

## Chapter 4



USFWS

*Royal terns roosting along oceanfront beach*

## Environmental Consequences

## Summary

This chapter predicts the foreseeable impacts of implementing the management strategies in each of the alternatives in Chapter 2. When detailed information is available, scientific and analytical comparisons are presented among the alternatives. When detailed information is unavailable, comparisons are based on professional judgment and experience. Both direct and indirect impacts are provided within the 15-year planning time frame; beyond that time frame they become more speculative.

The Refuge comprises approximately two percent of the area within extreme southeast coastal Virginia, and a miniscule area within the Albemarle Sound/Pamlico Sound watershed to the south in northeast North Carolina. The total acreage of the Refuge is also incredibly small in comparison with the entire Atlantic Flyway or the breeding ranges of the many birds that use it.

Back Bay NWR is not isolated ecologically from the surrounding land and water. However, because the analysis of impacts focuses mainly on the Refuge, it may not fully discuss the influence of the surrounding landscape on their duration and extent. Positive or negative impacts in that larger geographic context may have been understated. Nevertheless, many of the actions proposed conform with other plans identified in Chapter 1, and provide positive, incremental contributions to those larger landscape goals. A matrix at the end of this chapter summarizes the consequences of each alternative by topic.

Categorical exclusions are classes of actions which do not individually or cumulatively have a significant effect on the human environment, and are specifically detailed in 516 DM 8.5(B) and 43 C.F.R. Sections 46.210 and 46.215. Categorical exclusions apply except in exceptional circumstances (43 C.F.R. § 46.215). The following list of management activities are not analyzed in detail in this document because they would qualify for categorical exclusion under applicable regulations if independently proposed, and are trivial in effect or common to all alternatives.

- 1) conducting environmental education and interpretation programs (unless major construction is involved, or a significant increase in visitation is expected);
- 2) researching, inventorying resources, or otherwise collecting resource information;
- 3) operating and maintaining infrastructure and facilities (unless major renovation is involved);
- 4) recurring, routine management and improvements;
- 5) constructing small projects (e.g., fences, berms, small water control structures, interpretive kiosks) or developing access for routine management;
- 6) planting native vegetation;
- 7) changing minor amounts or types of public use;
- 8) prescribed burning and fire management activities;
- 9) issuing new or revised management plans when only minor changes are planned; and,
- 10) enforcing federal laws or policies.

## Physical Environment

The Affected Environment (Chapter 3) includes sections on location, climate, topography, geology, groundwater, soils, fire, and contaminants within the physical environment description. No impacts are anticipated for these topics, and will not be further addressed.

## Surface Waters, Water Quality, and Wetlands

### Impacts that would not vary by Alternative

Because the following management actions that could affect surface waters, water quality and wetlands will vary more as a matter of degree in each alternative, the similar beneficial and adverse impacts are discussed here.

We continually evaluate the potential to restore hydrology of lands that previously were drained for agriculture or other purposes on new and existing properties of the refuge. Once the hydrology is restored, wetland plants typically emerge without any planting necessary. Those wetlands then act as sponges, soaking up storm water and allowing it to percolate slowly into the ground rather than quickly running off into the nearest stream. That function can replenish ground water supplies and reduce the amount of sediments and nutrients that would have ended up in adjacent waters. As we acquire new properties, we will assess their potential for wetland restoration.

As the EPA notes, “Invasive species effects on water resources can be direct, as in the case of many aquatic nuisance species, or indirect, as in terrestrial species that change water tables, runoff dynamics, fire frequency, and other watershed attributes that in turn can alter water body condition” (<http://www.epa.gov/owow/watershed/wacademy/acad2000/invasive.html>).

One invasive species that affects hydrology is the common reed (*Phragmites australis*). Able, et al. (2003) found that as *Phragmites* invasions proceed, the marsh surface where they grow becomes more altered (flatter, more elevated, and with reduced standing water and water-filled depressions. That, in turn, can affect marsh functions negatively as nursery, feeding, and reproduction areas for fish. The refuge has taken an aggressive stand on controlling *Phragmites*, on both refuge land and private land in the Back Bay watershed. By keeping populations of *Phragmites* in check, we would continue to have a beneficial impact on marsh hydrology and ecological functions.

In managing the refuge, we would monitor closely and mitigate all of our routine activities that have some potential to result in the chemical contamination of water directly through leaks or spills, or indirectly through soil runoff. Those include the use of motorized watercraft, the control of weeds and insects around structures, the use of chemicals for de-icing roads and walkways, the concentrations of herbicides at locations where we clean spraying equipment, and the use of soaps and detergents for cleaning vehicles and equipment. Our personnel would take precautions to minimize the potential for the chemicals and petroleum products from becoming a water quality problem.

Regardless of the alternative selected, we would continue to aggressively identify and control invasive plant species before they cause large changes on the landscape. That “early detection – rapid response” approach can succeed in preventing much larger problems later on. We will use integrated pest management, which employs a variety of cultural, mechanical, biological, and chemical means of controlling unwanted plants, but our experience to date suggests that the use of herbicides will continue to be part of our invasive species control program.

The level of review that Service policy requires before we can apply any chemical on a refuge ensures that the environmental risk is minimized and that all facets of the proposed use have been examined and justified. Few of the herbicides we use on the refuge are labeled for use in aquatic areas, the exception being some formulations of glyphosate and imazapyr to control *Phragmites*. We follow all of the precautions listed on the labels to minimize impacts on ground and surface waters. When used appropriately, those products should not have direct or indirect negative impacts on water quality or hydrology.

Potential, concentrations of herbicides in low areas could build up to chronic levels over time. That potential depends on the balance of pesticide input and removal from the aquatic system. Herbicide inputs may occur through direct application, water inflow, or resuspension and diffusion from the sediment layer, volatilization, and settling or diffusion into the underlying sediment (Neitsch, et

al. 2001). Although we do not expect that effect on the refuge, because of the low volumes we are applying and the other precautions we are taking, our monitoring of sensitive species such as amphibians should give us early warning if problems were to arise.

#### *Climate Change*

In January 2001, the U.S. Department of the Interior issued an order requiring federal agencies, under its direction, that have land management responsibilities to consider potential climate change impacts as part of long range planning endeavors.

Climate change is defined as a change in the state of the climate characterized by changes in the mean and/or the variability of its properties, persisting for an extended period, typically decades or longer (IPCC 2007a). The change in climate has been attributed to the increase in carbon dioxide (CO<sub>2</sub>) and other greenhouse gases in the Earth's atmosphere, due in large part to human activities such as fossil fuel burning, agriculture, and land use change.

#### *Effects of Climate Change*

Rising sea levels are one of the most certain consequences of climate change (Titus and Narayanan 1995). Sea-level rise is expected to accelerate by two to five times the current rates due to both ocean thermal expansion and the melting of glaciers and polar ice caps. Impacts from sea-level rise include: land loss through submergence and erosion of lands in coastal areas; migration of coastal landforms and habitats; increased frequency and extent of storm-related flooding; wetland losses; and increased salinity in estuaries and coastal freshwater aquifers (US EPA 2009). In addition, patterns of precipitation and evaporation may be altered, leading to more severe weather, shifts in ocean circulation (currents, upwelling), as well as adverse impacts to economies and human health (OPIC 2000, IPCC 2001b, Buddemeier et al. 2004, IPCC 2007a). At the species level, climate change could lead to behavioral changes (especially regarding breeding habits), range shifts in response to changing climatic and habitat conditions, and possible species extinction for small, specialized populations (Bedoya et al. 2008).

#### *Climate Change in Back Bay*

Sea level rise is currently causing salt water intrusion into estuaries and threatened freshwater resources in parts of the mid-Atlantic region (Barlow 2003). A 2008 SLAMM (Sea Level Affecting Marshes Model) analysis by the National Wildlife Federation (NWF) used GIS models to predict sea level rise for the next 100 years. The model for Back Bay determined that a rise of 27.2 inches by 2100 would cause major changes to the ecosystem makeup of the refuge. Estuarine open ocean habitat cover would increase from 38% to 77% of the refuge, while other habitats, including undeveloped dry land, inland freshwater marshes, and salt marsh, would decrease in percent coverage of the refuge (Glick et al. 2008).

Back Bay Wildlife Refuge's coastal location is an important variable in predicting the impact of climate change in the near future. Rising sea levels would increase erosion rates of coastal beaches, thereby reconfiguring coastal shorelines and dune profiles. This could threaten species such as the loggerhead sea turtle that depend on the refuge beach. The inundation of coastal wetlands could change wetland community composition and push stressed wetland ecosystems further inland (Bedoya et al. 2008). Salinization of waters as sea levels rise could have a large impact on the oligohaline (low salinity) estuary system of Back Bay.

#### *Climate Change in Planning*

In relation to comprehensive conservation planning for national wildlife refuges, carbon sequestration constitutes the primary climate-related impact to be considered in planning. The U.S. Department of Energy's "Carbon Sequestration

Research and Development” defines carbon sequestration as “...the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere.” The report’s conclusions noted that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere. Conserving natural habitat for wildlife is the heart of any long-range plan for national wildlife refuges. The actions proposed in this CCP would conserve or restore land and habitat, and would thus retain existing carbon sequestration on the Refuge. This in turn contributes positively to efforts to mitigate human-induced global climate change. Prescribed burning for ecosystem management and invasive species control is considered a beneficial strategy because carbon emitted during burning is offset by carbon sequestered in new plant growth.

Other impacts of climate change that may need to be studied and addressed in the future include:

- Habitat available for cold water fish such as trout and salmon in lakes and streams could be reduced.
- Forests may change, with some species shifting their range northward or dying out, and other trees moving in to take their place.
- Ducks and other waterfowl could lose breeding habitat due to stronger and more frequent droughts.
- Changes in the timing of migration and nesting could put some birds out of sync with the life cycles of their prey species.
- Animal and insect Species historically found farther south may colonize new areas to the north as winter climatic conditions moderate

#### **Alternative A—No-Action Alternative**

The No-Action Alternative would maintain the status quo on routine activities that currently manage the surface waters and wetlands of the Refuge. This alternative would not manage and reduce boat and personal watercraft traffic that adversely affects water quality and SAV. There would be continued leasing to local farmers of approximately 100 acres of upland and prior-converted wetlands for growing corn and soybean crops. Such leasing would continue to present the potential for violations of Refuge farming permits’ best management practices (BMPs), involving soil disturbances inside the 15’ buffer (adjacent to ditches that transport water off-site into the watershed), which provide added potential for silt, nutrient and pesticide transport into the Back Bay watershed and Back Bay proper. These prior-converted wetlands would remain farmed instead of letting them revert to functional wetlands that can purify surface waters. At least 200 acres of common reed would be aerially sprayed annually with an EPA approved herbicide, and when used as directed, would not adversely impact surface waters, water quality, or wetlands. There would be no short-term construction with the No-Action Alternative, and thus no potential for impacting Refuge water quality. Also, this alternative would continue to acquire land from willing sellers within the approved acquisition boundary of the Refuge for the protection of water quality and wetlands within the Back Bay watershed. In doing so, we would prevent their conversion to uses that may negatively affect water quality. A study in southeast Virginia between 1994 and 2000 (Tiner, et al. 2005) reported a loss of more than 3,300 acres of forested wetland during that 6-year period. Residential development was the primary cause (71 percent) for the conversion of more than 2,100 acres to upland. Because of timber harvesting, over 1,000 acres of forested wetland were converted to emergent wetland. Those changes are temporary, but will last until the forest cover reestablished. By protecting land from conversion to residential development, and by not conducting timber management in

wetlands, we would help maintain water quality by keeping those wetlands intact, particularly forested wetlands.

Indirect impacts would include continued adverse impacts to water quality and SAV by boat and personal watercraft traffic, as well as farming infractions that would affect an important food source for waterfowl and other aquatic wildlife. The spraying of common reed is not expected to indirectly impact aquatic wildlife, since the EPA licensed Glyphosate herbicide has low toxicity, binds rapidly to soil particles and becomes inert very quickly. Therefore, the use of such an herbicide would have a negligible impact.

#### **Alternative B—Proposed Action**

The Proposed Action would reduce personal watercraft use in high waterbird-use areas, thereby reducing wave-action and suspended silt, and directly protecting water quality and SAV habitat. This alternative would eliminate approximately 100 acres of cooperative farming operations and 139 acres of old farm fields that would then be allowed to revert to shrub-scrub and forest habitats; some of which would effectively restore wetlands and better buffer the Back Bay watershed. Plant diversity in 250 acres of freshwater wetlands habitat would be improved within the western and northern marshes (and adjacent habitats) around Back Bay by increasing annual plant production. This action would effectively improve the quality of these wetlands. Further reduction of the feral hog and deer populations would be beneficial to surface waters, waterfowl and wetlands, as over-browsing on waterfowl foods and soil disturbance would be decreased. Also, wetlands restoration on the Refuge would continue to be pursued on a long-term basis. Wilderness Study Area (WSA) designation would be rescinded, resulting in spraying common reed with approved herbicides, which could have a minimal adverse effect on water quality as noted above. The Proposed Action would involve construction for new infrastructure (parking lots, buildings, and roads) that would create some additional acreage of new impervious surface, but associated stormwater runoff would have a negligible impact upon Refuge surface waters and wetlands in the long-term. Previous material for parking areas for launching sites would be used wherever practical. In the short-term, construction for new infrastructure may result in a temporary increase in soil erosion and siltation of Refuge surface waters, although BMPs would be employed to minimize this risk. Like Alternative A, this alternative would continue to acquire land from willing sellers within the approved acquisition boundary of the Refuge for the protection of water quality and wetlands within the Back Bay watershed.

Indirect beneficial impacts would include increasing the food source for waterfowl by increasing annual plant production, improving water quality and wetlands by decreasing siltation and nutrient enrichment from stormwater in cultivated areas, and improving surface waters and wetlands by restricting personal watercraft and thereby decreasing the amount of petroleum products entering these areas. The spraying of common reed is not expected to indirectly impact aquatic wildlife as the EPA licensed Glyphosate herbicide has low toxicity. Therefore, the use of such an herbicide would have a negligible impact.

Impacts to surface water, water quality, and wetlands from activities that have been determined to be compatible with refuge purposes such as non-trailer vessel launches, outdoor events, military, police and fire training, photography, weddings, and use of retriever dogs during the proposed waterfowl hunt would be minimal. Erosion may result because of non-trailer vessel launches, depending on frequency and time of use, in designated areas. This potential negative effect may be offset by an increased public awareness of the Bay that would result from this access and use. Outdoor events, military, police and fire training, and weddings are usually restricted to public use areas and managed so as to avoid impact to these resources.

Negative impacts from this Alternative will temporarily be greater than Alternative A to soils and topography; but not to geography/groundwater, climate and location. The temporary disturbance to surface soils created by construction will be mitigated by silt fencing and other soil conservation precautions, to minimize siltation, erosion and related negative impacts to surface waters. Disturbed soils will naturally vegetate and/or be reseeded to shorten the period of such disturbance impacts.

#### **Alternative C—Improved Biological Integrity**

Alternative C would include most of the above-mentioned proposed actions for Alternative B. In addition, it would result in a series of water-related impacts (particularly if the primary dunes are reduced or eliminated by hurricanes, or man-made leveling) that include the following: 1) considerably reduced acreages of shallow, fresh, open surface waters; 2) reduction in associated fresh-water wetlands, particularly during ocean over-washes, when saltwater would be trapped within impoundments and remain; and 3) possible impacts to groundwaters from the conversion of fresh-water to brackish waters, in areas where surface and groundwaters meet.

Alternative C would eliminate all motorized watercraft traffic within 0.5 mile of the Refuge proclamation boundary, thus reducing degradation of water quality by associated petroleum products and directly protecting SAV habitat. This alternative would also provide protective measures from public disturbance of Long Island and Ragged Island wetlands, and a nomination process would be initiated for wilderness area designation for all WSAs. Alternative C would result in similar acreage of new impervious surface area as by Alternative B, but associated stormwater runoff would have a negligible impact upon Refuge surface waters and wetlands in the long-term. In the short-term, construction for new infrastructure may result in a temporary increase in soil erosion and siltation of Refuge surface waters, although BMPs would be employed to minimize this risk.

Indirect beneficial impacts for this alternative would be similar to Alternative B. However, the added protection by eliminating motorized watercraft and protecting island wetlands as described above would be an indirect benefit to aquatic wildlife.

As with Alternative B, negative impacts from Alternative C will be greater than Alternative A to soils and topography. The temporary disturbance to surface soils created by construction will be mitigated by silt fencing and other soil conservation precautions, to minimize siltation, erosion and related negative impacts to surface waters. Disturbed soils will naturally vegetate and/or be reseeded to shorten the period of such disturbance impacts. Negative impacts to geography/surface waters will be greater than Alternatives A and B, in that 880 acres of freshwater pools may be reduced or eliminated; and be replaced by transitional brackish water areas. These changes should not impact groundwater, climate and location.

### **Air and Noise**

#### **Alternative A—No-Action Alternative**

##### *Air*

The No-Action Alternative would maintain the current long-term minimal levels of air pollution the Refuge experiences annually. Most notably, emissions from the farming of approximately 100 acres of cropland would continue. However, there would be no short-term construction with the No-Action Alternative, and thus no associated temporary sources of air pollution. No indirect impacts would result from this alternative.

U.S. Fish and Wildlife Service and Back Bay NWR fire management activities which result in the discharge of air pollutants, (e.g., smoke, carbon monoxide, and other pollutants from fires) are subject to, and must comply with, all applicable

Federal, state, interstate, and local air pollution control requirements. These requirements are specified by Section 118 of the Clean Air Act, as amended (42 USC 7418). Back Bay NWR will comply with Air Quality-Smoke Management Guidelines listed in Chapter 2.3 of the FWS Fire Management Handbook (USFWS, 2001). The fire management program will be in compliance with interstate, state (Virginia Department of Environmental Quality), and local air pollution control regulations, as required by the Clean Air Act. Refuge concerns revolve principally around effective smoke management that ensures the public's air quality and visibility is not reduced, particularly in the vicinity of homes and vehicle travel routes.

#### *Noise*

The No-Action Alternative would maintain the current long-term minimal levels of noise the Refuge experiences annually. Most notably, tractor noise from the farming of approximately 100 acres of cropland would continue. However, there would be no short-term construction with the No-Action Alternative, and thus no associated temporary sources of noise. No indirect impacts would result from this alternative.

### **Alternative B—Proposed Action**

#### *Air*

The proposed action under Alternative B would not impact the current air quality status for the Hampton Roads Region or affect the anticipated 2007 plan to reduce the level of ozone in non-attainment areas. It is expected that the Proposed Action would cause a slight decrease in the level of air pollution above the current levels the Refuge experiences annually. Alternative B would slightly decrease sources of air pollution by eliminating the cooperative farming program and implementing personal watercraft restrictions. Although there would be more recreational opportunities created by this alternative, vehicular traffic on the Refuge is expected to remain approximately the same, resulting in negligible changes in vehicular emissions. There would be an increase in prescribed burning in the 170-acre Green Hills area, though this would be a one-time event and result in a negligible impact on air quality. Emissions from construction equipment would temporarily increase air pollution during the 16-month construction period of the new headquarters and visitor contact station, as well as other proposed projects requiring such equipment, but these would be minor, short-term adverse impacts. Significant indirect impacts to air quality are not expected by Alternative B.

Occasional fire training by local fire departments would only be authorized for buildings no longer utilized for Refuge operations or housing. Fire department training could consist of the un-utilized building being burned down under a controlled training operation. A burn plan must be prepared, and approved by the Refuge Manager, for burning buildings. The prescribed burning of buildings would result in the discharge of air pollutants, (e.g., smoke, carbon monoxide, and particulate matter) which are subject to, and must comply with, all applicable Federal, state, interstate, and local air pollution control requirements. Refuge concerns revolve principally around effective smoke management that ensures the public's air quality and visibility is not reduced, particularly in the vicinity of homes and vehicle travel routes. The consideration of wind speed, direction, and mixing heights is all-important to managing smoke. In planning these activities, we would consider these factors. There will be no significant negative impacts from this use as the special use permits would strictly limit conditions around the permits' issuance; otherwise a Special Use Permit will not be issued for a specific request.

#### *Noise*

Noise levels generated from Alternative B would be mostly attributed to short-term construction and tree thinning events. Construction of the facilities

is expected to take approximately 16 months. However, sources of noise originating from various equipment associated with construction activities for the development of several structures and recreational facilities would occur only during daylight hours on weekdays. Typical noise levels from construction equipment range between 85 and 90 decibels at a distance of 50 feet. No sensitive noise receptors (i.e., residents, schools, church, and hospitals) have been identified in close proximity to the construction sites. There would be a temporary disturbance/displacement to noise-sensitive wildlife species during construction, tree thinning, and in proximity to hunting activities.

Decreasing the use of personal watercraft on the Refuge would likely decrease overall noise levels, a minor beneficial impact. Eliminating the cooperative farming program would reduce associated noise from tractors, combines, etc. Although the length of various hunting seasons would be expanded, associated firearm noise is expected to be negligible. Deer hunters could contribute up to 44 vehicles to the overall traffic on Sandbridge Road and Sandpiper Road during the early morning and evening hours on hunt days. That increase is immeasurable when compared to the thousands of daily vehicle trips on these roads. The sound of firearms discharging will be noticeable to surrounding homeowners (primarily adjacent to Hunting Zones A, D, F, and H) given the distance between homes and hunt areas (500 feet). Diesel-operated trams would result in minor adverse noise impacts, although this would be less than alternative vehicular traffic.

Indirect impacts by Alternative B would be expected to be a short-term decrease in recreational use of areas of the Refuge where construction activities are occurring because of the associated noise. Overall, ambient noise levels may be decreased indirectly by converting existing agricultural land into forest which can shield or disrupt noise traveling through the air.

### **Alternative C—Improved Biological Integrity**

#### *Air*

Alternative C would include all of the above-mentioned proposed actions for Alternative B, and would also eliminate all motorized watercraft traffic within 0.5 mile of the Refuge proclamation boundary, further reducing the air pollution generated from their outboard motors. There would be a temporary increase in localized air pollution from machinery and equipment during construction activities. Aerial spraying of common reed would temporarily place herbicides in the local atmosphere as well as contribute to fuel combustion pollution from aircraft engines during the spraying. Significant indirect impacts to air quality by Alternative C are not expected.

#### *Noise*

Alternative C would include all of the above-mentioned proposed actions for Alternative B. In addition, aerial spraying of common reed would create short-term noise from aircraft engines during spraying operations, a negligible impact. Conversely, Alternative C would eliminate all motorized watercraft traffic within 0.5 mile of the Refuge proclamation boundary, thus moderately reducing noise levels. As with Alternative B, expanded hunting seasons could result in additional firearm noise in adjacent residential areas (i.e. near Hunting Zones A, D, F, and H). However, we believe those impacts would be negligible. Indirect noise impacts by Alternative C are likely to be short-term and similar to Alternative B.

## **Visual Resources**

### **Alternative A—No-Action Alternative**

The expanses of visual natural resources that characterize the Refuge are of immeasurable value. Alternative A would maintain the current visual aesthetics throughout the Refuge. However, the existing HQ/VCS would remain unchanged and not be improved aesthetically. Indirect impacts to visual resources by Alternative A are expected to be negligible.

**Biological  
Environment—  
Vegetation  
Vegetation Types**

**Alternative B—Proposed Action**

Alternative B would include the development of new buildings, other structures, and land use changes to existing conditions. The new HQ/VCS itself would be a one-story medium facility with standard aesthetic design effectively blended with the surrounding terrain. The existing HQ/VCS would be renovated/remodeled to be more functional and aesthetically pleasing, both externally and internally. Replacing existing farmlands with managed forest would promote a more vegetated landscape that, over time, would be more attractive than row crops. The short-term disturbance to visual resources would be largely due to temporary and unsightly construction activities to develop parking lots, new buildings, road realignments, boat launches, and new trails. Indirect impacts to visual resources by Alternative B are expected to be negligible.

**Alternative C—Improved Biological Integrity**

Alternative C would also include the development of new buildings, other structures, and land use changes to existing conditions, including the proposed actions under Alternative B. The new HQ/VCS on New Bridge Road would incorporate aesthetics into design, whereas the existing HQ/VCS would be moved to Little Island City Park without any aesthetic improvements. Alternative C would include an expanded effort to protect the larger islands of the Refuge from public disturbance, and allow the impoundments to revert to more natural habitats, which may improve the aesthetics of these areas. However, allowing the impoundments to grow up naturally to brush would reduce public viewing of areas adjacent to remaining wetlands and wildlife use areas. This could reduce visual benefits to the public, since they would be unable to view many of them.

**Alternative A—No-Action Alternative**

The No-Action Alternative would maintain the status quo on routine maintenance activities that manage vegetation within impoundments and control invasive plant species such as common reed, American lotus, and Japanese stiltgrass by spraying, and control cattails by mowing, burning, and flooding. There would be passive succession of open lands to shrub-scrub habitat to benefit wildlife, especially breeding birds that require such habitat. There would also be continued farming of approximately 100 acres of upland and prior-converted wetlands in five tracts.

Indirect, adverse impacts by this alternative would be minimal as there would be no vegetation clearing for trails, a new HQ/VCS, new maintenance buildings, and parking lots, or permitted public use activities. Uses including non-trailerred vessel launches, outdoor events, military, police and fire training, photography, and weddings would also minimally or not impact vegetation.

**Alternative B—Proposed Action**

In addition to the impacts to vegetation mentioned in Alternative A, the Proposed Action would eliminate the Refuge cooperative farming operations and convert lands to forest and shrub-scrub habitats. Also, 139 acres of old farm fields are planned to be converted to shrub-scrub and forest habitats. A two-mile hiking trail would be established between the proposed headquarters and the Horn Point public access site to the south, which would require clearing of vegetation for the footpath, footbridges, and boardwalk. Parking lots for the proposed canoe/kayak trails would also require clearing of vegetation for parking areas and launch ramps. A new hiking/biking trail would be created along an existing powerline right-of-way between the existing HQ/VCS and the proposed parking lot by the Refuge entrance gate. The construction of a new HQ/VCS and maintenance compound would require the clearing of 8 acres of

mowed field habitat for the building, parking, and entrance road footprints, plus equipment staging.

Future road and trail development at the newly proposed headquarters/visitor contact station site will be accomplished on a previously disturbed agricultural site. Realignment of the entrance road and developing a multi-use trail will all occur in an area that has already been developed primarily to accommodate priority public uses and to deliver utilities to the current headquarters. Therefore, little wildlife value will be lost due to newly proposed construction projects. We expect no additional effects from providing these four priority uses on the Refuge.

There would be an expanded hunt for waterfowl (with use of retrieval dogs), white-tailed deer, and control of feral hogs by this alternative, though only deer hunting would require clearing vegetation for additional parking lots. Alternative B would rescind all proposed WSAs on the Refuge from Wilderness designation.

The direct impact of most of the above proposed actions would require some clearing of vegetation, primarily wetland species, and shrub scrub and herbaceous mowed fields, as well as the conversion of active croplands to natural woody habitats over time. The removal of Wilderness designations would also allow control of common reed and other pest plant species. Consequently, the net change in available natural habitats and treatment of invasive plants would be positive and beneficial as reforestation would far exceed loss of vegetation by proposed infrastructure. Furthermore, there would be a direct reduction in damage to/loss of vegetation with additional hunting of deer and control of feral hogs, though trampling of vegetation by hunters would somewhat minimize the benefit. Also, the addition of waterfowl hunting would cause minimal trampling of marsh vegetation by hunters.

Indirect impacts by the above actions would include a possible increase in the distribution of non-native plant species (see section below), a short-term increase in soil erosion (minimized by the use of Best Management Practices), and a short-term increase in siltation of adjacent surface waters (see section below) during land clearing. However, SAV habitat would be indirectly enhanced by managing/reducing personal watercraft and boat traffic, and improving water quality by reverting farmlands to natural habitats and increasing the removal of feral hogs.

#### **Alternative C—Improved Biological Integrity**

Alternative C would include all of the above mentioned proposed actions for Alternative B, with the following exceptions: 1) 880-acre Impoundment Complex would be allowed to revert to a natural state, and considerably modify existing vegetation communities; 2) existing HQ/VCS would be moved to Little Island City Park, requiring removal of less than 1/4 acre of cleared vegetation; 3) aerial spray program for the control of common reed will be expanded to encompass all Refuge islands, western marshes, and the North Bay marshes vicinities; and, 4) with little active management occurring within the impoundment complex, a resurgence of the exotic, invasive *Phragmites australis* could occur.

Direct impacts of Alternative C would include regrowth of native vegetation after all impoundments are allowed to revert to a natural state, with removal of common reed in selected areas (except WSAs). However, ceasing active management of the impoundments could include a reduction in the vegetative ability of those areas to feed, and otherwise support wintering and migrating waterfowl, shorebirds during the spring and fall, and other waterbirds throughout the year. Plant production will gradually revert to principally perennials over time. Perennial plants generally provide less food value to most migratory waterfowl than annuals.

The indirect impacts of this alternative would be similar to Alternative A, but could also include enhancing SAV habitat by the reduction or elimination of public boat disturbance at Ragged Island and southern Long Island; as well as eliminating motorized boat traffic within 0.5 mile of the Refuge proclamation boundary.

## Threatened and Endangered Plants

### Alternative A—No-Action Alternative

The No-Action Alternative would maintain the status quo on routine maintenance activities that would continue management of A-Pool and B-Pool impoundments which provide wetland habitat for the state Critically Imperiled (S1) Carolina grasswort (*Lilaeopsis carolinensis*). Consequently, there would be no adverse impact to this rare plant or other state or federal listed plant species by this alternative. Maintenance of existing water quality standards and water level management practices favor the presence of this species. Indirect impacts to listed plant species are not expected by this alternative.

### Alternative B—Proposed Action

Alternative B would thin 1 to 3 acres of loblolly pine, sweetgum and red maple in the forested “Green Hills” area along the western side of the A-Pool impoundment, and would not adversely affect the population of Carolina grasswort along the eastern, moist soil areas. In combination with other proposed actions for Alternative B, there would be no adverse impact to this rare plant or other state or federal listed plant species. Maintenance of existing water quality standards and water level management practices favor the presence of this species. The proposed clearing of woody plants in the A-pool impoundment may indirectly create additional open wetland habitat for the Carolina grasswort.

### Alternative C—Improved Biological Integrity

Like Alternative B, Alternative C would thin 1 to 3 acres of loblolly pine, sweetgum and red maple in the forested “Green Hills” area along the western side of the A-Pool impoundment. However, Alternative C would also allow the impoundments to revert to a more natural shrub-scrub and marsh wetland habitat. This action would probably result in the elimination of most impoundment populations of Carolina grasswort as well as some Back Bay populations (where ocean over-wash causes salinity changes), thereby potentially reducing its current abundance and distribution. In combination with other proposed actions for Alternative C, there would be no other known adverse impact to this rare plant. No other state or federally endangered, threatened or rare plant species are known to exist on the Refuge.

## Unique Ecosystems

### Alternative A—No-Action Alternative

The No-Action Alternative would maintain the status quo on routine maintenance activities that would continue management of unique ecosystems such as those within the 65-acre Green Hills maritime forest/shrubland along the west side of A-Pool and the 2-acre white cedar stand on Sandbridge Road.

The risk of introducing non-native plants to these unique ecosystems, a potential indirect adverse impact, would be minimal by the No-Action Alternative.

### Alternative B—Proposed Action

Alternative B would incorporate the removal (thinning) of 1 to 3 acres of loblolly pine, sweet gum, and red maple trees from the Green Hills maritime forest and from the woods north of Sandbridge Road, followed by prescribed burning. This alternative would provide a direct beneficial impact to a unique ecosystem.

The indirect impacts by Alternative B may include a slight risk of introducing non-native plants in areas disturbed after tree thinning, although this can be

minimized by frequent washing/ cleaning of equipment tires before entering thinning sites.

#### **Alternative C—Improved Biological Integrity**

In addition to converting the impoundments to more natural habitats, Alternative C would also incorporate the removal (thinning) of approximately 3 acres of loblolly pine, sweet gum, and red maple trees from the Green Hills maritime forest and from the woods north of Sandbridge Road. The white cedar stand in the Sandbridge Road Reforestation Site would also have remaining waxmyrtle, sweetgum and red maple trees removed if they are extensively blocking sunlight from reaching the high priority white cedars. This alternative would also provide for reforestation of an additional 100 acres of native hydrophytic tree species such as tupelos, bald cypress, and laurel and/or willow oaks. This alternative would restore native forest communities that were logged out during the early 20<sup>th</sup> Century and not replaced. Such restoration work could be considered of benefit to unique ecosystems, since these native bottomland hardwood forest communities are rare in this area. The indirect impacts by Alternative C would be essentially the same as for Alternative B, except non-native plants could dramatically increase in the reverted impoundments if not monitored and controlled.

The 880 acre fresh-water impoundment complex on the barrier island portion of the Refuge is considered by many local and State botanists to be a unique area of the Refuge. It is unique because of the concentration of unusual and sometimes rare wetland plants that occur therein and in very few other areas of the Back Bay Watershed. Because this area has been actively managed so intensively for the past 20 years, large acreages of annual, moist soil plant species occur there. Permitting this area of the Refuge to revert to the native shrub-scrub and emergent marsh normally found throughout Back Bay could cause the loss of this unique, highly diverse, mini-ecosystem.

### **Diversity of Plant Communities**

#### **Alternative A—No-Action Alternative**

The No-Action Alternative would maintain the status quo on routine maintenance activities that would continue management of various plant communities. Furthermore, the No-Action Alternative would not expand the hunting of deer or the control of feral hogs, and consequently excess populations of these species would continue to adversely affect the species diversity of various plant communities by browsing and uprooting, respectively.

Because this action involves no land disturbance activity, the indirect impacts by the No-Action Alternative would include a minimal risk of introducing non-native plants that could adversely affect plant diversity. However, the ecological benefits associated with expanded aerial spraying for common reed would not be realized; i.e., the natural revegetation of the sprayed area after a controlled burn.

#### **Alternative B—Proposed Action**

Alternative B would include the removal (thinning) of sweet gum, red maple, and loblolly pine, from selected areas, as well as the conversion of existing cultivated lands to shrub-scrub and forest that would dramatically improve plant diversity in these areas. Plant diversity in 250 acres of freshwater wetlands habitat would be improved within the western and northern marshes removing common reed and allowing native vegetation to grow. Also, 139 acres of old farm fields are planned to be converted to shrub-scrub and forest habitats. There would be an expanded hunt for white-tailed deer and control of feral hogs by this alternative, which could improve plant diversity by reduced browsing and ground disturbance of vegetation. It is expected that approximately 44 additional hunters during the October through December hunting season each year would remove some 38 additional deer amongst the 10 hunting zones (both gun and bow zones). Under this alternative the ecological benefits associated with expanded aerial spraying for common reed would not be realized; i.e., the natural revegetation of the sprayed area after a controlled burn.

Indirect impacts by the Proposed Action would include a moderate risk of introducing non-native plants in areas disturbed after tree thinning and construction projects, although this can be minimized by frequent washing/cleaning of equipment tires before entering thinning sites.

#### **Alternative C—Improved Biological Integrity**

Alternative C would increase common shrub-scrub and marsh wetland plant communities by allowing the impoundments to revert to a more natural state. In return, more diverse, existing freshwater plant communities could be lost. Many high-value waterfowl food-plants (including a variety of sedges, rushes, bulrushes, etc.) that occur therein will be lost. The end result will be a general alteration of vegetative diversity on the barrier island's impoundments, especially if those impoundments revert from freshwater to brackish water from ocean over-washes.

Indirect impacts by Alternative C would be essentially the same as for Alternative B; however, there is a good possibility that non-native plants, especially *Phragmites*, could dramatically increase in the reverted impoundments if not monitored and controlled. Such an invasive species recurrence could further reduce vegetative diversity by out-competing them.

### **Noxious/Invasive Weeds**

#### **Alternative A—No-Action Alternative**

The No-Action Alternative would maintain current levels of spraying of common reed on the Refuge, as well as additional control techniques for American lotus and Japanese stiltgrass.

Potential indirect impacts such as the spreading of non-native plants due to land disturbance from current Refuge management would be minimal.

#### **Alternative B—Proposed Action**

Alternative B would result in an effort by the Refuge to work with partners to treat common reed on properties immediately adjacent to the Refuge which would be a direct benefit to Refuge wetlands compromised by this non-native plant. However, this action would not expand the spraying or control of common reed on the Refuge.

The construction for new buildings, parking lots, and trail systems by the Proposed Action, however, would result in an indirect slight risk of spreading each of the above invasive plant species. Best management practices, such as minimizing soil tracked into and off of construction sites, would be employed to reduce the potential spread of these plants.

#### **Alternative C—Improved Biological Integrity**

In addition to converting the impoundments to natural habitats, Alternative C would include all of the above mentioned proposed actions for Alternative B, except that Alternative C would expand the current spraying/control of common reed to encompass all Refuge islands, western marshes, and North Bay marshes. This would be a direct net benefit in controlling common reed in wetland habitats on the Refuge and would minimize the likelihood of re-introduction of the species to previously cleared areas.

The area proposed for a parking and staging area on the western boundary of the Refuge on Tract 244 is previously farmed land that currently has minimal wildlife values other than as a buffer zone between new developments and the Refuge. Providing a connection for access to future non-Refuge trails would not result in adverse impacts to habitat. A compatibility determination for "Parking and Connecting Access for Horseback Riding" in Appendix A details potential impacts that may be predicted from uncontrolled horseback travel on Refuge habitats.

**Biological  
Environment—  
Wildlife**  
**Wildlife Habitats**

**Alternative A—No-Action Alternative**

The No-Action Alternative would maintain the status quo on routine activities that manage wildlife habitat within impoundments and elsewhere on the Refuge. There would be passive succession of open lands to shrub-scrub habitat to benefit wildlife, especially for breeding birds that require such habitat. There would also be continued farming of approximately 100 acres of upland and prior-converted wetlands in five tracts. Cooperative farmers would still contribute to habitat management in the form of mowing, discing, pest control and root-raking in Refuge impoundments and old fields. These actions provide natural foods for migratory waterbirds. Overall, indirect impacts would be less beneficial for wildlife habitats by this alternative. Populations of species that could harm the land such as feral hogs and white tailed-deer would tend to increase, causing harm to the existing landscape. The No-Action Alternative would not manage and reduce boat and personal watercraft traffic that adversely affects SAV habitat, which is an important food source for waterfowl and various aquatic animals. Indirect impacts for this alternative would be negligible.

**Alternative B—Proposed Action**

Wildlife habitat would increase with this alternative by the elimination of the Refuge's cooperative farming operations which would then be converted to shrub-scrub and forest habitats. Also, old farm fields are planned to be converted to shrub-scrub and forest habitats, adding 139 acres of enhanced wildlife habitat. Increased hunting of deer and control of feral pigs would improve habitats that would otherwise be degraded from over-browsing and soil disturbance. In particular, this action would allow recovery and development of an herbaceous layer and woody understory representative of a balanced ecosystem. Opening Green Hills to prescribed burns would improve plant diversity which would provide better habitat for wildlife. The Refuge's efforts to work with adjacent land owners to control common reed their property should improve the quality of local habitat. All proposed Wilderness Study Areas (WSAs) would be rescinded on the Refuge from wilderness designation, which may allow for better management to improve wildlife habitat. The Proposed Action would manage and reduce boat and personal watercraft traffic that adversely affects SAV habitat.

Wildlife habitat would be somewhat adversely affected by the creation of a two-mile hiking trail, which would be established between the proposed HQ/VCS and the Horn Point public access site, and would require clearing of vegetation for the footpath, footbridges, and a boardwalk that would segment the landscape—creating barriers for some wildlife. Parking lots for the proposed canoe/kayak trails would also require clearing of vegetation for parking areas and launch ramps. A new hiking/biking trail would be created along an existing powerline right-of-way between the existing HQ/VCS and the parking lot by the Refuge entrance. The construction of a new HQ/VCS and maintenance compound would require the clearing of 8 acres of mowed field habitat for the building, parking, and entrance road footprints, including equipment staging areas. Proposed areas for new hunting opportunities (including waterfowl hunting with use of retrieval dogs) would require clearing the land of vegetation for parking lots. Indirect impacts for this alternative would be negligible. Continuance of public use activities including outdoor events, military, police and fire training, photography, and weddings would cause minimal impacts to wildlife habitats.

**Alternative C—Improved Biological Integrity**

Alternative C would include most of the above-mentioned proposed actions for Alternative B except the WSAs, and eventually additional Refuge areas, would

retain the wilderness designations. In addition, the current 880 acre Refuge impoundment complex would revert to a natural state that would change habitat types. Native shrub-scrub habitats along the eastern, moist-soil areas (G, H, J Pools, and eastern A, B and C Pools) on the Refuge will be created through natural reversion as waxmyrtle and saltbush/high-tide bush reclaim those areas. The Refuge's aerial *Phragmites* control program would be expanded to Refuge islands and the western side of Back Bay; which would help control this non-native, invasive species and restore native wetland habitats.

## General Wildlife

### Alternative A—No-Action Alternative

The No-Action Alternative would maintain the continued management of 13 impoundments currently used as feeding and resting habitat for migratory waterfowl and shorebirds. Approximately 100 acres of upland and prior-converted wetlands would continue to be leased as farmland for growing corn and soybeans, which has less wildlife value than if it succeeded to shrub-scrub and forested habitat. The beneficial byproduct from cooperative farming in the form of waste corn and soybeans that are fed upon by migratory geese and waterfowl would be maintained. Management practices currently established to protect and conserve general diversity of wildlife would be retained. Current efforts to manage SAV would be maintained to provide forage to waterfowl. The No-Action Alternative plans would maintain existing hunting opportunities for white-tailed deer and feral hogs, and would maintain the status quo on those activities that manage reptiles. There would continue to be no waterfowl hunting on the Refuge. Lastly, Alternative A would not involve construction activities and attendant temporary disturbance of wildlife.

Indirect impacts by the No-Action Alternative would include the continued concern of degradation of terrestrial and aquatic habitats by deer, feral hogs, and farming operations. In particular, vehicular accidents/damage due to collisions with deer would not be reduced.

### Alternative B—Proposed Action

The Proposed Action would eliminate the cooperative farming of approximately 100 acres of cropland and allow such land to convert naturally to shrub-scrub and forested habitat. Old field habitat is transitory and especially valuable for various species of wildlife, including breeding prairie warblers and field sparrows. With the elimination of the cropland, waste corn and soybeans from farming activities would no longer be available for feeding upon by migratory geese and ducks, together with deer and other mammals.

Expanded hunting opportunities targeting deer and control of feral hog populations would be beneficial to other wildlife on the Refuge, which are less competitive and/or require greater plant diversity. It is expected that the increase in hunting would result in additional deer and additional feral hogs taken each year as well as the temporary disturbance/displacement of noise-sensitive wildlife species. The Refuge will continue to use the Abomasal Parasite Counts to determine if the deer population is above, below, or at the carrying capacity of the habitat. The addition of waterfowl hunting will involve removing species from the population; however as proposed, effects will not contribute to negative impacts of Atlantic flyway populations. Proposed trail development could have a minor adverse impact on the movement of small reptiles and amphibians where boardwalks can cause segmentation to contiguous habitat areas. Waterfowl would benefit by improved SAV habitat when siltation of waters from farming infractions into Refuge buffer areas is curtailed, and boat traffic and personal watercraft use is better managed or reduced. Though BMPs would be employed, temporary construction activities may generate some silt on a short-term basis that would have a minor adverse effect on SAV and associated wildlife. The

development of new kayak/canoe access points could have an impact of Refuge wildlife resources. Studies show that canoes and rowboats disturb wildlife (Bouffard 1982; Kaiser and Fritzell 1984; Knight 1984; Kahl 1991). They may affect waterfowl broods, wintering waterfowl, shorebirds, raptors, and long-legged waders, but because of their low speed and their use primarily during the warmer months the impact would be expected to be insignificant, especially on wintering waterfowl and raptors. In addition, there may be a slight increase in wildlife disturbance from park visitors once new hiking trails are constructed, which may result in a minor adverse impact.

Public use activities in the Proposed Action, including wildlife observation, photography, environmental education, and interpretation, can affect the wildlife resource positively or negatively. A positive effect of public involvement in these priority public uses will be a better appreciation and more complete understanding of Refuge wildlife and habitats. That can translate into more widespread, stronger support for the Refuge, the Refuge System, and the Service.

Human activity has the potential of impacting shorebird, waterfowl, marshbirds and other migratory bird populations feeding and resting near the trails and on beaches during certain times of the year. Use of upland trails is more likely to impact songbirds than other migratory birds. Human disturbance to migratory birds has been documented in many studies in different locations.

We anticipate impacts that result in a temporary displacement without long-term effects on wildlife individuals or populations. Some species will avoid the areas people frequent, such as the developed trails and the buildings, while others seem unaffected by or even drawn to the presence of humans. Overall, those effects should not be significant, because most of the Refuge will experience minimal public use.

Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes: departure from site (Owen 1973, Burger 1981, Korschgen et al 1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of suboptimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990). McNeil et al. (1992) found that many waterfowl species avoid disturbance by feeding at night instead of during the day. The location of recreational activities impacts species in different ways. Miller et al. (1998) found that nesting success was lower near recreational trails, where human activity was common, than at greater distances from the trails. A number of species have shown greater reactions when pedestrian use occurred off trail (Miller, 1998). In addition, Burger (1981) found that wading birds were extremely sensitive to disturbance in the northeastern U.S. In regard to waterfowl, 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. She also found gulls and sandpipers to be apparently insensitive to human disturbance, with Burger (1981) finding the same to be true for various gull species.

For songbirds, Gutzwiller et al. (1997) found that singing behavior of some species was altered by low levels of human intrusion. Pedestrian travel can impact normal behavioral activities, including feeding, reproductive, and social behavior. Studies have shown that ducks and shorebirds are sensitive to pedestrian activity (Burger 1981, 1986). Resident waterbirds tend to be less sensitive to human disturbance than migrants, and migrant ducks are

particularly sensitive when they first arrive (Klein 1993). In areas where human activity is common, birds tolerated closer approaches than in areas receiving less activity.

Laskowski et al. (1993), studied behavior of snowy egrets, female mallards, and greater yellowlegs on Back Bay NWR within 91.4 meters of impoundment dikes used by the general public. Behavior of snowy egrets was recorded during August and September 1992 to represent post-breeding marsh and wading birds. Mallards were monitored during migration (November 1992) and during the winter January (1993). Greater yellowlegs' behavior was observed during the northward shorebird migration (May 1993). Behavior was monitored during the typical public activities of walking, bicycling, and driving a vehicle past the sample sites.

The study found that snowy egret resting behavior decreased and alert behavior increased in the presence of humans. Preening decreased when humans were present, but this change was not significant. Feeding, walk/swim, and flight behaviors were not related to human presence. Female mallards in November increased feeding, preening and alert behaviors in the presence of humans. Resting, walk/swim, and flight behavior were not influenced by human presence. In January, female mallard resting and preening behavior were not influenced by the presence of humans. However, feeding, alert, walk/swim, and flight behaviors were related to human presence. Greater yellowlegs increased alert behavior in the presence of humans. No other behaviors were affected. Maintenance behavior (combined feeding, resting, and preening) decreased when humans were present for all study species. In addition, this decrease was accompanied by an increase in escape behavior by each species. Maintenance behavior of mallards in January decreased in the presence of vehicles and combined disturbance. Escape behavior increased when vehicles were present. Maintenance behavior of greater yellowlegs declined when bicycles and vehicles were present but was not influenced by pedestrian presence.

The presence of bicycles and vehicles increased escape behavior. Snowy egrets and female mallards increased movement between subplots and to areas within the study area but further from the disturbance.

During a five year study which involved nine different species of birds, they found only minimal evidence that intrusion affected bird distributions (Gutzwiller and Anderson 1999). This study also found that the species affected by intrusion were not consistent from year to year or within study areas and could be due to habituation of intrusion (Gutzwiller and Anderson 1999).

People can be vectors for invasive plants by moving seeds or other propagules from one area to another. Once established, invasive plants can out-compete native plants, thereby altering habitats and indirectly impacting wildlife. The threat of invasive plant establishment will always be an issue requiring annual monitoring and treatment when necessary. Our staff will work at eradicating invasive plants and educating the visiting public. Also, opening Refuge lands to public use can often result in littering, vandalism, or other illegal activities on the Refuge.

Additional indirect impacts by the Proposed Action would include reduced degradation of terrestrial habitats on the Refuge by deer and feral hogs, and reducing erosion and siltation caused by feral hog and by reverting farmlands to natural habitats. In addition, the indirect benefits of expanded deer hunting include a beneficial reduction in deer/vehicle accidents, a beneficial reduction in Refuge and residential browse damage, and fewer deer available to transport Lyme-disease-bearing ticks.

### **Alternative C—Improved Biological Integrity**

Alternative C would include all of the above mentioned proposed actions for Alternative B, except for the following: 1) 880-acre Impoundment Complex would be allowed to revert to natural shrub-scrub and emergent marsh habitats; 2) wetlands and open-water pothole habitats in Ragged Island and southern Long Island would be protected from public disturbance; 3) aerial *Phragmites* reed control program would be expanded to include all Refuge islands and marshes; 4) motorized watercraft use would be eliminated within 0.5 mile of the Refuge Proclamation Boundary; 5) A nomination process would be initiated for wilderness area designation for all WSAs, and eventually additional other Refuge areas.

Direct impacts by Alternative C are both positive and negative. There would be beneficial impacts to wildlife (particularly migratory waterbirds) by reduced disturbance to habitats around and within Ragged Island and southern Long Island through access restriction, and by eliminating motorized watercraft traffic within 0.5 mile of the Refuge proclamation boundary.

However, allowing the impoundments to revert to natural shrub-scrub (along the eastern, moist-soil areas) and marsh habitats (along the western areas) could result in a more adverse impact on fulfillment of a primary purpose for Refuge establishment—“... to provide resting and feeding habitat for wintering and migrating waterfowl.” Migratory waterfowl use may be reduced if diversity of their plant and animal foods decreases. Increased shrub-scrub habitat will not benefit waterbird use; instead, it will decrease it. Natural emergent marsh habitats in this area generally produce lower levels of desirable waterfowl food-plants. Only shallow open water areas with high submerged aquatic vegetation (SAV) production are as productive in Back Bay’s natural wetlands. This negative impact to the local migratory waterbird resource should be noteworthy, since currently 60%-80% (depending on SAV abundance in Back Bay) of Back Bay’s wintering waterfowl population currently use the Impoundment Complex.

The impacts of allowing the impoundments to revert to less actively managed, natural shrub-scrub and less diverse emergent marsh will likely have a negative impact on the white-tail deer and feral hog population that occupies the barrier island portion of the Refuge. Hunting them also will be more difficult due to the increased dense cover provided by the shrub-scrub and black needlerush marsh habitats that would develop within the impoundment complex.

Indirect impacts would be similar to Alternative B except that the increased control of common reed by Alternative C would be more beneficial to wildlife diversity and greater public access and watercraft control would be a benefit to SAV populations (through less water disturbance and siltation) which attract migratory waterfowl. The herbicide used in the aerial spraying to control the common reed is not expected to impact wildlife.

## **Threatened and Endangered Wildlife**

### **Alternative A—No-Action Alternative**

The No-Action Alternative would continue current management practices for state and Federal listed wildlife that occur within the Refuge, including the piping plover, king rail, least bittern, eastern big-eared bat, loggerhead sea turtle, and eastern glass lizard. This would include the phasing-out of Refuge Motor Vehicle Access (MVA) permits to minimize disturbance to shorebirds and sea turtles. The Refuge would have to continue to rely on the availability of volunteers. Alternative A would not hire additional staff to monitor sea turtle nests and conduct sea turtle patrols. This alternative would not involve construction activities and possible temporary disturbance to rare species of wildlife.

Indirect impacts by the No-Action Alternative would be insignificant to species of wildlife that are state and federal listed.

#### **Alternative B—Proposed Action**

The Proposed Action would incorporate all of the current management practices for state and federal listed wildlife, and would include the phasing-out of Refuge Motor Vehicle Access (MVA) permits to minimize disturbance to shorebirds and sea turtles. Similarly, this alternative would eliminate dog walking, and possible disturbance to birds. The Proposed Action would not hire additional staff to monitor sea turtle nests and conduct sea turtle patrols. The Refuge would have to continue to rely on the availability of volunteers. This alternative would expand deer hunting, but the timing and location of deer hunting is expected to preclude disturbance of any federal- or state-listed endangered or threatened species. Therefore, the action would not have an adverse affect on any threatened or endangered species.

Indirect impacts by the Proposed Action would be more beneficial than Alternative A to species of wildlife that are state and federal listed. The Proposed Action would better manage personal watercraft in high waterbird-use areas than Alternative A, and thereby reduce disturbance to rare fauna. The Proposed Action would involve new construction activities and possible indirect, temporary disturbance (such as increased noise levels) to rare species of wildlife. However, the time of construction would take into consideration the sensitivity of rare species of wildlife.

#### **Alternative C—Improved Biological Integrity**

Alternative C would incorporate all of the current management practices for state and Federally listed wildlife as with Alternatives A and B, and would include the phasing-out of Refuge Motor Vehicle Access (MVA) permits to minimize disturbance to shorebirds and sea turtles. Similarly, this alternative would eliminate dog walking, and possible disturbance to birds. Also, expanded herbicide treatments for common reed will not impact any known threatened or endangered species. The applications will be highly localized and plant-specific, with the ultimate goal of improving habitats.

This alternative would be more beneficial to rare wildlife than Alternative A, but similar to Alternative B. Alternative C would eliminate motorized watercraft within 0.5 mile of the Refuge proclamation boundary, and therefore would indirectly further reduce disturbance to rare fauna on the islands of Back Bay.

Allowing 880 acres of impoundments to revert to shrub-scrub and natural emergent marshes may result in a decline in those amphibians that prefer open, emergent wetlands and reptile populations that depend on the freshwater marshes. However, most of these species are not considered to be either Federally or State listed species, except for the Eastern glass lizard, which has been occasionally observed in wet areas of the impoundment vicinity. As a result, the Eastern glass lizard is considered to be a State Listed Threatened species and could experience a reduction of desirable wetlands habitats.

### **Non-native Species and Animal Damage Control**

#### **Alternative A—No-Action Alternative**

The No-Action Alternative would maintain the status quo on routine activities that manage and control non-native wildlife species such as feral hogs, feral cats, and wild horses, and manage indigenous populations of white-tail deer that can over-browse habitats. Hunting and trapping programs would not be expanded. Therefore, this alternative would not take additional steps to increase the control of non-native and destructive wildlife.

Indirect impacts by Alternative A would likely result in an increase and greater distribution of non-native and invasive animal species, which in turn would reduce the quality of both terrestrial and aquatic habitats.

**Alternative B—Proposed Action**

The Proposed Action would continue routine activities that manage and control non-native wildlife species, and would increase the control of feral hogs and native white-tailed deer that over-browse habitats. Overall, the Proposed Action would be more beneficial to habitat protection and wildlife diversity than Alternative A.

Indirect impacts by the Proposed Action would include much less disturbance to plant communities and habitats by deer and feral hogs which would in turn reduce the spread of invasive plants, both terrestrial and aquatic. Water quality on the Refuge would also be improved by much less ground disturbance by wildlife, and consequently less soil erosion and siltation into surface waters.

**Alternative C—Improved Biological Integrity**

Alternative C would continue routine activities that manage and control non-native wildlife species, and would increase the control of feral pigs and native white-tailed deer that over-browse habitats. However, allowing the impoundment complex to revert to natural shrub-scrub will reduce the amount of feeding habitat on the barrier island for feral hogs and deer, thereby creating additional stress on their populations. The moist soil units within the eastern sides of most impoundments will revert to shrub-scrub and cease producing the annual plants and bulrush bulbs that the pig population roots for and deer browse on. This “limiting factor” should help keep the population stable, and not permit large increases. However, the increased cover afforded by the additional shrub-scrub habitats generated under this option may result in a reduced pig and deer harvest during the annual hunts since hunters will have reduced open areas to hunt in.

As with Alternative B, Alternative C would only be more beneficial to habitat protection and wildlife diversity, if increased control of feral hogs was implemented. Indirect impacts by Alternative C would be similar to that for Alternative B, as long as increased controls on the barrier island pig and deer populations are implemented.

Burrowing concerns by muskrats and nutria in Refuge dikes would no longer be as important, since dike maintenance and water management would be a lower priority with the reduced impoundment management goals and objectives under this Alternative.

**Socio-Economic Environment**

**Setting**

The setting of the Refuge is of no significant issue in regard to the CCP and consequently will not be further addressed.

**Population**

The subject of population is of no significant issue in regard to the CCP and consequently will not be further addressed.

**Employment**

**Alternative A—No-Action Alternative**

The No-Action Alternative would maintain current levels of maintenance activities on the Refuge and would not require additional staffing. This alternative would include the necessity of enlisting the aid of volunteers as well as interfacing with the staff of False Cape State Park (FCSP) and other existing partners to accomplish various goals, objectives, and strategies on and adjacent to the Refuge. Indirect impacts by Alternative A would include an element of uncertainty in addressing some Refuge goals, objectives, and strategies due to fluctuating levels of volunteerism on an annual basis.

**Alternative B—Proposed Action**

The Proposed Action, which includes expansion of visitor facilities and services, would require additional staffing support in the long term to meet public expectations, and provide for public safety, convenience, and a high quality experience for Refuge visitors. However, as current staffing projections for the foreseeable future appear constrained, partnering, interagency agreements, service contracting, internships, and volunteer opportunities would increase in order to provide this staffing support. In particular, this alternative would increase volunteer hours by 10 % within five years of the CCP approval. Short-term employment opportunities would be associated with the 16-month construction period of the new HQ/VCS, as well as other proposed projects. This action would have no long-term adverse impact on local or regional employment.

Like Alternative A, indirect impacts by the Proposed Action would include an element of uncertainty in addressing some Refuge goals, objectives, and strategies due to fluctuating levels of volunteerism on an annual basis. Overall, however, there would be considerable improvements in the efficiency of Refuge operations over Alternative A.

**Alternative C—Improved Biological Integrity**

Alternative C, which includes expansion of visitor facilities and services, would require additional staffing support to meet public expectations, and provide for public safety, convenience, and a high quality experience for Refuge visitors. However, as current staffing projections for the foreseeable future appear constrained, partnering, interagency agreements, service contracting, internships, and volunteer opportunities would increase in order to provide this staffing support. In particular, this alternative would increase volunteer hours by 20 % and increase Refuge internships by 50 % within five years of the CCP approval. However, at the same time the need for interns may be correspondingly reduced; as management needs for those 880 acres are reduced when the impoundments are allowed to revert to shrub-scrub and natural marsh. Furthermore, Alternative C would hire additional staff to monitor sea turtle nests and conduct sea turtle patrols. Consequently, Alternative C would be more beneficial to Refuge employment than Alternatives A and B.

Under this alternative, within 5 years of CCP approval a concession service would allow a commercial enterprise to operate the tram system in its entirety. Short-term employment opportunities would be associated with the 16-month construction period of the new HQ/VCS, as well as other proposed projects. This action would have no long-term adverse impact on local or regional employment.

Indirect impacts by Alternative C would be similar to that for Alternative B. Overall, however, there would be considerable improvements in the efficiency of Refuge operations over Alternative A, and slight improvements over the Proposed Action.

**Income****Alternative A—No-Action Alternative**

Alternative A would provide the current level of income producing activities for the Refuge and local economy to include the benefits derived from cooperative farming. Income producing activities of the other alternatives to include construction and expanded recreational activities would not be realized under this alternative. The most notable adverse activity under this alternative would be the Refuge's continued program of land acquisition. Land acquired by the Refuge is taken off the tax rolls; therefore, property tax income that used to go to the local government from the acquired property would be lost. The Refuge offsets this impact through an established revenue sharing program with the local government that replaces much of the lost property income tax. Indirect impacts by this alternative would be negligible given regional employment and income producing opportunities.

### **Alternative B—Proposed Action**

Alternative B provides for a variety of construction activities and expanded recreational and educational opportunities that would be expected to provide additional revenue streams primarily to the Refuge and local economy. The expected revenue to be generated as a result of the expanded activities has not been quantified, but the beneficial impact is expected to be modest when compared to the regional economy. Expected income producing activities include the purchasing of supplies for hunting and other outdoor/wildlife recreational pursuits such as canoeing, kayaking, fishing, environmental education, etc. Revenue producing activities for the Refuge would include the expansion of fee-related activities such as the tram and commercial kayak/canoe launching areas. The removal of approximately 100 acres of cooperative farming would have an adverse impact on the cooperative farmers as well as the Refuge, as the income generated for the farmers by the crops would be lost. In addition, the Refuge would not benefit in the form of direct payments or payment-in-kind in form of refuge habitat improvements from farmers. The cost of payment-in-kind activities undertaken by the farmers, such as mowing, discing, pest control and root-raking would have to be paid for directly by the Refuge. Like Alternative A, the continued acquisition of land by the Refuge would have a negative effect on property tax collection by the local government. This however, would be offset by local revenue sharing by the Refuge. The construction activities would have a short-term beneficial impact that would largely occur during the 16-month construction phase of the action.

An indirect impact would include additional staffing or volunteer support to conduct the payment-in-lieu services provided by the farmers. The services provided are important to the overall wildlife management activities of the Refuge. Otherwise, the indirect impacts would be negligible given regional employment and income producing opportunities.

### **Alternative C—Improved Biological Integrity**

Implementation of Alternative C would include the above mentioned actions for the Proposed Action. Therefore, the overall beneficial and adverse impacts of the action would be insignificant when compared to the regional economy. This alternative would have an additional beneficial income producing activity associated with hiring additional staff members. Also under Alternative C, the cost and responsibility associated with operating the tram would be assumed by a private organization. This would occur within 5 years of CCP approval. The indirect impact of this action would be the same as for Alternative B.

## **Land Use**

### **Alternative A—No-Action Alternative**

The No-Action Alternative would incorporate objectives and strategies that largely maintain the existing management and land uses. Minimal changes in land use would include allowing shrub-scrub growth (while limiting larger trees) in areas where it is not detrimental to moist soil management or Refuge objectives. However, cooperative farming of some 100 acres would continue under the No-Action Alternative. Also, this alternative would maintain and manage 2,165 acres of proposed wilderness that was designated under the 1974 EIS. Although there would be no major immediate changes in land use by this alternative, the Refuge would gradually over time acquire land from willing sellers within the approved boundary for legal protection of water quality within the Back Bay watershed. This alternative would not create a new HQ/VCS on the undeveloped parcel at Sandbridge and New Bridge Roads, nor parking lots and access ramps for canoe/ kayak launch sites. The No-Action Alternative would not expand deer, feral hog, and waterfowl hunting to additional tracts of the Refuge.

Indirect impacts by this alternative would include introduction of nuisance wildlife/plant species, and limited, long-term soil erosion and siltation of Refuge surface waters from occasional annual plowing/tilling infractions into the 15'

buffer within and adjacent to Refuge agricultural fields. The continued farming would not be beneficial to wildlife and species of birds that require old field/shrub-scrub habitats. The No-Action Alternative would not incorporate new trails north of the existing HQ/VCS or on the west side of the Refuge, thereby avoiding short-term disturbances to wildlife. Motorized watercraft, however, would still be permitted within 0.5 mile of the proclamation boundary, thus indirectly and adversely affecting SAV habitat and associated wildlife.

#### **Alternative B—Proposed Action**

All land use proposals of the Proposed Action would be compatible with new and adjacent land use activities. The Proposed Action would eliminate the Refuge cooperative farming operations and convert lands to forest and shrub-scrub habitats. A two-mile hiking trail would be established between the proposed headquarters and the Horn Point public access site to the south, which would require clearing of vegetation for the footpath, footbridges, and boardwalk. Parking lots for the proposed canoe/kayak trails would also require clearing of vegetation for parking areas and launch ramps. A new hiking/biking trail would be created along an existing powerline right-of-way between the existing HQ/VCS and the newly proposed parking lot by the Refuge entrance. The construction of a new HQ/VCS and maintenance compound would require the clearing of 8 acres of mowed field habitat for the building, parking, and entrance road footprints, and equipment staging areas, while the existing HQ/VCS would be renovated with no additional land impacts. Also, this alternative would expand deer and waterfowl hunting to additional tracts on the north and west sides of the Refuge, requiring clearing land of vegetation for parking lots (deer hunting only). Overall, land use changes by the Proposed Action would provide many additional recreational opportunities as compared to Alternative A, but relatively similar to those for Alternative C. The expected changes in land use activities under this alternative are not expected to result in additional traffic to the Refuge that would result in an adverse impact to the carrying capacity of the local or Refuge roadway system. With the expectation of additional seasonal traffic due to expanded hunting, additional vehicular trips to the Refuge as a result of this action are expected to be insignificant.

Indirect impacts by land use changes of the Proposed Action would include a long-term reduction in soil erosion and siltation of Refuge surface waters, as well as a net beneficial impact to wildlife and species of birds that require old field/shrub-scrub habitats. There would, however, be short-term disturbances to wildlife and an increased risk in the spread of non-native invasive plants during the construction phase of this alternative. Also, changes in land use by this alternative would result in long-term impacts to visual resources that would be generally beneficial. However, there would be short-term visual impacts associated with unsightly construction activities in the development of parking lots, new buildings, road realignments, boat launches, and new trails. There would be insignificant long-term impacts to the movement of wildlife species through segmentation of habitat due to the creation of additional trails.

#### **Alternative C—Improved Biological Integrity**

Alternative C would include most of the above mentioned actions for the Proposed Action, except WSAs and potentially other Refuge areas in the future would be nominated as “Wilderness Areas,” access to Long Island and Ragged Island wetlands would be prohibited, and the existing HQ/VCS would be moved to City property just north of the Refuge entrance and south of Little Island City Park (requiring 1 acre of cleared dune habitat). Although the land available for the relocated HQ/VCS consists of unvegetated dune and asphalt slab, enhancements would be incorporated to minimize potential beach/dune erosion. Overall, land use changes by Alternative C would provide many additional recreational and biological opportunities as compared to Alternative A but relatively similar to those for Alternative B.

Indirect impacts by land use changes for Alternative C would be similar to that for Alternative B. In addition, by moving the existing HQ/VCS there would be an opportunity to restore natural habitat at the site of the building's footprint, though this instead could be converted to additional space for public parking.

## Historical and Archaeological

### Alternative A—No-Action Alternative

Alternative A would not involve construction ground disturbance activities. No known cultural resources would be impacted by continued operation and maintenance activities. In the event that cultural resources were located inadvertently during operations and maintenance activities, work would be halted at that location. Work would resume only after the resources have been evaluated for National Register of Historic Place eligibility by a qualified professional archaeologist. No indirect impact would result from this action.

### Alternative B—Proposed Action

Cultural resources are not expected to be a significant issue in the implementation of Alternative B. There is, however, a small cemetery on Tract 244 near the location of the proposed HQ/VCS. Though final design of the building and possible re-alignment of New Bridge Road is unknown at this time, should the final construction limits potentially impact the cemetery, appropriate agency coordination will be required in advance to assess the cemetery for National Register of Historic Place (NRHP) eligibility. An archeological reconnaissance of Back Bay NWR was conducted in October 1989 (Goodwin & Associates, Inc. 1989) that details local early history (1600s) to the present, together with archeologically sensitive areas on Back Bay NWR. A copy of this volume is on file at the Refuge headquarters. It should be referenced during the planning phase of new projects, to determine if a proposed construction site is archeologically sensitive or not. Furthermore, in the event that cultural resources are located inadvertently during construction projects, operations, or maintenance activities of this alternative, work would be halted at that location. Work would resume only after the resources have been evaluated for NRHP eligibility by a qualified professional archaeologist. No indirect impact would result from this action.

### Alternative C—Improved Biological Integrity

Implementation of Alternative C would include the above mentioned impacts for the Proposed Action.

## Refuge Administration and Use

### Refuge Goals

#### Alternative A—No-Action Alternative

The No-Action Alternative would incorporate objectives and strategies that maintain the existing management for each of the seven Refuge goals, and overall would be beneficial to the public and natural resources more so than a reduction in objectives/strategies or none at all.

#### Alternative B—Proposed Action

Goal 1 for the Proposed Action would increase the control of feral hogs on the Refuge. Goal 2 would thin loblolly pine, sweet gum, and red maple from the white cedar stand on Sandbridge Road and the Green Hills maritime forest. Goal 3 would conduct comparative vegetation surveys between G, H, and J Pools vs. similar dune swale habitats at FCSP. Goal 4 would rescind all proposed WSAs on the Refuge from Wilderness designation; eliminate cooperative farming operations and convert the land to shrub-scrub and forest habitats; and restrict use of personal watercraft in the sensitive, high waterbird-use areas of Ragged Island and Long Island. Goal 5 would develop three additional canoe/kayak launch sites and trails; construct handicap accessible trail on Tract #244, in

conjunction with new HQ/VCS, after remaining land is reforested; develop a 2-mile hiking trail between the new VCS and Horn Point public access site; relocate and construct new fee booth, create a new parking lot by the entrance gate, and develop a new hiking/biking trail along the existing powerline right-of-way parallel to the re-aligned entrance road; develop a new HQ/VCS, and maintenance compound at the intersection of Sandbridge and New Bridge Roads; renovate the existing HQ/VCS; utilize trams for transportation to the wildlife viewing facility. Goal 6 would expand deer hunting opportunities at various locations and waterfowl hunting at Redhead Bay and the Colchester impoundment. Goal 7 would utilize the Price House as temporary office space until the new HQ/VCS is completed, and thereafter convert to an EEC.

The direct impact of the above proposed actions would result in achieving Refuge goals, increasing the number of Refuge visitors, increasing the public awareness and understanding of local natural resources, increasing recreational hunting and related revenues, complying with ADA standards, better protection of wildlife from dog activity, and providing more efficient Refuge operations than by Alternative A, but similar to Alternative C. With the relocation of the VCS and expansion of the tram system, the Proposed Action would likely provide a beneficial reduction in roadway traffic to and from the barrier island portion of the Refuge. However, Alternative B may result in an increase in disturbance of wildlife and habitat through clearing activities and along newly established trails. These impacts would be offset by Refuge-wide improvements to wildlife habitat and management practices. In the short-term, there would be additional traffic congestion, as well as noise and air pollutants, during the construction period of all Proposed Actions, and there would also be a long-term irretrievable commitment of fossil fuels.

Indirect impacts may include the unintended spread of invasive plant species due to land clearing activities, though this would be minimized by BMPs. The indirect impacts of expanded deer hunting may include a beneficial reduction in deer/vehicle accidents, a beneficial reduction in Refuge and residential browse damage, and an insignificant increase in noise from firearm use (which will be a minimum of 500 feet from residences).

#### **Alternative C—Improved Biological Integrity**

Alternative C would incorporate many of the same strategies to achieve common goals as Alternative B, with the following exceptions: 1) Goal 1 for Alternative C would: (a) allow the impoundments to revert to natural shrub-scrub and marsh habitats; (b) allow or encourage ocean wash-over of Refuge beaches (including the reduction or elimination of primary and/or secondary dunes); and (c) expand aerial herbicide applications of the exotic invasive, common reed to encompass all Refuge islands and marshes. 2) Goal 4 would: (a) gain jurisdictional control over navigable waters that surround the WSAs in order to provide greater protection and eliminate all motorized watercraft traffic within 0.5 mile of the Refuge's Proclamation boundary; (b) initiate a nomination process for wilderness area designation for all WSAs and other Refuge areas; and (c) shift resources to restoration efforts in Back Bay. 3) Goal 5 would: (a) privatize the tram system by way of a concession service; (b) develop a 1.5 mile hiking trail along Nanney's Creek; and (c) consider establishing a trail head, and/or staging areas for parking that connects with nearby partner trail systems for horseback riding on the west side of the Refuge. 4) Goal 7 would relocate the current HQ/VCS to Little Island City Park to serve as an interagency visitor contact point.

The direct impact of the above Alternative C actions would also result in achieving most existing Refuge goals (except supporting migratory waterbird use of the barrier island's impoundment complex; have a more beneficial impact to protecting the WSAs than Alternatives A or B, since Alternative C would take jurisdictional control of navigable waters surrounding the WSAs, and motorized

watercraft would be excluded within 0.5 mile of the Proclamation boundary. As with Alternative B, Alternative C may result in an increase in disturbance of wildlife and habitat through clearing activities and along newly established trails. These impacts would be offset by Refuge-wide improvements to wildlife habitat and management practices. In the short-term, there would be additional traffic congestion, as well as noise and air pollutants, during the construction period of Alternative C, and there would also be a long-term irretrievable commitment of fossil fuels. Indirect impacts by Alternative C would be essentially the same as for Alternative B.

**Land Acquisition History**

The land acquisition efforts of the Refuge are intended to provide for the protection of water quality within the Back Bay watershed. The impact of the effort has not, and would not be expected to result in any significant impact to the resources addressed under this EA. All lands are acquired from willing sellers who are made aware of the terms and conditions associated with the acquisition.

**Staffing and Budgets**

Staffing and budgets for the Refuge is addressed under Section 4.5 – Employment and Income.

**Refuge Revenue Sharing Payments to City**

No adverse impact to the existing revenue sharing program would be expected by either the No-Action or action alternatives. However, it is expected that implementation of Alternatives B or C would generate comparable increases in fee revenue that would be shared with the local government. However, under both action alternatives, the increase in revenue would be somewhat offset by a decrease in revenue as a result of ending approximately 100 acres of cooperative farming on the Refuge.

Under Alternatives A, B, and C the Refuge would continue its land acquisition program. Under the program the Refuge acquires land adjacent to or near the existing boundary of the Refuge. The acquired land is then taken off the tax roles and property tax income that used to go to the local government is lost. The Refuge would offset this impact through their established revenue sharing program with the local government. Indirect impacts from implementation of either the No-Action Alternative or the action alternatives would be insignificant.

**Infrastructure**

**Alternative A—No-Action Alternative**

The No-Action Alternative would generally incorporate management and strategies that maintain the existing buildings, recreational amenities, and infrastructure support systems (e.g., waterlines, storm water, etc.) on the Refuge.

The indirect impacts of this resource action are primarily socioeconomic and when compared with the other alternatives may include stagnation or a decrease in Refuge visitation and revenues, employment and income, and environmental awareness opportunities.

**Alternative B—Proposed Action**

The Proposed Action would create canoe/kayak launch sites in three new locations (Ashville Bridge Creek, Hell's Point Creek, and Beggar's Creek); realign the existing Refuge entrance road, move and construct new fee booth and create an adjacent parking lot; create a separate hiking/biking trail to the VCS; renovate the existing HQ/VCS; construct a new HQ/VCS, and maintenance compound with associated parking and entrance/exit roads at the intersection of Sandbridge and New Bridge Roads; convert the Ashville Bridge Creek EEC to a maintenance facility once new HQ/VCS is constructed; utilize the Price House as a temporary office until new HQ/VCS is constructed and thereafter convert to an EEC; and develop a 2-mile hiking trail, with associated boardwalks and footbridges, along Ashville Bridge Creek between the new VCS and the Horn Point public access site.

The direct impact of the above proposed actions would result in improved/more efficient/safer infrastructure, as well as new infrastructure providing natural resources viewing opportunities on the Refuge. The expansion and construction of building and recreational amenities requires support infrastructure systems to include, potable water, sanitary sewer or septic systems, storm water management, solid waste disposal, roadway systems, and utilities. The construction of buildings and recreational amenities as planned for in this alternative are not expected to result in a significant adverse impact on existing support infrastructure programs, the public health/safety, or the environment. Support infrastructure plans for building and recreational amenities would provide specifics for necessary conveyance systems that protect public health and safety and the natural environment. All actions of this alternative would be conducted in accordance with applicable federal, state and local regulation and Refuge plans.

The indirect impacts of this resource action are primarily socioeconomic and may include an increase in Refuge visitation and revenues, employment and income opportunities, and environmental awareness programs. The increase in revenues for the Refuge may be offset by increases in additional maintenance required for new infrastructure.

#### **Alternative C—Improved Biological Integrity**

Alternative C would incorporate most of the actions mentioned for Alternative B, with the exception of moving the existing HQ/VCS to Little Island City Park, providing a privatized shuttle service from the VCS to the barrier island portion of the Refuge, and developing a 1.5 mile hiking trail along Nanny's Creek. Like Alternative B, the construction of buildings and recreational amenities are not expected to result in a significant adverse impact on existing support infrastructure programs, the public health/safety, or the environment.

Infrastructure maintenance responsibilities would decline, particularly those involving dikes, dike roads, water control structure and pump station maintenance programs. The direct impact of the Alternative C actions would be similar to Alternative B. Overall, Alternative C would be more beneficial for the public than Alternative A, but slightly less beneficial than Alternative B which would enhance the existing on-site HQ/VCS. Indirect impacts by Alternative C would be essentially the same as for Alternative B.

### **Refuge Visits**

#### **Alternative A—No-Action Alternative**

The No-Action Alternative would not provide additional amenities to increase Refuge visitation. Visitation has averaged 110,714 during FYs 2003 through 2006, with an overall net increase of 12 %, including a decrease in FY 2005. Alternative A would maintain the existing HQ/VCS, which is inadequate for efficient visitor services and administrative use and would not provide infrastructure improvements and educational programs to enhance visitor experience.

Indirect impacts may include a stagnation of community support for the Refuge as there would be no significant improvements in the visitor experience.

#### **Alternative B—Proposed Action**

No adverse impact to existing Refuge visitation would be expected under this alternative. The Proposed Action would promote an increase in Refuge visitation and services for the public. This alternative would renovate and improve the existing HQ/VCS, as well as construct new HQ/VCS on the west side of the Refuge (New Bridge Road), both of which would be more efficient and educationally friendly. An improved tram system would be expected to provide ease of access to and from areas of the Refuge. Wildlife sport and environmental education awareness programs would be expanded and real-world areas would

be provided for application of this new knowledge. All these new activities would be expected to result in new and repeated visitation by the public. Much of the new visitation is expected to be a result of passer-by traffic at the new HQ/VCS on New Bridge Road. Otherwise, vehicular traffic at the Refuge is expected to increase insignificantly.

The indirect impacts of this resource action are primarily socioeconomic and may include an increase in Refuge revenues, employment and income opportunities, and environmental awareness programs. The increase in revenues for the Refuge may be offset by increases in additional maintenance and operations required for new infrastructure and programs. In addition, this action may include stronger community support for the Refuge as the visitor experience would be enhanced.

#### **Alternative C—Improved Biological Integrity**

Alternative C would incorporate the actions mentioned for Alternative B. The only notable accessibility change to the Refuge in this alternative is that the existing HQ/VCS would be moved to the Little Island City Park (LICP) approximately one mile north of the existing Refuge HQ/VCS. Consequently, the new location would be closer to populated areas. This slight change in location, however, may result in an increase in Refuge “visitation” by people who wish to sunbathe at the LICP beach and find the Refuge parking lot more convenient for parking. Appropriate signage (to prohibit parking for beach access) may minimize such an adverse impact upon visitor parking for Refuge information. Nevertheless, most new Refuge visitation is expected to occur at the new facility along New Bridge Road.

### **Recreation**

#### **Alternative A—No-Action Alternative**

The No-Action Alternative would not incorporate objectives and strategies to enhance or change the recreational experience of Refuge visitors. There would be no expansion of deer hunting or waterfowl hunting opportunities with Alternative A. The No-Action Alternative would not develop a new biking/hiking trail near the existing Refuge entrance or develop hiking and canoe/kayak trails on the west side of the Refuge. Horse trail connections would also not be established with Alternative A and the tram system would not be improved. Also, Alternative A would not eliminate all motorized watercraft traffic within 0.5 mile of the Refuge’s Proclamation boundary, or manage personal watercraft use in high waterbird-use areas.

Indirect impacts by Alternative A may include stagnation or reduced visitation as recreational opportunities for the public would not be expanded. There is also the potential for an increase in personal watercraft use within 0.5 mile of the Proclamation boundary and in areas of high waterbird use- to the detriment of wildlife.

#### **Alternative B—Proposed Action**

No adverse impact to existing recreational pursuits would be expected under this alternative. This action would both expand and change recreation activities on the Refuge. The Proposed Action would expand deer hunting and waterfowl hunting opportunities, develop a new biking/hiking trail near the existing Refuge entrance and develop hiking and canoe/kayak trails on the west side of the Refuge, construct handicap accessible trail on Tract #244 (in conjunction with new HQ/VCS) after remaining land is reforested, manage personal watercraft use in high waterbird-use areas, and improve the tram system.

Direct impacts would include an estimated take of 38 deer from 44 hunters on 15 days, or 660 hunter days (occurring only during daylight hours). In addition, expanded kayaking/canoeing opportunities would have the potential to disturb wildlife. Studies show that canoes and rowboats can disturb wildlife (Bouffard 1982; Kaiser and Fritzell 1984; Knight 1984; Kahl 1991). Non-motorized

watercraft may affect waterfowl broods, wintering waterfowl, shorebirds, raptors, and long-legged waders. However, because of their low speed and use primarily during the warmer months the impact would not be significantly adverse, especially on wintering waterfowl and raptors. Overall, the Proposed Action would be very beneficial to recreational opportunities on the Refuge.

Indirect impacts would include increased visitation because of the expanded recreational opportunities. The expanded awareness of the Refuge and its recreational opportunities could result in an increase in personal watercraft use within 0.5 mile of the Proclamation boundary which would be to the detriment of wildlife. The indirect benefits of expanded deer hunting could include a reduction in deer/vehicle accidents, a reduction in Refuge and residential browse damage, and fewer deer available to transport Lyme-disease-bearing ticks. Expanded recreational hunting would result in an insignificant increase in noise to sensitive receptors in proximity to Hunting Zones A, D, F, and H. Also, the timing and location of expanded hunting, would not be expected to adversely disturb federal- or state-listed endangered or threatened species. A reduction in browse damage as a result of hunting would increase plant density and species diversity, and added vegetative growth would provide the structure necessary to benefit ground-nesting birds, as well as reptiles, amphibians and small mammals.

#### **Alternative C—Improved Biological Integrity**

Alternative C would incorporate most of the actions mentioned for Alternative B with the exception that Ragged Island and southern Long Island would now be protected from public disturbance; motorized watercraft traffic within 0.5 mile of the Refuge's Proclamation boundary would be eliminated; a trail would be established along Nanny's Creek; and a designated parking area and trailhead access to connect to potential adjacent City and neighborhood horse trail system for horseback riding would be established on the western boundary of the Refuge at Tract 244. The impacts would be similar to Alternative B with the notable exception of eliminating motorized watercraft within 0.5 miles of the boundary which would reduce indirect disturbance to wildlife more so than by Alternative B. Indirect impacts would be similar to Alternative B.

## **Cumulative Impacts**

Council on Environmental Quality (CEQ) regulations stipulate that the cumulative effects analysis within an EA should consider the potential environmental impacts resulting from "the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions" (40 CFR 1508.7).

Past, present, and reasonably foreseeable future actions of concern in this cumulative impact analysis focus on growth and development pressures associated with the Hampton Roads Region and the planning initiatives of the local government and non-government agencies to respond to those pressures. The No-Action and action alternatives of this EA for implementation of the CCP would not result in an adverse cumulative impact when combined with regional growth and planning efforts. Although the degree of beneficial impact varies between the alternatives of the CCP, each action alternative provides for a greater beneficial impact to the health and diversity of flora and fauna, habitats, water quality, wetlands, air quality, visual aesthetics, and recreation activities that complements the planning initiatives of organizations tasked with planning for areas outside the Refuge boundary. In combination with the Refuge's planning effort, the City of Virginia Beach plans for orderly growth and the protection of natural resource while trying to balance the needs of its population. The Hampton Roads Regional Planning District Commission also actively plans for the protection and acquisition of sensitive natural resources within the region. When combined with the Refuge's CCP, the planning actions of these organizations along with others in the region provide a relative degree of natural

resource protection that would not be realized in the absence of these planning efforts.

There are two specific recommendations from the alternatives of this EA that when combined with the development pressures outside of the boundary of the Refuge provide for a cumulative, but insignificant impact. The reduction of farmland under Alternative B and C of the CCP would combine with the gradual decline in agricultural cropland that is occurring on a regional and national basis. In addition, Alternatives B and C and the No-Action alternative continue the land acquisition strategy for land near or adjacent to the Refuge. When combined with the already existing competition for land by development organization, the two actions combine to reduce the availability and affordability of land in the region. The cumulative results of the acquisition effort would be offset by improved water quality within the Back Bay watershed.

## Cumulative Impacts Analysis

### Migratory Birds

The U.S. Fish and Wildlife Service annually prescribes the maximum number of waterfowl hunting days for each State, and the number of birds that may be taken and possessed. This framework is necessary to allow State selections of season and limits for recreation and sustenance; aid Federal, State, and tribal governments in the management of migratory game birds; and permit harvests at levels compatible with population status and habitat conditions. Because the Migratory Bird Treaty Act stipulates that all hunting seasons for migratory game birds are closed unless specifically opened by the Secretary of the Interior, the Service annually promulgates regulations (50 CFR Part 20) establishing the frameworks from which States may select season dates, bag limits, shooting hours, and other options for the each migratory bird hunting season. The frameworks are essentially permissive in that hunting of migratory birds would not be permitted without them. Thus, in effect, Federal annual regulations both allow and limit the hunting of migratory birds.

Migratory game birds are those bird species so designated in conventions between the United States and several foreign nations for the protection and management of these birds. Under the Migratory Bird Treaty Act (16 U.S.C. 703-712), the Secretary of the Interior is authorized to determine when “hunting, taking, capture, killing, possession, sale, purchase, shipment, transportation, carriage, or export of any ... bird, or any part, nest, or egg” of migratory game birds can take place, and to adopt regulations for this purpose. These regulations are written after giving due regard to “the zones of temperature and to the distribution, abundance, economic value, breeding habits, and times and lines of migratory flight of such birds,” and are updated annually (16 U.S.C. 704(a)). This responsibility has been delegated to the U.S. Fish and Wildlife Service as the lead Federal agency for managing and conserving migratory birds in the United States. Acknowledging regional differences in hunting conditions, the Service has administratively divided the nation into four Flyways for the primary purpose of managing migratory game birds. Each Flyway (Atlantic, Mississippi, Central, and Pacific) has a Flyway Council, a formal organization generally composed of one member from each State and Province in that Flyway. Back Bay NWR is within the Atlantic Flyway.

The process for adopting migratory game bird hunting regulations, located in 50 CFR part 20, is constrained by three primary factors. Legal and administrative considerations dictate how long the rule making process will last. Most importantly, however, the biological cycle of migratory game birds controls the timing of data-gathering activities and thus the dates on which these results are available for consideration and deliberation. The process of adopting migratory game bird hunting regulations includes two separate regulations-development schedules, based on “early” and “late” hunting season regulations. Early hunting seasons pertain to all migratory game bird species in Alaska, Hawaii, Puerto Rico, and the Virgin Islands; migratory game birds other than waterfowl (e.g.

dove, woodcock, etc.); and special early waterfowl seasons, such as teal or resident Canada geese. Early hunting seasons generally begin prior to October 1. Late hunting seasons generally start on or after October 1 and include most waterfowl seasons not already established. There are basically no differences in the processes for establishing either early or late hunting seasons. For each cycle, Service biologists and others gather, analyze, and interpret biological survey data and provide this information to all those involved in the process through a series of published status reports and presentations to Flyway Councils and other interested parties. Under the proposed action, Back Bay NWR estimates a maximum additional 30-45 ducks, and 15-25 geese will be harvested each year. This harvest impact represents less than one-tenth of a percent of Virginia's average harvest. Liberal duck seasons (75 days, 5 bird bag limit) and resident goose seasons have resulted in high waterfowl harvests in Virginia during the past several years. Harvest has averaged ~150,000 ducks and ~60,000 geese from 2000–2005, compared to 115,000 ducks and 25,000 geese during the 1990's (USFWS. 2007. Migratory bird hunting activity and harvest during the 2005 and 2006 hunting seasons: Preliminary estimates. <http://www.fws.gov/migratorybirds/reports/reports.html>). The long season length and liberal bags offer greater opportunity and a greater cumulative harvest over the course of the season.

Because the Service is required to take abundance of migratory birds and other factors into consideration, the Service undertakes a number of surveys throughout the year in conjunction with the Canadian Wildlife Service, State and Provincial wildlife-management agencies, and others. To determine the appropriate frameworks for each species, we consider factors such as population size and trend, geographical distribution, annual breeding effort, the condition of breeding and wintering habitat, the number of hunters, and the anticipated harvest. After frameworks are established for season lengths, bag limits, and areas for migratory game bird hunting, migratory game bird management becomes a cooperative effort of State and Federal Governments. After Service establishment of final frameworks for hunting seasons, the States may select season dates, bag limits, and other regulatory options for the hunting seasons. States may always be more conservative in their selections than the Federal frameworks but never more liberal. Season dates and bag limits for National Wildlife Refuges open to hunting are never longer or larger than the State regulations.

NEPA considerations by the Service for hunted migratory game bird species are addressed by the programmatic document, "Final Supplemental Environmental Impact Statement: Issuance of Annual Regulations Permitting the Sport Hunting of Migratory Birds (FSES 88– 14)," filed with the Environmental Protection Agency on June 9, 1988. We published Notice of Availability in the Federal Register on June 16, 1988 (53 FR 22582), and our Record of Decision on August 18, 1988 (53 FR 31341). Annual NEPA considerations for waterfowl hunting frameworks are covered under a separate Environmental Assessment, "Duck Hunting Regulations for 2006-07," and an August 24, 2006, Finding of No Significant Impact. Further, in a notice published in the September 8, 2005, Federal Register (70 FR 53376), the Service announced its intent to develop a new Supplemental Environmental Impact Statement for the migratory bird hunting program. Public scoping meetings were held in the spring of 2006, as announced in a March 9, 2006, Federal Register notice (71 FR 12216). More information may be obtained from: Chief, Division of Migratory Bird Management, U.S. Fish and Wildlife Service, Department of the Interior, MS MBSP-4107-ARLSQ, 1849 C Street, NWR, Washington, DC 20240.

### **Deer**

In the absence of top-level, mammalian predators (wolves, coyotes, cougar, bears, etc.) a consistent deer hunt harvest is essential to maintain a herd at or below habitat carrying capacity. When deer exceed the carrying capacity of a habitat, they over-browse or strip that habitat. Such degradation can completely

change the habitat species composition, and reduce overall plant and animal biodiversity of that habitat. During the past few years, the Refuge has reforested approximately 500 acres with bottomland hardwood and bald cypress tree species. Tree seedlings of this age (1-9 years old) can be killed by over-browsing. Failure to establish this native bottomland hardwood forest will have negative impacts on future resident and non-resident wildlife populations. Such a failure would also eliminate Refuge efforts to close up the forest canopy and consolidate the last large forest tract in Virginia Beach. Deer overpopulation can lead to starvation, hemorrhagic disease, bluetongue and Chronic Wasting Disease (CWD) outbreaks, as well as increased car-deer collisions and poorer overall herd health.

Deer hunting does not have regional population impacts due to restricted home ranges; only local impacts occur. During the past deer season, 223,198 deer were reported killed by hunters in Virginia. This total included 106,595 antlered bucks, 19,652 button bucks, and 96,951 does (43.4%). This represents a 4% increase from the 215,082 deer reported killed last year. It is also 7% higher than the last 10-year average of 208,300. As stated earlier, direct impacts on hunting of deer from Alternative B or C would include an estimated take of 38 deer from 44 hunters on 15 days, or 660 hunter days (occurring only during daylight hours).

These harvest and survey data confirm that decades of deer hunting on surrounding private lands have not had a local cumulative adverse effect on the deer population. Therefore, expanding hunting on 1,394 acres of Refuge lands for a very limited deer hunt (maximum 660 hunter-days) should not have negative cumulative impacts on the deer herd; instead, it should support better overall herd health and maintain or increase habitat biodiversity.

White-tailed deer management in Virginia is based on the fact that herd density and health are best controlled by regulating and encouraging antlerless deer harvest levels. Female deer harvest numbers have been at record levels for the past four consecutive years. Deer management objectives and regulations are set on a county basis, and regulations are evaluated and amended every other year on odd years. For the vast majority of the Commonwealth of Virginia, current deer management objectives call for the deer herd(s) to be stabilized at their early to mid 1990's deer harvest levels. These objectives appear to be working fairly well over most of the state.

Disturbance to nongame migratory birds, mammals and other wildlife by deer hunters could have some short-term negative local impacts (i.e., disturbance to daily wintering activities, such as feeding and resting). However, cumulative and significant negative impacts are not expected as the hunting seasons do not coincide with the normal breeding seasons. Long-term future impacts related to deer hunting are therefore not relevant, because of the relatively short hunting season.

### **Feral Hogs**

Feral hogs are an introduced, non-native species that is extremely invasive and is not considered a game species by the Commonwealth of Virginia. No bag limits are established for feral hogs. Feral hogs are considered a threat to the biological integrity of the Refuge. They can harbor a large number of infectious diseases, many of which can be fatal to wildlife. By rooting and wallowing, feral hogs destroy habitat that wildlife depend on. Destruction includes erosion along waterways and wetlands and the loss of native plants. Additionally, feral hogs compete directly with other birds and mammals for plant and animal foods. They are opportunistic predators of small mammals, young deer fawns, ground-nesting birds (including ducks, geese, quail and turkeys), reptiles and invertebrates.

The hunting of feral hogs provides the Refuge with another management tool in reducing this detrimental species, and offers an opportunity enjoyed by local hunters. Cumulative effects to this invasive species is not of major concern, as the

Refuge would like to extirpate this species on Refuge lands. Hunting of hogs is not considered detrimental to the biological integrity of the Refuge; is not likely to create a conflict with other public uses; and is within the wildlife dependent public uses to be given priority consideration. Since hogs are non-native, they are not a priority species in Refuge management considerations. They are a popular game species though, and the public interest would best be served by continuing this activity on the Refuge. However, even with hunting, feral hogs are likely to always be present because they are prolific breeders. Sightings of feral hogs by Refuge staff have steadily increased over the past five years, despite the existing public hunting program.

Disturbance to nongame migratory birds, mammals and other wildlife by feral hog hunters could have some short-term negative local impacts (i.e., disturbance to daily wintering activities, such as feeding and resting). However, cumulative and significant negative impacts are not expected as the hunting seasons do not coincide with the normal breeding seasons. Long-term future impacts related to feral hog hunting are therefore not relevant, because of the relatively short hunting season.

#### **Nongame Wildlife**

Nongame wildlife include the following: migratory birds such as songbirds, wading birds, raptors, and other landbirds; small mammals such as voles, moles, mice, shrews, and bats; reptiles and amphibians such as snakes, skinks, turtles, lizards, salamanders, frogs and toads; and invertebrates such as butterflies, moths, other insects and spiders. Except for migratory birds, these species have very limited home ranges and hunting could not possibly affect their populations regionally; thus, only local effects will be discussed.

Disturbance to nongame migratory birds could potentially have some regional, local, and flyway effects. However, cumulative negative impacts are not expected as the hunting seasons do not coincide with the nesting season. Any long-term future impacts that could occur if reproduction was reduced by hunting are therefore not relevant for this reason. Disturbance to the daily wintering activities, such as feeding and resting, of birds may occur, but any disturbance to birds caused by hunters is probably commensurate with that caused by non-consumptive users.

Disturbance of non-target resident wildlife, particularly the less mobile mammals, reptiles and amphibians is likely during the fall hunt, prior to the onset of weather cold enough to bring on their winter hibernation or torpor. However, the nocturnal habits of many wildlife residents should minimize this disturbance level. Hunt regulations will further protect non-target species (particularly reptiles) from harm or disturbance by banning the injuring or shooting of non-target species. As hunting seasons extend into the winter, the level of disturbance will be further reduced. The hunt benefits (reduced deer and feral pig populations, together with the resulting protection and improvements to wildlife habitat diversity) outweigh possible temporary disruptions to nongame wildlife communities that also use these areas. The hunting program's resulting habitat improvement, also indirectly and directly benefits resident wildlife communities.

### **Adverse Environmental Effects Which Cannot Be Avoided Should an Action Alternative be Implemented**

The action alternatives would result in direct minor adverse effects upon vegetation to construct proposed infrastructure (i.e. visitor buildings, recreational amenities, etc.), revenues to farmers and associated revenues or services to the Refuge from the farmers' activities, and recreational amenities due to changes in access and availability. The loss of vegetation for infrastructure construction would be more than offset by the natural resource management actions proposed under the action alternatives. For example, the action alternatives propose the conversion of approximately 100 acres of cropland to shrub-scrub and forested habitat (over time) and the conversion of 139 acres of old farm fields to shrub-scrub and forest habitats. In addition, recreational and

wildlife sport and environmental education amenities proposed under the action alternatives will provide a long-term value in educating people about natural resource protection. Reduced revenues and service provided to the Refuge from farming operations would be offset through reductions in air emissions, noise, fertilizers, and pesticides into the local environment from farming operations and improved wildlife habitat. In addition, the action alternatives provide for expanded recreational amenities that would offset the limited changes in amenities and result in additional revenues for the Refuge.

With Alternative C, an important loss of beneficial foods (annual and perennial plants, invertebrates, etc.) to migratory waterbirds (especially waterfowl and shorebirds) will follow when the impoundment complex is allowed to revert to shrub-scrub and natural emergent marshes. This loss may reduce the ability of the Refuge to meet its waterbird management goals and objectives.

**Relationship Between Short-Term Uses of Man's Environment and Long-Term Productivity**

Short-term use of the environment associated with the action alternatives would include changes to the physical environment and energy and utility use during the construction of new buildings, parking lots, roadways, and trails, as well as the reversion to natural shrub-scrub and wetlands on 880 acres of the barrier island portion of the Refuge for Alternative C. Long-term productivity of flora and fauna would increase from either action alternative; since they would probably increase the recreational and educational opportunities, and improve the quality of flora, fauna, and habitat resources on the rest of the Refuge.

**Irreversible and Irretrievable Commitment of Resources**

Irreversible and irretrievable resource commitments are related to the use of non-renewable resources and the effects that the uses of these resources have on future generations. An irreversible effect primarily results from the uses or destruction of a specific resource (i.e., energy or minerals) that cannot be replaced within a reasonable timeframe.

Short-term irreversible commitment of resources would occur by the action alternatives, and include the use of energy during construction of new buildings, parking lots, roadways, and trails. The long-term commitment of resource would include the acquisition of additional lands by the Refuge for water quality protection.

Irretrievable commitments of resources are those resources that would be lost for a period of time. In this case, the duration for which the USFWS would maintain the proposed infrastructure improvements. The degree of irretrievable commitments of resources varies by alternative, but for the action alternatives they would include vegetation communities removed within the footprint of proposed infrastructure and the loss of active farmland.

**Table 4.1. Summary of the effects of management alternatives on Back Bay Refuge resources**

Subject Areas	Alternative A	Alternative B	Alternative C
Surface Waters, Water Quality, & Wetlands	No reduction in watercraft, feral hogs, or elimination of farming that would improve water quality. No short-term adverse impacts from construction.	Reduction in personal watercraft use, feral hogs, and elimination of farming would improve water quality. Short-term minor adverse impacts during construction period.	Same as Alternative B, except that motorized watercraft eliminated within 0.5 mile of proclamation boundary.
Air and Noise	No long-term reduction of air emissions and noise from existing tram use, farming, and watercraft on the Refuge. No short-term increase in air emissions or noise from construction.	Long-term reduction of air emissions and noise from increased tram use, fewer watercraft, and no farming on the Refuge. Short-term minor increase in air emissions and noise from construction.	Same as Alternative B, except that there would be more reduction in air emissions and noise as motorized watercraft eliminated within 0.5 mile of proclamation boundary.
Visual Resources	No change in visual aesthetics from current conditions.	New HQ/VCS, boardwalks, and canoe/kayak launches would use aesthetic designs. Existing HQ/VCS would be renovated internally & externally.	Same as Alternative B, except the existing HQ/VCS would be moved, without aesthetic improvements, to Little Island City Park.
Vegetation Types	On-going control of invasive plants would minimally improve plant diversity, and farming of croplands would continue. There would be no clearing of vegetation from construction.	Croplands and old farm fields would be converted to shrub-scrub and forested habitats. There would be minimal clearing of vegetation for proposed infrastructure.	Same as Alternative B, except that only croplands would be converted, and there would be greater removal of common reed to improve plant diversity.
Threatened and Endangered Plants	Routine management would be provided for rare flora.	Same as Alternative A.	Same as Alternative A, except that greater removal of common reed may benefit rare flora.
Unique Ecosystems	Routine management for the Green Hills maritime forest and white cedar stand.	There would be beneficial thinning and prescribed burning for the Green Hills maritime forest.	Same as Alternative B, except that prescribed burning would be optional.
Diversity of Plant Communities	Routine management of Refuge plant communities. No reduction in deer or feral hogs that adversely affect such habitats.	Reduction in deer and feral hogs would improve plant communities on the Refuge.	Same as Alternative B, except that there would also be greater removal of common reed to the benefit of such habitats.
Noxious/Invasive Weeds	Routine spraying of invasive species such as common reed, Japanese stiltgrass, and American lotus.	Same as Alternative A, except that the Refuge would encourage treatment of common reed outside its boundaries.	Same as Alternative A, except that there would be greater removal of common reed on the Refuge.
Wildlife Habitats	There would be passive succession of open lands and routine management of wildlife habitats. Existing cropland would continue to provide minimal habitat value. Watercraft traffic harmful to habitats would not be reduced. No reduction in deer or feral hogs that adversely affect wildlife habitats.	Existing cropland and old farm fields would be converted to shrub-scrub and forested habitats. Increased hunting of deer and feral hogs would improve wildlife habitats. New infrastructure would result in long-term minor adverse impacts on wildlife habitats.	Same as Alternative B, except that only croplands would be converted and greater removal of common reed may benefit wildlife.

Subject Areas	Alternative A	Alternative B	Alternative C
General Wildlife	Cropland having minimal food value for wildlife would continue to be farmed. Existing levels of hunting would occur for deer and feral hogs. There would be no waterfowl hunting on the Refuge.	Increased hunting of deer and feral hogs would benefit other species of wildlife. Waterfowl hunting would be established on the north and west sides of the Refuge. New hiking trails and canoe/kayak trails may increase disturbance to wildlife, whereas reducing personal watercraft would reduce such disturbance.	Same as Alternative B, except that eliminating motorized watercraft within 0.5 mile of proclamation boundary would further reduce disturbance to wildlife.
Threatened and Endangered Wildlife	Current management practices would be provided for rare fauna. There would be no additional staff and/or volunteers to monitor sea turtle nests and conduct patrols. Dog-walking would be permitted on the barrier spit.	Volunteers would be sought to help monitor sea turtle nests and conduct patrols. A reduction in personal watercraft in high waterbird -use areas and the phasing out of Refuge Motor Vehicle Access (MVA) may benefit rare fauna. Also, dog-walking would be eliminated on the refuge, including the barrier spit.	Motorized watercraft would be eliminated within 0.5 mile of the proclamation boundary.
Non-native Species & Animal Control	Current management to control deer, feral hogs, feral cats, and wild horses.	Expanded control of deer and feral hogs.	Same as Alternative B.
Employment	Maintain current levels of staffing on the Refuge. No short-term employment for construction.	Increase volunteer hours by 10 % to support expansion of visitor facilities and services. Short-term increase in employment associated with construction for proposed infrastructure. Limited addition of staff to support visitor facilities and services over the long term.	Same as Alternative B, except that volunteer hours would increase by 20 % and internships would increase by 50 %. Also, additional staff would be hired to support expansion of visitor facilities and services, as well as to monitor sea turtle nests and conduct patrols.
Income	Current levels of income would be maintained, including that from cooperative farming.	Expanded recreational and educational opportunities may result in additional revenue. However, the elimination of cooperative farming would reduce Refuge income. There would be a short-term increase in income for some construction workers during infrastructure construction.	Same as Alternative B, except that there would also be new sources of income for the additional staff hired to support expansion of visitor facilities and services, as well as to monitor sea turtle nests and conduct patrols.
Land Use	Cooperative farming would be continued, and WSAs would not be changed. Open land would not be developed for new infrastructure, and new waterfowl and deer hunting zones would not be established.	Current croplands and old farm fields would be converted to shrub-scrub and forested habitats over time. A minor amount of open land would be converted to proposed new infrastructure. New waterfowl and deer hunting zones would be created.	Same as Alternative B, except WSAs would be nominated as "Wilderness Areas," and access to Long Island and Ragged Island would be prohibited.

Subject Areas	Alternative A	Alternative B	Alternative C
Historical & Archaeological	There would be no ground disturbance from construction activities that could impact cultural resources.	Construction activities by the Proposed Action would not impact known cultural resources.	Same as Alternative B.
Refuge Goals	The existing goals, objectives, and strategies would continue to be implemented.	The objectives and strategies for the Proposed Action would be more beneficial to recreation, education, and natural resources than Alternative A.	Same as Alternative B.
Refuge Revenue Sharing	No change in the existing revenue sharing program. Revenue from cooperative farming would continue.	Proposed action would increase revenue, though somewhat offset by loss of cooperative farming revenue.	Same as Alternative B.
Infrastructure	No changes in the existing infrastructure.	New infrastructure would include 3 new canoe/kayak launch sites, new HQ/VCS, new EEC & maintenance compound, renovate existing HQ/VCS, construct new trails along Ashville Bridge Creek & north of existing HQ/VCS.	Same as Alternative B, except the existing HQ/VCS would be moved to Little Island City Park and there would be a new hiking trail along Nanny's Creek.
Refuge Visits	No substantial actions to encourage an increase in visitation.	New and improved infrastructure for education and recreation would promote increased visitation.	Same as Alternative B.
Recreation	Deer, hog, and waterfowl hunting would not be expanded. There would be no new hiking or canoe/kayak trails established. The tram system would not be improved.	Expanded deer, hog, and waterfowl hunting. More recreational opportunities than Alternatives A and C. Also, the tram system would be improved.	Same as Alternative B, except motorized watercraft eliminated within 0.5 mile of proclamation boundary and a new trail would be placed along Nanny's Creek.
Cumulative Impacts	No adverse cumulative impacts.	Beneficial cumulative impact with other regional plans regulating growth and protecting natural resources. Adversely combines with the regional issue of competition for land and reduced farmland.	Same as Alternative B