1–31

The average take of deer each year on the refuge is 70 animals. We predict that number would not change under this alternative. All deer hunters are required to check their animals in at a state-administered check station. State biologists track deer harvests throughout New Jersey, and adjust season and bag limits accordingly. The refuge is located in Deer Management Zone 2, where the total deer harvest for 2005–2006 was 2,446 animals. The refuge hunt constitutes a small percentage of the overall annual harvest, and we conclude that hunting under this alternative would have little impact on local or regional deer populations.

The Service would continue to manage beaver and muskrat populations at Liberty Marsh through trapping. We predict a harvest of no more than 20 individuals from each species each year. We would also provide information to private landowners on techniques to control flooding caused by beavers. To the extent practicable, we would use non-lethal means of addressing beaver impacts in areas where they are flooding adjacent landowners or affecting sensitive refuge habitats. We would use lethal means of removing problem animals only when necessary.

Some members of the public would continue to view as inhumane the trapping and removal of muskrat, beaver, and woodchuck. We would continue to use our outreach and education programs to inform the public and landowners nearby about the need for and ecological soundness of hunting and animal damage control measures.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits

Mammals would benefit substantially from refuge expansion under alternative B, because it would improve our ability to provide and maintain habitat for all mammal species. Under alternative B, we would also manage to create a 100-meter mature forest floodplain buffer on both sides of the Wallkill River, and would restore other areas of contiguous forest to serve as movement corridors, particularly for bobcat and black bear. Bats use trees for feeding and roosting.

Only beneficial impacts would result, especially from alternatives B and C, where we would be establishing forested areas larger than in alternative A.

Adverse Impacts
Mowing, haying, and prescribed burning would continue to result in injury of inadvertent take of small mammals in grassland management units. The increased visitation under alternative B would slightly increase the possibility of adverse encounters between humans and other mammals.

Currently, we allow no hunting on Service-owned lands in the State of New York. However, as we acquire additional land in that state, we may consider opening it to hunting, under regulatory requirements.

As we expand the refuge and acquire more land, the areas in which we would permit deer hunting would expand, thereby increasing the potential for controversy concerning the deer harvest. We predict that the number of deer harvested under alternative B would be double the number of deer harvested under alternative A (140 animals), because this alternative would double the refuge boundary. That still constitutes only a small percentage of the total number of deer harvested in State Deer Management Zone No. 2 (2,446 animals). The effects of trapping would likely be similar to those under alternative A.

Also under this alternative, we would open the refuge to bear hunting on Service-owned lands, in accordance with state seasons. Since 1953, the New Jersey Division of Fish and Wildlife (DFW) and the Fish and Game Council (Council) have managed black bear as a game animal. Their status as game animals protected bears from indiscriminate killing and stabilized the population. From 1958 through 1970, limited hunting was legal in 10 seasons, and resulted in a harvest of 46 bears. Based on the data gathered through the regulated hunting seasons, the status of the bear population was assessed, and the Council closed the bear-hunting season in 1971 (Lund 1980). Since the 1980s, the black bear population has increased, and its range has expanded due to the protection afforded them by their status as game animals (NJDEP 2004).

The estimate of the total population of bears in a 580-square-mile sample area in northwest New Jersey was 1,490, or 2.56 bears/sq. mile, at the start of the 2003 bear-hunting season. DFW biologists determined the population in 2005 for the same 580 sq. miles at 1,606, or 2.76 bears per square mile.

Black bears in New Jersey have adapted to live close to people and human development, taking advantage of protected habitats and food sources around humans. Increasing human development and the coincident increase of the bear population has resulted in an increase in conflicts between bears and humans. The expanding interface between human habitat and bear habitat provides the potential for conflict, because individual black bears searching for food throughout their home ranges are encountering humans. Further complicating that issue is recent evidence that the home range of a female black bear in the prime New Jersey habitat (which encompasses the refuge) has decreased in size from an average of 6.5 sq. miles documented in the early 1990s to the present average of 2 sq. miles (NJDEP 2004).

Cooperative studies are ongoing among the New Jersey Division of Fisheries and Wildlife (NJDFW), Rutgers University, and East Stroudsburg University. The analysis of female bears' stomach contents indicates that most are obtaining forage from food sources derived from humans, regardless of whether the individual bear has been classified as a nuisance. The NJDFW research has demonstrated that older females in the 5- to 10-year-old class are consistently

producing litter sizes of 2.7 cubs. Studies also have indicated that bears are beginning to reproduce as early as 3 years of age.

Incidents involving bears damaging property and livestock remain high in frequency and severity. The New Jersey DFW Wildlife Control Unit (WCU) received 1,096 complaint calls in 2001, 1,412 complaint calls in 2002, and 1,308 complaint calls in 2003. Those complaints included raiding garbage bins and bird feeders, attacking humans, entering homes, killing livestock and pets, or destroying beehives and agricultural crops. The damage estimates exceeded $100,000 annually (NJDEP 2004). In addition, the emigration of bears from New Jersey into neighboring Pennsylvania and New York has affected those states. The Pennsylvania Game Commission has extended open hunting seasons in the wildlife management units that have the highest bear densities, and where conflicts have significantly increased. Two of those management units abut northwestern New Jersey, and accounted for 17 percent of Pennsylvania's total 2005 harvest statewide (Penn GC Digest 2006-07).

The State of New Jersey 1997 Black Bear Management Plan (McConnell et al. 1997) recognizes that the cultural carrying capacity had been reached in northern New Jersey, and the bear population was large enough to sustain a limited, regulated hunting season. In 2000, the New Jersey Council amended the Game Code to include a three-segment season for hunting black bears. Its purpose was to reduce the bear population to 350 bears, or 1 bear per 2.5 sq. miles, to reduce the associated conflicts between bears and humans, including property damage.

We believe that a controlled bear hunt is an important management tool that will help maintain the biological and cultural carrying capacity of the black bear population on and around the refuge. The analysis of the results of the 2003 NJDFW-controlled hunt shows that it met its harvest goals, and that the NJDFW can accurately predict the results of the hunt.

In 2003, New Jersey held its first black bear hunt in more than 30 years. Seven thousand hunting permits were issued, and 328 bears were harvested during a one-week season. In 2005, the state held a second bear hunt, during which about 4,000 permits were issued, and 280 bears were harvested. Based on such a success rate, (4.7 percent and 7 percent), the hunt on the refuge, for which we anticipate issuing about 100 permits, would yield a harvest of 4 to 7 bears. The refuge offers good, but not prime, bear habitat, so those numbers may be slightly higher than the actual figures. In addition, much of the refuge is difficult to access, and the challenge of removing the bear could reduce hunter interest, the areas hunted, and success rates.

At most, the refuge could provide habitat for about 20 to 22 bears (8 sq. miles with 2.6 bears per sq. mile). The state, whose guidance the refuge uses in all its hunt programs, aims for a 20-percent reduction in the population after a hunt. Our expectations for the refuge hunt should match those results. With the state estimating the bear population at 900 individuals, we expect our proposed hunt and projected success rate to have no major impact on the local, regional, or state population. At the typical rate of bear reproduction, this level of hunting would not affect the long-term populations. The result would be a stable population of bears on the refuge. With stable replacement rates in the surrounding areas, we do not expect impacts on a larger scale either.

Although we propose to allow dog walking on the Liberty Loop Trail in alternative B, we would require that all dogs be leashed, to minimize impacts on other mammals on the refuge.

Impacts of Alternative C

Benefits
As noted above for alternative B, mammals would also benefit substantially from refuge expansion under alternative C, because of our improved ability to provide and maintain habitat for all mammal species. Alternative C would favor woodland-dependent species, because we would allow early successional habitats to mature.

We would also create a 100-meter mature forest floodplain buffer on both sides of the Wallkill River, and would restore other areas of contiguous forest to serve as movement corridors, in particular for bobcats and black bears. Further, we would allow all refuge lands to succeed to forest in the long-term, thus enhancing their value as movement corridors for larger mammals.

Adverse Impacts
Populations of mammals that inhabit grassland habitats, such as the meadow vole and woodchuck, would decline as we allow grassland to grow to later successional vegetation. Those species are abundant in the farmlands and other grassed areas in the region, so no significant impacts on the species off the refuge would result.

The impacts of deer hunting on deer populations would be similar to those in alternative B, because we would open a similar area for hunting. No other mammals would be hunted under this alternative.

A mature forest canopy would limit the value of refuge lands for providing prey animals for bobcats and the omnivorous diet of bears.

Effects on Reptiles and Amphibians

Wallkill River refuge supports a great diversity of reptiles and amphibians, including one federal-listed species and six state-listed species. The refuge also supports species that are relatively abundant, including the northern redback salamander, northern spring peeper, common snapping turtle, and eastern garter snake. To assess the occurrence, abundance, and health of these species, the refuge has participated in five surveys: (1) the regional anuran call count survey; (2) vernal pool survey; (3) streamside salamander survey; (4) surveys for the New Jersey Herptile Atlas; and (5) malformed frog surveys. Although the latter found malformations, no conclusive evidence shows that the pesticides used nearby in agricultural operations or mosquito control caused them.

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Black snakes are a common refuge resident.

We compared the potential benefits and adverse effects of the alternatives on amphibians and reptiles based on the following:

Benefits
- benefits from land acquisition and refuge expansion
- benefits from measures to improve water quality and restore and maintain wetlands

Adverse Effects
- adverse effects from refuge habitat management actions
- adverse effects from construction or maintenance projects
- adverse effects from visitor activities

Impacts That Would Not Vary by Alternative

Benefits
Regardless of the alternative selected, we would protect and manage the bog turtle and its habitat on refuge lands, as discussed in the section "Endangered and Threatened Species." We would also continue to protect habitat for the state-

listed endangered blue-spotted salamander, the state-listed threatened eastern mud salamander, longtail salamander, wood turtle, northern spring salamander, and spotted turtle, and the eastern box turtle (pending state listing as a species of special concern).

Adverse Impacts
Our actions, such as mowing and prescribed burning to manage habitats and control invasive species may result in the injury or inadvertent take of individual reptiles or amphibians. For example, box turtles would be particularly susceptible, because they range throughout upland habitats and are slow moving.

Anglers must comply with all state and refuge regulations. We do not allow the taking of reptiles and amphibians from the refuge.

Impacts of Alternative A—Current Management

Benefits
Our acquiring 2,021 acres of additional land, including 523 acres of emergent and non-forested wetlands, 356 acres of forested floodplain, and 27 acres of open water, would improve the benefits of long-term protection in alternative A. The improvements in water quality we describe in the section "Water Quality" would also specifically benefit amphibians, because they are highly susceptible to water pollutants. Monitoring vernal pools will help us maintain up-to-date information about the condition of those habitats, which is crucial for breeding amphibians.

Adverse Impacts
Mowing, haying, and prescribed burning in grassland management units would continue to cause the occasional, inadvertent injury or death of individual amphibians and reptiles.

The increased visitation in alternative A will minimally increase the likelihood of human encounters with amphibians and reptiles. Some of those encounters may result in harm to the animal involved or a negative reaction on the part of the visitor. Educational programs, brochures, and signs should keep those problematic encounters rare.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits
Amphibians and reptiles would benefit substantially under alternative B from refuge expansion with protection of a total 16,637 acres on the refuge, including 8,913 acres of forested and non-forested wetland habitat and open water.

We would employ the same measures we discussed in alternative B for collaborating for water quality improvement, and we would expect similar benefits. A new Habitat Inventory and Monitoring Plan will include the monitoring of vernal pools to provide the best available data on these habitats, so crucial for breeding amphibians.

Adverse Impacts
Mowing, haying, and prescribed burning would continue to cause the occasional injury or inadvertent take of individual amphibians and reptiles in grassland management units.

Refuge expansion and increased visitation in alternative B will increase the likelihood of problematic encounters between humans and amphibians or reptiles beyond that described in alternative A. Educational programs, brochures, and signage should minimize any chance of such encounters.

Impacts of Alternative C

Benefits
Amphibians and reptiles would benefit substantially under alternative C from our expanding the refuge to protect 14,691 acres, including 7,990 acres of forested

and non-forested wetland habitat and open water. We would employ the same measures we discussed in alternative B for collaborating to improve water quality, and we would expect similar benefits.

Adverse Impacts
The loss of some individual reptiles and amphibians would continue from methods such as prescribed burning, hydroaxing, and mowing to control invasive plants. However, the prescribed burning, haying, or mowing for grassland management would no longer be a risk, because we would allow all grassland to succeed to later successional stages. That would not affect species populations.

Refuge expansion under alternative C will increase the likelihood of problematic encounters between humans and amphibians or reptiles described in alternative A. However, that likelihood would tend to decrease as visitation and management for mature forested habitat decreases. As in alternatives A and B, educational programs, brochures, and signage should minimize such encounters.

Effects on Invertebrates

The refuge hosts a wide variety of invertebrate species, from the butterflies that populate the grasslands to the mussels that dwell in the river bottoms. That great diversity of form and habitat provides a major portion of the food biomass on which refuge wildlife species depend. A number of invertebrate species are rare or declining in New Jersey or nationally, and are of special management concern. The federal-protected invertebrate species that may be found in the future on the refuge include the Mitchell's satyr butterfly and the dwarf wedge mussel. We address those species in the section "Endangered and Threatened Species."

We compared the potential benefits and adverse effects of the alternatives on invertebrates based on the following:

Benefits
- benefits from land acquisition and refuge expansion
- benefits from measures to improve water quality and restore and maintain wetlands

Adverse Effects
- adverse effects from refuge habitat management actions
- adverse effects from construction or maintenance projects
- adverse effects from visitor activities

Impacts That Would Not Vary by Alternative

Benefits
Regardless of which alternative we select, we would continue to manage our current refuge lands to support diverse ecosystem components, including a wide array of insects, spiders, earthworms, aquatic arthropods, and other invertebrates. Invertebrates are critical food items for insectivorous warblers, bats, moles, shrews, raccoons, fish and a number of other wildlife species. We would not apply chemical insecticides to control insects in any of the habitats on the refuge.

We discuss in the section "Endangered and Threatened Species" the benefits to the federal-listed invertebrates, Mitchell's satyr butterfly and dwarf wedge mussel, which live in Sussex County and may live on the refuge in the future. The improvements in water quality and wetland restoration would benefit populations of aquatic invertebrates in the Wallkill River and elsewhere.

Adverse Impacts
Some losses of invertebrates may continue, for example, ants and earthworms, from the equipment used in prescribed burning, hydroaxing, and mowing to control invasive plants. Those would be minimal, highly localized, and short-term losses, and would not affect invertebrate species populations.

Impacts of Alternative A—Current Management

Benefits
Maintaining up to 632 acres of grasslands under alternative A will benefit native butterfly species. Maintaining emergent wetlands will benefit dragonflies and damselflies.

Adverse Impacts
Burning for grassland habitat management would cause short-term impacts, occasionally resulting in the injury or inadvertent take of insects and other invertebrates on burn sites, but those areas would begin to recover rapidly, and no long-term effects would occur.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits
The refuge expansion under alternative B will benefit invertebrates by bringing additional habitat under Service protection and management. The management of up to 1,381 acres of grasslands in the current refuge and its expansion areas would increase the benefits for native butterfly species. Expanding that protection to more than 3,439 acres of non-forested wetlands and open water habitats would increase the benefits for aquatic insects, crustaceans and other aquatic invertebrates.

Adverse Impacts
Burning for grassland habitat management would cause similar short-term impacts on insects and other invertebrates on the burn sites, as in alternative A.

Impacts of Alternative C

Benefits
The refuge expansion in alternative C will benefit invertebrates by bringing additional habitat under Service protection and management.

Adverse Impacts
We would not burn prescribed fires to manage grassland habitat. We would limit prescribed burning to control invasive species and improve bog turtle habitat. That may also cause short-term impacts, occasionally resulting in the injury or inadvertent take of insects and other invertebrates on burn sites, but those areas would recover rapidly, and no long-term adverse effects would result.

Effects on Public Use and Access

Providing opportunities for compatible public uses, including hunting, fishing, environmental education, interpretation, wildlife observation and photography, is integral in our overall management of the refuge. Those are priority uses of the National Wildlife Refuge System, under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105–57). Other refuge uses that we determine to be appropriate and compatible with our goals in managing the refuge can also provide public benefit, as long as we adequately address any potential conflict with our goals. An appropriate use must be

- under our jurisdiction
- compliant with applicable laws and regulations (federal, state, tribal, and local)
- consistent with applicable Executive orders and Department and Service policies

- consistent with public safety
- consistent with goals and objectives in an approved management plan or other document
- newly proposed or not previously denied
- manageable within available budget and staff
- manageable in the future within existing resources
- contributory to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources
- accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality, compatible, wildlife-dependent recreation into the future

Bassett's Bridge is a popular spot for river access.

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We have conducted appropriateness reviews and compatibility determinations for the following non-priority public uses:

- motorized and non-motorized boating
- dog-walking
- cross-country skiing and snowshoeing
- grazing
- haying
- controlling mosquitoes
- conducting research

We evaluated the impacts of each of the alternatives by considering the extent to which refuge access to pursue priority uses, as well as the opportunities for appropriate and compatible non-priority uses, would stay the same, improve, or diminish.

Impacts That Would Not Vary by Alternative

Benefits

Regardless of alternative, we would continue to allow compatible, wildlife oriented public uses including hunting, fishing, observing and photographing wildlife. We would also continue to allow cross-country skiing and snowshoeing to facilitate wildlife observation and photography in the winter, when access on foot is difficult. We would continue to provide the public with wildlife interpretation and environmental education opportunities. To support public use, we would continue to maintain the refuge facilities including the refuge headquarters, the Owens Station facility, and parking areas, observation platforms, kiosks and trails.

Adverse Impacts

To ensure visitor safety and protect refuge resources, the refuge is open 1 hour before official sunrise to 1 hour after official sunset. Regardless of the alternative, we would not allow night hunting, because of its potential for unsafe encounters between hunters, the increased disturbance of adjacent landowners, and the increased likelihood of poaching and other illegal activities. Permitted hunters can access the refuge 2 hours before sunrise to 2 hours after sunset.

Current restrictions will remain in place in all the alternatives. No horses, no off-road motorized travel, no biking, and no dogs would be permitted, except in the dog-walking area.

Prescribed burning to control invasive plants or manage bog turtle habitat may affect public use temporarily, but the effects should be minimal, because most burn areas are small, we usually burn during seasons of low visitation, smoke disperses readily, and the locations are not near areas of visitor concentration.

Impacts of Alternative A—Current Management

Benefits

Some minimal benefit would accrue to public use and access with the acquisition of up to 2,021 acres of additional land within the current refuge boundaries, because of the additional opportunities provided by Service-managed habitats for hunting, fishing, observing wildlife, cross-country skiing, and snowshoeing. However, public use would remain the same as it is now in alternative A.

Adverse Impacts

Increasing development pressure and the concomitant demand for outdoor recreational opportunities in Sussex County will likely lead to an increase in user conflicts and enforcement issues on the refuge, if we provide no improvements or additional opportunities.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits

The benefits for public users would increase substantially under alternative B. We plan to increase the opportunities for public use in a few areas and improve the quality of existing programs. Opportunities for hunting would expand to include black bear hunting. The quality of the interpretive materials would improve at existing trails. The Wood Duck Nature Trail would expand, providing additional wildlife observation, photography, and interpretation, as well as additional opportunities to cross-country ski and snowshoe. Allowing dog walking on the entire Liberty Loop Trail would improve public safety, because dog owners would be able to walk on the road after using the Appalachian Trail.

In alternative B, a number of construction projects will expand opportunities for the public to participate in wildlife-oriented activities.

The affluent, densely populated communities in the area increasingly seek outdoor recreational activities. The publicity about these improvements would likely increase public use. Rails-to-trails planned for the expansion area, and likely to be owned or managed by the state or another agency, with the potential for other connections to a countywide system of recreational trails, would get moderate to heavy use by bicyclists, rollerbladers, and walkers if they were paved, especially if parking areas are associated with them.

Adverse Impacts
Expanding the refuge, increasing visitation, and increasing the opportunities for compatible, wildlife-oriented, consumptive and non-consumptive uses would combine to increase the risk of conflicts between humans and wildlife and habitat damage. More instances of trespassing are likely, especially in the Papakating Creek expansion areas. The likelihood of minor accidents would be greater, particularly those involving bicyclists and rollerbladers that will require law enforcement assistance on the rail trail. Parking issues will arise during times of heavy use, when lots fill and people try to park in unauthorized locations.

Impacts of Alternative C

Benefits
In general, under alternative C, public use opportunities would remain as they are for the near future. The refuge will provide accessible, high quality opportunities for hunting white-tailed deer and Canada geese on Service-owned lands within the current and expanded refuge boundaries, and will increase fishing opportunities on Service-owned lands within the expanded refuge boundary, both for able-bodied anglers and for anglers with disabilities.

Adverse Impacts
Over the long-term, priority public use opportunities, with the exception of fishing, would diminish, as natural flooding would preclude access to much of the refuge's interior. That would particularly affect hunting opportunities. In a landscape dominated by red maple swamp, opportunities for wildlife viewing and photography would also diminish. A large segment of refuge users likely would not embrace that reduction in the accessibility and feasibility of many of the now compatible uses of the refuge the public enjoys. That might lead to increasing public demand for a change in management direction.

Effects on Cultural and Historic Resources

Rock shelters and open sites show evidence of pre-historic use of the refuge by paleo-Indians. Historic sites are limited to rock weirs used in the eel fishery. No other significant historic use was made of these "drowned lands." Nevertheless, the Service recognizes the importance of continued compliance with the National Historic Preservation Act to ensure that known sites are protected, and any sites that are found in the course of refuge management and public use are properly addressed.

Impacts that Would Not Vary by Alternative

Benefits
Areas with the potential to contain cultural or historic resources would be protected, regardless of which alternative we select. We would not knowingly include any sites on the National Register of Historic Properties in our land acquisition area.

Adverse Impacts
We would take all necessary precautions to ensure that no sites or structures on National Historic register would be affected. As part of our section 106

compliance, we will send this CCP to the N. J. State Historic Preservation Office (SHPO), and all the individual projects will continue to comply with section 106.

Impacts of Alternative A—Current Management

Benefits
The Service protection of 5,065 acres currently and our acquisition of another 2,021 acres within the current acquisition boundary will benefit cultural resources by ensuring that none of the substantial impacts related to development for residential or commercial uses would affect known or undiscovered cultural and historic resources on those lands.

Adverse Impacts
We have surveyed the refuge for cultural and historic properties. There is some risk that refuge visitors may inadvertently or intentionally damage or disturb those sites. We would manage those resources to protect the sites, structures, and objects of importance for scientific study, public appreciation and socio-cultural use by complying with section 106 of the National Historic Preservation Act of 1966, promoting academic research on, or relating to, refuge lands, adding language from the Antiquities Resource Protection Act (ARPA) to appropriate public use materials to warn visitors about illegal looting, and maintaining law enforcement personnel trained in ARPA enforcement.

Impacts of Alternative B—The Service-Preferred Alternative

Benefits
The benefits in terms of protecting historic resources would increase under alternative B with our acquisition and protection of up to 16,637 acres within the current and expanded refuge boundaries, and with the enhanced program proposed under this alternative. We would include cultural resources information in environmental education and interpretation programs to interpret Native American history and prehistory. We would complete the evaluations of historic refuge structures for National Register eligibility, and survey potential prehistoric sites (quarries, living/working areas) and share archaeological information through interpretive programs.

Adverse Impacts
Refuge expansion, increased visitation, and increased opportunities for consumptive and non-consumptive uses would combine to increase the likelihood of the damage or disturbance of cultural and historic resources on the refuge. We would monitor known prehistoric sites on the refuge to protect them from looting and other ARPA violations.

Impacts of Alternative C

The benefits and adverse effects on cultural and historic resources would be similar to those in alternative A. Reducing visitation and allowing the refuge lands to succeed to later stages of vegetation would diminish the likelihood of impacts on those resources.

Summary of Alternatives

Table 4-10 below summarizes the impacts of the alternatives and presents them in comparative form.

Cumulative Impacts

According to the CEQ regulations on implementing NEPA (40 CFR 1508.7), a "cumulative impact" is the impact on the environment that 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 non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

This assessment of cumulative impacts includes the actions of other agencies or organizations if they are interrelated and influence the same environment. This analysis considers the interaction of activities at the refuge with other actions occurring over a larger spatial and temporal frame of reference.

Air Quality
We expect none of the alternatives to have major, cumulative, adverse impacts on air quality locally or regionally in New Jersey or New York. We would expect some short-term, negligible, localized effects on air quality from the air emissions of motor vehicles and motorized boats used by refuge visitors and equipment such as hydroaxes used by refuge staff.

We predict no cumulative impacts on Class I airsheds from our actions. None of the proposed management alternatives would affect visibility due to emission-caused haze at the nearest Class I airshed, Brigantine National Wildlife Refuge. Brigantine is 70 miles distant to the south, and the prevailing wind patterns from the west preclude air emissions from Sussex County reaching that Class I area.

With our partners, we will continue to contribute to improving air quality through cooperative land protection and management of natural vegetation and wetlands. Protecting land from development, which is happening at an increasing rate in New Jersey and New York, and maintaining it in natural upland vegetation or wetlands, ensures that those areas will continue to filter out many air pollutants harmful to humans and the environment.

Water Quality
Restoring disturbed sites and unused roads and trails on acquired lands would produce cumulative benefits for water quality. More intensive measures to restore natural hydrology, such removing culverts, would also produce cumulative benefits under alternatives B and C.

None of the alternatives would produce major, adverse, cumulative effects on water quality. We would use best management practices and measures to control erosion and sediment on construction sites to ensure minimal impacts. Those projects are few in number, and are widely dispersed through the refuge, so their local effects would not be additive.

Socioeconomic Resources
We expect none of the alternatives to have a major adverse cumulative impact on the economy of Sussex County, N.J., or Orange County, N.Y. We expect none of the proposed alternatives to alter substantially the demographic characteristics of the regional community. As a result, no impacts would be associated with changes in the community character or demographic composition.

Implementing alternative B would result in several beneficial impacts for the social communities near the refuge and in the region. We expect the public use of the refuge to increase, thereby increasing the number of visitor days spent in the area and, correspondingly, the level of visitor spending in the region. Also important to the communities around the refuge is our objective of adding 9,550 acres to the refuge boundary, substantially affecting local land use and ownership, as well as extending protection for a large land area and furthering the goals of the Sussex County Open Space Plan. Bringing the current refuge staff up to five employees would also make a small but important contribution to employment and income in the local community.

Carlisle Muck, or black dirt, is a great organic soil for growing wetland plants.

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Physical Resources: Soils and Wetlands
The greatest past, present, and foreseeable future adverse impacts on the soils in the Wallkill River watershed are from development. We will improve watershed soil conditions and minimize site-level soil impacts by acquiring land; restoring the vegetation of developed sites, roads, and trails; employing best management practices on construction sites, collaborating in protecting land with important habitat; and exchanging technical information with landowners throughout the watershed.

We would accomplish that to some degree under alternative A. Under alternatives B and C, we propose a major increase in Service land acquisition and a wide range of restoration and mitigation practices to improve soil conditions on all refuge land in the watershed.

Biological Resources—Protected Habitats and Species
All the alternatives would maintain or improve biological resources on the refuge, in the Wallkill River watershed, and in the Northern Ridge and Valley ecosystem. The combination of our management actions with those of other organizations could result in major, beneficial, cumulative effects by (1) increasing the protection and management for federal-and state-listed threatened and endangered species; (2) improving uplands and wetlands habitats that are regionally declining; and (3) preventing the spread of or reducing invasive plants and animals.

None of the alternatives would produce major, cumulative, adverse effects on biological resources, because the changes in habitat components that we would manage for directly or expect to realize through natural succession would, on balance, be beneficial. Biological resources that we would manage to control, prevent or eliminate, such as invasive plants or mute swans, are not natural

components of the Wallkill River ecosystem, so we would not consider adverse the loss of those biotic components, wherever it occurs.

The impact analysis has looked at each type of hunting allowed on refuge lands, and has discussed the impacts associated with individual hunt programs. Here, we will address the potential accumulated impacts of the hunts.

The following table shows the refuge hunting seasons. The refuge is open to some kind of hunting for eight months of the year, with the exception of Sundays, although our seasons vary slightly with changes in state seasons. During the other four months and on all Sundays, refuge lands are available for visitors to enjoy the other five priority public uses identified in the National Wildlife Refuge System Improvement Act of 1997 without hunting occurring on the refuge.

Table 4.9. Hunting Seasons at Wallkill River National Wildlife Refuge.

	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	Apr	May	June	July
Mig Bird												
Deer												
Turkey												
Bear												

Although hunting seasons occasionally overlap, usually they spread out in space and in time so that accumulating impacts do not occur. For example, deer hunting does not always occur at the same time or in the same location as waterfowl hunting.

The Service staff recognizes that all uses of refuge lands create some impact on refuge wildlife and their habitats. Those refuge uses, taken together, have the potential to create accumulating impacts as the number of uses increases. Because of that potential, refuge uses are limited to those which we have formally determined to be compatible with the purposes for which the refuge was established and the mission of the Refuge System. When we review those formal compatibility determinations (every 10 to 15 years), we will consider possible accumulating affects that may have occurred in succeeding years, and will address them as necessary. We do not expect them to have major impacts.

Cultural Resources
We expect none of the alternatives to have a major, adverse, cumulative impact on cultural resources in New Jersey or New York. Depending on the alternative, beneficial impacts would accrue at various levels, because of the proposed environmental education and interpretation programs and increased field surveys to identify and protect any sites discovered.

Relationship Between Short-Term Uses of the Human Environment and the Enhancement of Long-Term Productivity

This section evaluates the relationship between local, short-term uses of the human environment and maintaining the long-term productivity of the environment. By long-term, we mean that the impact would extend beyond the 15-year planning horizon of this draft CCP/EA.

All of the alternatives strive to maintain or enhance the long-term productivity and sustainability of natural resources on the refuge. The alternatives strive to protect our federal trust species and the habitats they depend on, evidenced by the public use restrictions on access and the prohibition of types of use other than foot traffic and non-motorized boating. The outreach and environmental education in each alternative would encourage visitors to be better stewards of our environment.

The dedication of certain areas for new trails, parking areas, and river access facilities on the refuge represents a loss of long-term productivity on localized areas but, given the comparative refuge land base, we do not consider that a major loss.

In summary, we predict that all the alternatives would contribute positively in maintaining or enhancing the long-term productivity of the environment.

Unavoidable Adverse Impacts

Unavoidable adverse effects are the effects of those actions that could cause significant harm to the human environment, and cannot be avoided, even with measures to mitigate them. All the alternatives would produce some minor, localized, unavoidable adverse effects: for example, the minor, short-term, localized adverse effects of building new parking areas and upgrading trails. Our acquiring land in all the alternatives would cause property tax losses in the towns where we acquired it. Under alternatives A and B, increased visitation could have unavoidable effects. However, none of those effects rises to the level of significance. All would be mitigated, so in fact, no major, unavoidable, adverse impacts would arise in any of the alternatives.

Potential Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be reversed, except perhaps in the extreme long-term or under unpredictable circumstances. An example of an irreversible commitment is an action that contributes to a species' extinction. Once extinct, it can never be replaced.

By comparison, irretrievable commitments of resources are those that can be reversed, given sufficient time and resources, but represent a loss in production or use for a period. An example of an irretrievable commitment is our maintenance of grasslands to benefit grassland birds under alternatives A and B. If for some reason, in the future grassland birds were no longer an objective, those grasslands would gradually revert to mature forest, or plantings could expedite the process.

Only a few actions the alternatives propose would result in an irreversible commitment of resources. One is the construction of the proposed new parking facilities. All the alternatives propose that we continue to pursue that action.

Another irreversible commitment of resources affecting local communities is Service land acquisition. Alternative A limits our acquisition to the current refuge acquisition boundary. Alternatives B and C propose refuge expansion. Once these lands become part of the refuge, it is unlikely they would ever revert to private ownership.

The commitment of resources to maintain the wetlands is small, compared to the benefits derived from the increase in biodiversity. Those wetlands provide nesting, foraging, and migrating habitat for many bird species of conservation concern. They also benefit refuge visitors by providing wildlife observation opportunities.

Table 4.10. Summary impact comparison of the Wallkill River refuge CCP alternatives.

Alternative A Current Management	Alternative B The Service-Preferred Alternative	Alternative C
Air Quality		
Minimal carbon sequestration benefits from continuing to protect 2,863 currently owned forest acres and 795 additional acquired forested acres. Negligible adverse effects from air emissions from prescribed burning 115 acres/year for grassland and bog turtle habitat maintenance and invasive plant control. Negligible increase in vehicle emissions from 10 percent increase in visitation.	Minor increase in carbon sequestration benefits from managing 4,170 acres within the current boundary and 5,590 acres within the expanded boundary. Increased but still negligible adverse effects from particulate emissions from prescribed burning 200 acres/year for grassland and bog turtle habitat maintenance and invasive plant control. Negligible increase in vehicle emissions from 15 percent increase in visitation.	Minor increase in carbon sequestration benefits from managing 5,442 acres of forest within the current boundary and 5,816 acres within the expanded boundary over the next 50+ years. Decreased adverse effects from particulate emissions from prescribed burning 50 acres/year for bog turtle habitat maintenance and invasive plant control. Negligible decrease in vehicle emissions from 5-percent decrease in visitation.
Water Quality		
Minimal water quality benefits from continuing the watershed protection afforded by 5,106 currently owned refuge acres and 2,021 additional acquired acres and from wetland restoration projects. Negligible, short-term, localized stream and river sedimentation from trail and other maintenance and construction projects. No effects from the herbicide glyphosate used for invasive species control.	Minor increase in water quality benefits because we would expand the current acquisition boundary by 9,550 acres, thus increasing the potential for watershed protection. Negligible, short-term, localized stream and river sedimentation from trail and other maintenance and construction projects. No effects from the herbicide glyphosate used for invasive species control.	Minor increase in water quality benefits because we would expand the current acquisition boundary by 7,609 acres, thus by increasing the potential for watershed protection. In addition, wetland restoration projects and allowing grasslands to succeed to forest will improve water quality. Negligible, short-term, localized stream and river sedimentation from trail and other maintenance and construction projects. No effects from the herbicide glyphosate used for invasive species control.
Socioeconomics		
Local communities benefit from $850,000 of annual visitor spending and $55,000 in federal revenue sharing payments.	Local communities' benefits increased to $890,000 in annual visitor spending and $133,000 in federal revenue sharing payments.	Local communities' benefits decrease to $736,000 in annual visitor spending but increase to$107,000 in federal revenue sharing payments.
Soils		
Substantive soil benefits from continuing the protection afforded by 5,106 currently owned refuge acres and up to 2,021 additional acquired acres within the current refuge boundary. Minor, short-term, localized soil compaction and erosion from trail and other maintenance and construction projects and from prescribed fire used to maintain grassland and bog turtle habitat.	Increased soil benefits from continuing the protection afforded by 5,106 currently owned refuge acres and expanding the refuge boundary by 9,550 acres. Minor, short-term, localized soil compaction and erosion from trail and other maintenance and construction projects and from prescribed fire used for grassland and bog turtle habitat maintenance and invasive plant control.	Substantial soil benefits from continuing the protection afforded by 5,106 currently owned refuge acres and expanding the refuge boundary by 7,609 additional acres. Minor, short-term, localized soil compaction and erosion from trail and other maintenance and construction projects and from prescribed fire used for bog turtle habitat maintenance and invasive plant control.

Emergent and Non-Forested Wetlands		
Benefits from managing 1,216 acres of emergent wetlands including 335 acres of moist soil unit acres and 523 acres of newly acquired emergent and non-forested wetlands. Additional benefits from wetlands restoration. Negligible impacts from minimal parking lot and road runoff of petroleum products or other chemicals because of filtering buffer vegetation.	Increased benefits from managing 1,420 acres of emergent and non-forested wetlands within the current boundary and a potential 1,904 acres in the expanded boundary. Negligible impacts from minimal parking lot and road runoff of petroleum products or other chemicals because of filtering buffer vegetation.	Benefits limited compared to alternatives A and B from management of 1,082 acres of emergent and non-forested wetlands. Additional benefits from wetlands and hydrology restoration. Negligible impacts from minimal parking lot and road runoff of petroleum products or other chemicals because of filtering buffer vegetation.
Forested and Upland Vegetation		
Benefits from 999 acres of scrub-shrub habitat, 632 acres of grasslands, and 1,560 acres of upland forest protected and managed. Some risk of short-term negligible localized impacts on these habitats from prescribed burning, hydro-axing, and other management practices.	Increased benefits from 1,708 acres of scrub-shrub habitat, 1,381 acres of grasslands, and 4,286 acres of upland forest protected and managed within the current and expanded refuge boundaries. Some risk of short-term negligible localized impacts on these habitats from prescribed burning, hydro-axing, and other management practices.	Grassland habitats allowed to succeed to shrub and forest habitats. Natural causes would leave about 463 acres in grasses. Up to 1,488 acres of scrub-shrub and 4,444 acres forested upland protected in the long term with minor areas of shrub. Some risk of short-term negligible localized impacts on those habitats from prescribed burning, hydro-axing, and other management practices.
Endangered and Threatened Species		
Protecting one known and two potential bog turtle sites on current refuge lands and acquiring one known site on private land within current acquisition boundary would continue to be a management priority. Surveying, monitoring, poaching prevention, and coordination with Recovery Team, NJ, NY, and conservation partners would continue. Would survey for dwarf wedge mussel and develop recovery plan tasks if found. Minor, localized soil and water quality effects from livestock grazing, mowing, and hydroaxing used to maintain bog turtle habitat.	Substantial upgrade in refuge bog turtle recovery by continuing all efforts in alternative A plus acquiring and managing up to 10 bog turtle Population Analysis Sites on expansion lands. Would possibly restore HQ pond site and create bog turtle habitat at other favorable sites. Would expand surveys to include dwarf wedge mussel, Indiana bat, and Mitchell's satyr butterfly, and develop and implement recovery plan tasks when necessary. Increase in minor, localized soil and water quality effects from grazing, mowing, and hydro-axing to maintain all current and additional bog turtle habitat.	Substantial upgrade in refuge bog turtle recovery by continuing all efforts in alternative A plus acquiring 2 of 4 expansion land focus areas and managing up to 10 bog turtle Population Analysis Sites. Would expand surveys to include dwarf wedge mussel, Indiana bat, and Mitchell's satyr butterfly. Increase in minor, localized soil and water quality effects from grazing, mowing and hydro-axing to maintain all current and additional bog turtle habitat.

Landbirds			
Continued management of our current lands and acquisition of habitat within the refuge boundary would ensure protection of 7,086 acres of grassland, shrubland, and forested habitat for bird species. Short-term localized impacts on bird habitat and temporary displacement of birds from management practices such as haying, mowing, and prescribed burning and hydroaxing for grassland management or invasive plant control.	This alternative would be most beneficial to refuge birds by ensuring protection of 12,849 acres of grassland, shrubland, and forest within the current and expanded acquisition boundaries. Methods used to maintain or restore habitats or control invasive species may adversely affect individual birds by temporary displacement and seasonal loss of their specific habitat. Effects short-term and highly localized should not affect any species populations. Measures would not be employed during the major portion of the nesting season, so adverse impacts on bird reproduction would not occur. Habitat improvements and control of invasive plants would benefit birds in the longer-term.	Refuge expansion would generally benefit the Cerulean warbler and Louisiana water thrush and other forest floodplain and riparian forest dependent bird species by managing for and ensuring protection of these habitats in the long-term. Grassland birds would be adversely affected under alternative C because their habitat would not be maintained on the refuge but rather will be allowed to progress through natural stages of vegetative succession, ultimately to mature forest. Methods used to manage other habitats and control invasive species may adversely affect individual birds but no species populations would be affected.
Waterfowl			
Continued benefits to waterfowl from managing 335 acres of moist soil units and protecting natural wetlands and open water. Minor increase in benefits to migratory waterfowl from acquiring up to 523 acres of non-forested wetlands and 27 acres of open water within current acquisition boundary. Mute swan control measures would improve conditions for native waterfowl survival and reproduction. A 10 percent increase in refuge visitation may minimally increase human disturbance of waterfowl near trails, at river crossings, or in watercraft. Visitor education and adequate signage should keep these encounters rare.	Alternative B would provide the greatest benefits to migratory and breeding waterfowl. We would manage 3,324 acres of non-forested wetlands within the current and expanded boundaries, including 335 acres of moist soil units. A 15 percent increase in refuge visitation may result in some minor increase in human disturbance of waterfowl near trails, at River crossings, or in watercraft.	Alternative C would be the least beneficial of the alternatives because we would reduce management of non-forested wetlands to 1,082 acres including expansion areas. Allowing seasonally flooded areas to succeed to forest would provide long-term benefit to wood duck, hooded merganser and common merganser because natural nest cavities would increase. Areas flooded naturally or by beaver would benefit breeding and migratory waterfowl. Removal of all water control structures associated with the 335 acres of moist soil management units, which would eliminate our direct management of these areas for the benefit of migrating waterfowl. Their value in supporting migrating waterfowl would likely diminish with beaver or would greatly diminish with reversion to floodplain forest. The breeding productivity of the wood duck, hooded merganser, and common merganser at the refuge would also likely diminish through removal of all nest boxes.

Shorebirds, Wading Birds, and Waterbirds		
Acquisition and protection of additional wetlands habitat under alternative A would increase benefits to shorebirds, wading and waterbirds by ensuring these habitats exist for the long-term. 10 percent increase in refuge visitation would minimally elevate the potential for impacts on wetlands and disturbance to shorebirds, wading and waterbirds. Except for developing a parking area at the Wallkill River on Route 565, we plan no construction projects under alternative A, so disturbance would be highly unlikely.	Managing 3,324 acres of non-forested wetlands would substantively benefit shorebirds, wading, and waterbirds as well as migrating waterfowl under alternative B. Areas that are continuously flooded naturally or by beaver-created impoundments would benefit these species. Control of mute swans, including removal of adults and addling of eggs, would benefit other waterfowl and wetland breeding birds by reducing these aggressive non-indigenous birds. Alternative B poses the highest, albeit still minimal, risk of wetland impacts and disturbance to shorebirds, wading and waterbirds from refuge construction projects and from visitors, which would increase by 15 percent.	Reducing management of non-forested wetlands to 1,082 acres would reduce benefits to shorebirds, wading, and waterbirds. Areas that are continuously flooded naturally or by beaver-created impoundments would benefit these species. Allowing the seasonally flooded areas of the refuge to succeed to forest would be of long-term benefit to herons because these areas may ultimately provide breeding habitat. Control of mute swans would benefit other waterfowl and wetland breeding birds. Eliminating management of the 335 acres of moist soil management units would reduce benefits. Their value in supporting these birds would likely diminish with only beaver management or would greatly diminish with reversion to floodplain forest. Allowing natural succession on all refuge grasslands would likely affect the American woodcock population adversely, because those open habitats are important components of their breeding cycle.
Fisheries		
Acquisition of 550 additional acres and conservation of a resulting total of 1,243 acres of non-forested wetland and open water habitat under alternative A would minimally increase benefits to the Wallkill River fishery. Long-term risk of water quality problems that might affect these habitats would be somewhat higher under this alternative than under alternatives B and C because additional watershed land conservation would be limited to land acquisition within the current refuge boundary.	Managing up to 3,324 acres of non-forested wetlands and 115 acres of open water within the current and expanded boundaries, and collaborating to improve water quality, should substantially increase benefits to the refuge fishery. A creel/user census; signage with fishing regulations, adding parking for fishing access, and providing fishing access in the expansion areas and for disabled persons would enhance fishing. Increased pressure may begin to cause decreases in fish populations of warm water sport fish such as bass. Warm water fisheries are relatively robust and can absorb a substantial amount of pressure before the fishery begins to degrade.	Benefits to refuge fishery similar to alternative B. Refuge expansion in terms of protecting additional wetlands and open water habitat would be lower than alternative B. However, we expect refuge visitation to decrease by 5 percent rather than increase by 15 percent, a 20 percent difference that is likely result in a lower level of fishing pressure and habitat disturbance compared to alternative B. Adverse impacts would be similar to those discussed for alternatives A and B.

Fisheries (cont'd)		
Refuge visitors who boat and fish may cause localized, minor, short-term impacts by disturbing the bottom substrate in shallow areas or causing minor spills or leaks of petroleum products. In addition, discarded items such as fishing line and lures and plastic containers present a risk to waterfowl and other birds. Brochures and signage would notify these users of proper precautions, including retrieving broken line and lures and carrying all trash out.	Refuge visitors who boat and fish may cause localized, minor, short-term impacts by disturbing the bottom substrate in shallow areas or causing minor spills or leaks of petroleum products. In addition, discarded items such as fishing line and lures and plastic containers present a risk to waterfowl and other birds. Brochures and signage would notify these users of proper precautions, including retrieving broken line and lures and carrying all trash out.	
Mammals		
Mammalian species would benefit as we continue to manage refuge habitats for wildlife under alternative A and as we seek to acquire up to 2,021 additional acres within the current refuge boundary. Wetland restoration work and sustaining a forested floodplain buffer would continue to provide valuable wildlife corridors, especially for larger mammals moving through the area. Mowing, haying, and prescribed burning would continue occasionally to result in injury or inadvertent take of individual small mammals in grassland management units. Increased visitation would minimally increase the likelihood of human/wildlife encounters with mammals but unlikely to result in harm to the animal involved because most mammals would quickly leave the location. Educational programs, brochures, and signage should keep these problematic encounters a rarity. Some members of the public would continue to view as inhumane the harvest of deer and trapping of muskrat, beaver, and woodchuck. Public and landowner outreach would address these issues.	Benefits to mammals would substantively increase from land acquisition and refuge expansion, which would improve the Service's ability to maintain habitat for all mammal species. We would also manage to create a 100-meter mature forest floodplain buffer on both sides of the Wallkill River and would restore other areas of contiguous forest to serve as movement corridors, in particular for bobcat and black bears. Mowing, haying, and prescribed burning would continue occasionally to result in injury or inadvertent take of individual small mammals in grassland management units. Increased visitation under alternative B would slightly increase the possibility of adverse encounters between humans and mammalian wildlife. We would open the current refuge to black bear hunting and increase the amount of area open for deer hunting through a refuge expansion, thereby increasing the potential for controversy concerning bear and deer harvest. Trapping controversy would likely be similar to any seen under alternative A.	Mammals would benefit substantively from refuge expansion under alternative C because of our improved ability to provide and maintain habitat for all mammal species. Woodland dependent species would be favored because we would allow a large amount of earlier successional habitats to mature. We would also manage to create a 100-meter mature forest floodplain buffer on both sides of the Wallkill River and would restore other areas of contiguous forest to serve as movement corridors, in particular for bobcat and black bears. Further, we would allow all lands to succeed to forest in the long-term thus enhancing their value as movement corridors for larger mammals. Populations of mammals, such as the meadow vole and woodchuck, which favor grassland habitats would decline as we allow grasslands to grow to later successional vegetation. These species are abundant in the farmlands and other grassed areas nearby in the Region so there would be no major impacts on the species off the refuge. The value of refuge lands for providing prey animals for bobcat and the omnivorous diet of bears would be limited under a mature forest canopy.

Amphibians and Reptiles			
Service acquisition of 2,021 additional acres, including 523 acres of emergent and non-forested wetlands, 356 acres of forested floodplain, and 27 acres of open water would improve the benefits of long-term protection in alternative A. Improvements in water quality described in the Water Quality section would also specifically benefit amphibians, because they are known to be highly susceptible to water pollutants. Vernal pool monitoring will help maintain up-to-date information about the condition of these critical amphibian breeding habitats. Mowing, haying, and prescribed burning would continue occasionally to result in injury or inadvertent take of individual amphibians and reptiles in grassland management units. Increased visitation under alternative A will minimally increase the likelihood of human/wildlife encounters with amphibians and reptiles. Some of these encounters may result in harm to the animal involved or a negative reaction on the part of the visitor. Educational programs, brochures, and signage should keep these problematic encounters a rarity.	Amphibians and reptiles would benefit substantially under alternative B from refuge expansion and the protection of 16,586 total refuge acres, including more than 8,913 acres managed as forested and non-forested wetland habitat and open water within the current and expanded boundaries. We would employ he same measures discussed in alternative B for collaborating in improving water quality, and would expect similar benefits. A new Habitat Inventory and Monitoring Plan will include monitoring of vernal pools to provide the best available data on these critical amphibian breeding habitats. Mowing, haying, and prescribed burning would continue occasionally to result in injury or inadvertent take of individual amphibians and reptiles in grassland management units. Refuge expansion and increased visitation under alternative B will increase the likelihood of problematic human/wildlife encounters with amphibians and reptiles as described under alternative A. Educational programs, brochures, and signage should minimize any chance of such encounters.	Amphibians and reptiles would substantially benefit under alternative C from a refuge expansion and from managing 7,990 acres as forested and non-forested wetland habitat and open water within the current and expanded boundaries. We would employ the same measures discussed in alternative B for collaborating in improving water quality, and would expect similar benefits. There would continue to be some losses of individual reptiles and amphibians from methods, such as prescribed burning, hydroaxing, and mowing to control invasive plants. However, prescribed burning, haying, or mowing for grassland management would no longer pose risks to reptiles or amphibians because we would allow all grassland areas to succeed to later successional stages. Species populations would not be affected. Refuge expansion under Alternative C will increase the likelihood of problematic human/wildlife encounters with amphibians and reptiles as described under alternative A, but decreased visitation and management for mature forested habitat would tend to decrease that likelihood. As with alternatives A and B, educational programs, brochures, and signage should minimize the chances of such encounters.
Invertebrates			
Maintaining up to 632 acres of grasslands under alternative A will benefit native butterfly species. Maintenance of emergent wetlands will benefit dragonflies and damselflies. Burning for grassland habitat management would cause short-term impacts, potentially resulting in inadvertent take of insects and other invertebrates on burn sites, but these areas would begin to recover rapidly and no long-term effects would occur.	Refuge expansion under alternative B will benefit invertebrates by bringing additional habitat under Service protection and management. Management of up to 1,381 acres of grasslands in current and expansion areas would increase benefits to native butterfly species. Expanding protection to 3,439 acres of non-forested wetlands and open water habitats would increase benefits to aquatic insects, crustaceans and other aquatic invertebrates. Burning for grassland habitat management would cause similar short-term impacts, to insects and other invertebrates on burn sites, as under alternative A.	Refuge expansion under alternative C will benefit invertebrates by bringing additional habitat under Service protection and management. There would be no burning for grassland habitat management. Burning would be limited to invasive species control and bog turtle habitat improvement, which may cause short-term impacts, including injury or inadvertent take of insects and other invertebrates, on burn sites but these areas would begin to recover rapidly and no long-term effects would occur.

Public Use and Access		
Acquisition of up to 2,021 acres within the current refuge boundary would increase opportunities for hunting, fishing, and wildlife observation. However, the types of public uses would remain the same as they are now. Increasing development pressure and concomitant demand for outdoor recreational opportunities in Sussex County will likely lead to an increase in user conflicts and enforcement issues on the refuge if we provide no improvements or additional opportunities.	Benefits to public users would substantively increase because we would prove more opportunities for public use, and would improve the quality of existing programs. The refuge would be open to black bear hunting and more lands would be open with the expanded boundary. We would improve the interpretive materials at existing trails. The Wood Duck Nature Trail would expand, providing additional wildlife observation, photography, and interpretation opportunities, and 10 new construction projects would expand opportunities for the public to participate in wildlife-oriented recreation. Refuge expansion, increased visitation, and increased opportunities for consumptive and non-consumptive uses would combine to increase the risk of human-wildlife conflicts and habitat damage, instances of trespassing, especially in the Papakating Creek expansion areas, minor accidents that will require law enforcement assistance on the rail trail, and parking issues during times of heavy use.	Public use opportunities would decrease, as the refuge would be open only for white-tail deer and resident Canada goose hunting. The expanded boundary would offer more opportunities for fishing. Over the long-term, priority public use opportunities, except fishing, would decrease, as natural flooding would preclude access to much of the interior portions of the refuge. This would particularly affect hunting opportunities. Eventually, with a red maple swamp dominated landscape, opportunities for wildlife viewing and photography would also decrease. A large segment of refuge users would not likely embrace that reduction in accessibility and feasibility of many of the now compatible uses. That would probably lead to increasing public demand for a change in management direction.
Cultural and Historic Resources		
Protecting 5,065 current and 2,021 acquired acres will benefit cultural resources by ensuring that impacts related to development would not affect known or yet undiscovered cultural or historic resources on those lands. Warning visitors about illegal looting, maintaining law enforcement personnel trained in ARPA enforcement, and distributing appropriate public use materials to educate them about these resources would address risk of visitors inadvertently or intentionally damaging or disturbing cultural sites.	Benefits increase with acquisition and protection of up to 16,586 acres and enhanced program including cultural resources information in environmental education and interpretation programs to interpret Native American history and prehistory. We would complete evaluations of historic refuge structures for National Register eligibility and survey potential prehistoric sites (quarries, living/working areas) and share archaeological information through interpretive programs. Refuge expansion, increased visitation, and increased opportunities for consumptive and non-consumptive uses would combine to increase the likelihood of damage or disturbance of cultural and historic resources on the refuge. We would monitor known prehistoric sites on the refuge to protect from looting and other ARPA violations.	Benefits and adverse effects to cultural and historic resources would be similar to alternative A. Reduced visitation and allowing the refuge lands to succeed to later stages of vegetation would diminish the likelihood of impacts on these resources.