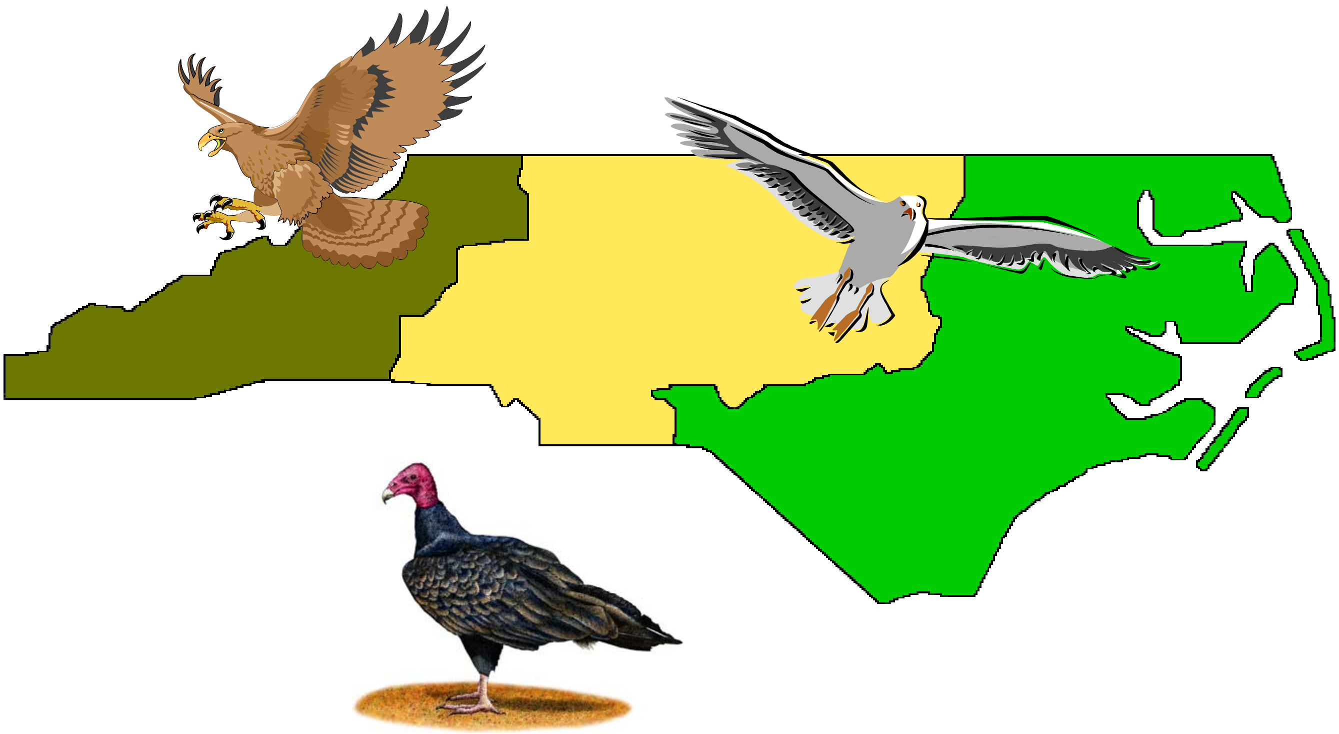
ENVIRONMENTAL ASSESSMENT
(FINAL)

REDUCING BIRD DAMAGE IN THE STATE OF NORTH CAROLINA



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ACRONYMS

AI	Avian Influenza
APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
BBS	Breeding Bird Survey
BCR	Bird Conservation Region
CBC	Christmas Bird Count
CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
DNC	4,4'-dinitrocarbanilide
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
FY	Fiscal Year
HDP	2-hydroxy-4,6-dimethylpyrimidine
INAD	Investigational New Animal Drug
LD	Median Lethal Dose
LC	Median Lethal Concentration
MBTA	Migratory Bird Treaty Act
MOU	Memorandum of Understanding
NASS	National Agricultural Statistics Service
NCDACS	North Carolina Department of Agriculture and Consumer Services
NCWRC	North Carolina Wildlife Resources Commission
NEPA	National Environmental Policy Act
NWRC	National Wildlife Research Center
ROD	Record of Decision
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
USAF	United States Air Force
USC	United States Code
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WS	Wildlife Services

CHAPTER 1: NEED FOR ACTION AND SCOPE OF ANALYSIS

1.1 INTRODUCTION

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS)[1] program in North Carolina continues to receive requests for assistance or anticipates receiving requests for assistance to resolve or prevent damage occurring to agricultural resources, natural resources, and property, including threats to human safety associated with several bird species. Those bird species include Canada geese (*Branta canadensis*), mallards (domestic/wild) (*Anas platyrhynchos*), feral waterfowl[2], wild turkeys (*Meleagris gallopavo*), rock pigeons (*Columba livia*), mourning doves (*Zenaida macroura*), American coots (*Fulica americana*), killdeer (*Charadrius vociferous*), upland sandpipers (*Bartramia longicauda*), Bonaparte's gulls (*Chroicocephalus philadelphia*), laughing gulls (*Leucophaeus atricilla*), ring-billed gulls (*Larus delawarensis*), herring gulls (*Larus argentatus*), great black-backed gulls (*Larus marinus*), double-crested cormorants (*Phalacrocorax auritus*), brown pelicans (*Pelecanus occidentalis*), great blue herons (*Ardea herodias*), black vultures (*Coragyps atratus*), turkey vultures (*Cathartes aura*), osprey (*Pandion haliaetus*), bald eagles (*Haliaeetus leucocephalus*), golden eagles (*Aquila chrysaetos*), eastern kingbirds (*Tyrannus tyrannus*), American crows (*Corvus brachyrhynchos*), fish crows (*Corvus ossifragus*), barn swallows (*Hirundo rustica*), eastern bluebirds (*Sialia sialis*), northern mockingbirds (*Mimus polyglottos*), European starlings (*Sturnus vulgaris*), house sparrows (*Passer domesticus*), house finches (*Haemorhous mexicanus*), Eastern meadowlarks (*Sturnella magna*), red-winged blackbirds (*Agelaius phoeniceus*), brown-headed cowbirds (*Molothrus ater*), and common grackles (*Quiscalus quiscula*).

In addition to those species, WS could also receive requests for assistance to manage damage and threats of damage associated with several other bird species but requests for assistance associated with those species would occur infrequently and/or requests would involve a small number of individual birds of a species. Damages and threats of damages associated with those species would occur primarily at airports where individuals of those species pose a threat of aircraft strikes. Appendix B contains a list of species that WS could address in low numbers and/or infrequently when those species cause damage or pose a threat of damage.

This environmental assessment (EA) will assist in determining if the proposed cumulative management of bird damage could have a significant impact on the environment based on previous activities conducted by WS and based on the anticipation of conducting additional efforts to manage damage. WS' mission and directives[3] would be to provide assistance when the appropriate property owner or manager requests such assistance, within the constraints of available funding and workforce; therefore, it is conceivable that additional damage management efforts could occur beyond those efforts conducted during previous activities. Thus, this EA anticipates those additional efforts and the analyses would apply to actions that may occur in any locale and at any time within North Carolina as part of a coordinated program. The analyses contained in this EA are based on information derived from WS' Management Information System, data from the USFWS, published documents (see Appendix A), interagency consultations, public involvement, and other environmental documents.

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[1]The WS program is authorized to protect agriculture and other resources from damage caused by wildlife through the Act of March 2, 1931 (46 Stat. 1468; 7 USC 8351-8352) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 8353).

[2]Free-ranging or feral domestic waterfowl refers to captive-reared, domestic, of some domestic genetic stock, or domesticated breeds of ducks, geese, and swans. Examples of domestic waterfowl include, but are not limited to, mute swans, Pekin ducks, Rouen ducks, Cayuga ducks, Swedish ducks, Chinese geese, Toulouse geese, khaki Campbell ducks, Embden geese, and pilgrim geese. Feral ducks may include a combination of mallards, Muscovy ducks, and mallard-Muscovy hybrids.

[3]At the time of preparation, WS' Directives occurred at the following web address: https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/SA_WS_Program_Directives.

This EA evaluates the need for action to manage damage associated with birds in the State, the potential issues associated with bird damage management, and the environmental consequences of conducting alternative approaches to meeting the need for action while addressing the identified issues. WS initially developed the issues and alternatives associated with bird damage management in consultation with the USFWS and the North Carolina Wildlife Resources Commission (NCWRC). The USFWS has the overall regulatory authority to manage populations of migratory bird species, while the NCWRC has the authority to manage wildlife populations in the State of North Carolina. To assist with identifying additional issues and alternatives to managing damage, WS will make this EA available to the public for review and comment prior to the issuance of a Decision[4].

WS has previously developed EAs that analyzed the need for action to manage damage associated with several bird species in North Carolina[5]. The previous EAs identified issues associated with managing damage that birds cause in North Carolina and analyzed alternative approaches to meet the specific need identified in the EAs while addressing the issues associated with managing damage. Changes in the need for action and the affected environment have prompted WS to initiate this new analysis to manage bird damage in the State. This new EA will address more recently identified changes and will assess the potential environmental impacts of program alternatives based on a new need for action, primarily a need to address damage and threats of damage associated with several additional species of birds. Because this EA will re-evaluate those activities conducted under the previous EAs to address the new need for action and the associated affected environment, the analysis and the outcome of the Decision issued for this EA will supersede the previous EAs that addressed the need to manage damage associated with birds.

This new EA will assist in determining if the proposed management of damage associated with birds could have a significant impact on the environment for both people and other organisms. This EA will analyze several alternatives to address the need for action and the identified issues and document the environmental consequences of the alternatives to comply with the National Environmental Policy Act (NEPA). In addition, this new EA will inform the public and coordinate efforts between WS, the USFWS, the NCWRC, and other entities.

1.2 NEED FOR ACTION

Some species of wildlife have adapted to and have thrived in human altered habitats. Those species, in particular, are often responsible for the majority of conflicts between people and wildlife. Those conflicts often lead people to request assistance with reducing damage to resources and to reduce threats to human safety. Wildlife can have either positive or negative values depending on the perspectives and circumstances of individual people. In general, people regard wildlife as providing economic, recreational, and aesthetic benefits. Knowing that wildlife exists in the natural environment provides a positive benefit to some people. However, activities associated with wildlife may result in economic losses to agricultural resources, natural resources, property, and threaten human safety. Therefore, an awareness of the varying perspectives and values are required to balance the needs of people and the needs of wildlife. When addressing damage or threats of damage caused by wildlife, wildlife damage management professionals must consider not only the needs of those people directly affected by wildlife damage but a range of environmental, sociocultural, and economic considerations as well.

Resolving wildlife damage problems requires consideration of both sociological and biological carrying capacities. The wildlife acceptance capacity, or cultural carrying capacity, is the limit of human tolerance

[4]After the development of the EA by WS and after public involvement in identifying new issues and alternatives, WS will issue a Decision. Based on the analyses in the EA and public involvement, a decision will be made to either publish a Notice of Intent to prepare an Environmental Impact Statement or publish a notice a Finding of No Significant Impact in accordance to the NEPA and the Council of Environmental Quality regulations.

[5]See Section 1.7 of this EA for further discussion on the previous EA developed by WS to manage damage caused by bird species.

for wildlife or the maximum number of a given species that can coexist compatibly with local human populations. The biological carrying capacity is the ability of the land or habitat to support healthy populations of wildlife without degradation to the species' health or their environment during an extended period of time (Decker and Purdy 1988). Those phenomena are especially important because they define the sensitivity of a person or community to a wildlife species. For any given damage situation, there are varying thresholds of tolerance exhibited by those people directly and indirectly affected by the species and any associated damage. This damage threshold determines the wildlife acceptance capacity. While the biological carrying capacity of the habitat may support higher populations of wildlife, in many cases the wildlife acceptance capacity is lower. Once the wildlife acceptance capacity is met or exceeded, people begin to implement population or damage management to alleviate damage or address threats to human health and safety.

Wildlife damage management is the alleviation of damage or other problems caused by or related to the behavior of wildlife and can be an integral component of wildlife management (The Wildlife Society 2015). The threat of damage or loss of resources is often sufficient for people to initiate individual actions and the need for damage management can occur from specific threats to resources. Those animals have no intent to do harm. They utilize habitats (*e.g*., reproduce, walk, forage) where they can find a niche. If their activities result in lost economic value of resources or threaten human safety, people characterize this as damage. When damage exceeds or threatens to exceed an economic threshold and/or poses a threat to human safety, people often seek assistance with resolving damage or reducing threats to human safety.

The threshold triggering a request for assistance is often unique to the individual person requesting assistance and many factors can influence when people request assistance (*e.g.*, economic, social, aesthetics). Therefore, what constitutes damage is often unique to an individual person. What one individual person considers damage, another person may not consider as damage. However, the use of the term "*damage*" is consistently used to describe situations where an individual person has determined the losses associated with wildlife is actual damage requiring assistance (*i.e*., has reached an individual threshold). Many people define the term "*damage*" as economic losses to resources or threats to human safety; however, "*damage*" could also occur from a loss in the aesthetic value of property and other situations where the behavior of wildlife was no longer tolerable to an individual person.

The need for action to manage damage and threats associated with birds in North Carolina arises from requests for assistance[6] received by WS to reduce and prevent damage from occurring to four major categories. Those four categories are agricultural resources, natural resources, property, and threats to human safety. WS has identified those bird species most likely to be responsible for causing damage to those four categories in the State based on previous requests for assistance and assessments of the threat of bird strike hazards at airports in the State. Many of the bird species addressed in this EA can cause damage to or pose threats to a variety of resources (see Table 1.1). In North Carolina, most requests for assistance received by WS are related to threats associated with those bird species being struck by aircraft at or near airports in the State. Bird strikes can cause substantial damage to aircraft requiring costly repairs. In some cases, bird strikes can lead to the catastrophic failure of the aircraft, which can threaten passenger safety.

WS also receives requests for assistance to manage damage to many other resources. For example, WS could receive requests for assistance to harass birds away from oil slicks or spills and to recover birds that become impaired after landing in oil slicks or spills. WS could provide assistance with projects to reduce

[6]WS would only conduct bird damage management after receiving a request for assistance. Before initiating bird damage activities, a Memorandum of Understanding, work initiation document, or another comparable document must be signed between WS and the cooperating entity that lists all the methods the property owner or manager would allow to be used on property they own and/or manage.

damage to structures from bird droppings or nesting materials. Those structures may range from a homeowner's wood siding to vast power substations and transmission lines to the roofs of buildings at railway transfer stations. Damage could also occur to agricultural resources, primarily from birds that consume livestock feed, feed on livestock, or pose disease risks to livestock. Similarly, threats to natural resources would primarily be associated with birds preying upon threatened or endangered species or competing with other wildlife species for resources.

Table 1.1 – Primary bird species that WS could address and the resource types threatened

	Resource*					Resource			
Species	**A**	**N**	**P**	**H**	**Species**	**A**	**N**	**P**	**H**
Canada Goose	X	X	X	X	Turkey Vulture	X		X	X
Mallard	X	X	X	X	Osprey	X		X	X
Feral Waterfowl	X	X	X	X	Bald Eagle			X	X
Wild Turkey	X		X	X	Golden Eagle			X	X
Rock Pigeon	X	X	X	X	Eastern Kingbird			X	X
Mourning Dove			X	X	American Crow	X	X	X	X
American Coot			X	X	Fish Crow	X	X	X	X
Killdeer			X	X	Barn Swallow	X		X	X
Upland Sandpiper			X	X	Eastern Bluebird			X	X
Bonaparte's Gull	X	X	X	X	Northern Mockingbird			X	X
Laughing Gull	X	X	X	X	European Starling	X	X	X	X
Ring-billed Gull	X	X	X	X	House Sparrow	X	X	X	X
Herring Gull	X	X	X	X	House Finch			X	X
Great Black-backed Gull	X	X	X	X	Eastern Meadowlark			X	X
Double-crested Cormorant	X	X	X	X	Red-winged Blackbird	X		X	X
Brown Pelican			X	X	Brown-headed Cowbird	X		X	X
Great Blue Heron	X		X	X	Common Grackle	X	X	X	X
Black Vulture	X		X	X					

*A=Agriculture, N =Natural Resources, P=Property, H=Human Safety (includes aviation safety and potential disease transmission to humans)

Some of the species addressed in this EA are gregarious (*i.e.*, form large flocks), especially during the fall and spring migration periods or during the breeding season. Although damage and threats can occur throughout the year, damage or the threat of damage is often highest during those periods when birds are concentrated into large flocks, such as migration periods, and during winter months when food sources are limited. For some bird species, high concentrations of birds occur during the breeding season where suitable nesting habitat exists, such as swallows and gulls. The flocking behavior of many bird species during migration periods can pose increased risks when those species occur near or on airport properties. Aircraft striking multiple birds not only can increase the damage to the aircraft but can also increase the risk that a catastrophic failure of the aircraft might occur, especially if multiple birds are ingested into aircraft engines. The following subsections of the EA provide additional information regarding the need to manage bird damage.

Need to Resolve Bird Damage to Agricultural Resources

Agriculture continues to be an important sector in the North Carolina economy with the National Agricultural Statistics Service (NASS) estimating the market value of agricultural products sold in North Carolina at nearly $12.6 billion during 2012 (NASS 2017). In 2016, agricultural production occurred pm 8.2 million acres of land in North Carolina associated with approximately 48,000 farms (NASS 2017). During 2012, poultry, hogs, grains, and tobacco products accounted for over 81% of the agricultural cash receipts in the State (NASS 2017). The top farm commodities for cash receipts were generated from the production of poultry products and eggs, which together accounted for nearly 38% of the cash receipts in the State. In 2012, cattle and calves accounted for over $333 million in cash receipts with over $179 million in cash receipts from the production of dairy products and milk (NASS 2017). The cattle and calf inventory in 2016 was estimated at nearly 830,000 cattle with hogs estimated at 9.3 million head (NASS 2017). Cash receipts from the production of catfish and trout totaled over $23 million in 2012 (NASS 2017).

A variety of bird species can cause damage to agricultural resources in the State. Damage and threats of damage to agricultural resources is often associated with bird species that exhibit flocking behaviors (*e.g.*, red-winged blackbirds, European starlings) or colonial nesting behavior (*e.g.*, rock pigeons). Damage occurs through direct consumption of agricultural resources, the contamination of resources from fecal droppings, or the threat of disease transmission to livestock from contact with fecal matter. As shown in Table 1.1, many of the bird species addressed in this EA have been identified as causing damage to or posing threats to agricultural resources in North Carolina.

Damage to Aquaculture Resources

Damage to aquaculture resources occurs primarily from the economic losses associated with birds consuming fish and other commercially raised aquatic organisms. Damage can also result from the death of fish and other aquatic wildlife from injuries associated with bird predation as well as the threat of disease transmission from one impoundment to another or from one aquaculture facility to other facilities as birds move between sites. The principal species propagated at aquaculture facilities in North Carolina are catfish and trout (NASS 2014*a*). In 2013, there were 146 commercial aquaculture operations in North Carolina with nearly $25.1 million in sales (NASS 2014*b*).

Double-crested cormorants can feed on fish that people raise for human consumption, and on fish commercially raised for bait and restocking in North Carolina. Price and Nickum (1995) concluded that the aquaculture industry has small profit margins so that even a small percentage reduction in the farm gate value due to predation is an economic issue. The magnitude of economic impacts that cormorants have on the aquaculture industry can vary dependent upon many different variables including, the value of the fish stock, number of depredating birds present, and the time of year the predation is taking place. The frequency at which double-crested cormorants occur at a given aquaculture facility can be a function of many interacting factors, such as the size of the regional and local cormorant population, the number, size, and distribution of aquaculture facilities, and the size distribution, density, health, and species composition of fish populations at facilities. Other factors may include the number, size, and distribution of wetlands in the immediate area, the size distribution, density, health, and species composition of free-ranging fish populations in the surrounding landscape, the number, size, and distribution of suitable roosting habitat, and the variety, intensity and distribution of local damage abatement activities.

Double-crested cormorants are adept at seeking out the most favorable foraging and roosting sites. As a result, cormorants rarely distribute evenly over a given region, but rather tend to be highly clumped or localized. Damage abatement activities can shift bird activities from one area to another; thereby, not eliminating predation but only reducing damage at one site while increasing damage at another location (Aderman and Hill 1995, Mott et al. 1998, Reinhold and Sloan 1999, Tobin et al. 2002). Thus, some aquaculture producers in a region may suffer little or no economic damage from cormorants while others experience exceptionally high predation.

Great blue herons, great egrets, and other wading birds may forage at aquaculture facilities. These problems have been associated with depredations on trout (Parkhurst et al. 1992, Pitt and Conover 1996, Glahn et al. 1999*a*, Glahn et al. 1999*b*), baitfish (Hoy et al. 1989), and ornamental fish (Avery et al. 1999). The two primary wading bird species implicated in depredations on catfish are the great blue heron and the great egret (Hodges 1989, Ross 1994, Glahn et al. 1999*c*). Herons and egrets occur at most catfish farms throughout the year (Glahn and King 2004). However, recent research has clarified that great blue herons and great egrets mostly eat catfish that are unhealthy, or they eat live, healthy catfish that are close to the surface and margins of the pond, such as during feeding operations. Studies showed that almost half of great blue heron diets consisted of live catfish, but the other half was already dead catfish and wild fish, including sunfish and *Gambusia* spp. (Stickley et al. 1995, Glahn et al. 1999*c*). Of the live catfish consumed by herons in the fall and winter, most were identified as being diseased (Glahn et al. 2002). By contrast, most of the live fish consumed during the summer were healthy (Glahn et al. 2002).

The assumption was that when catfish were actively being fed in the summer, herons consumed more healthy live fish as they are near the pond edge or at the surface eating feed. Based on heron numbers and their seasonal consumption rate of live, healthy catfish at these times, Glahn et al. (2000*a*) projected an annual loss per pond of 575 fish or less than 1% of catfish populations in either grow-out or fingerling ponds. Still, great blue herons and great egrets are widespread at aquaculture facilities, and little is known about their potential to spread parasitic diseases to fish. Great blue herons are thought to have a greater impact on baitfish, trout, brood fish, and minnow production. Loss of trout in ponds with herons present ranged from 9.1% to 39.4% in Pennsylvania with an estimated loss in production ranging from $8,000 to nearly $66,000 (Glahn et al. 1999*b*). The stomach contents of great blue herons collected at trout producing facilities in the northeastern United States contained almost exclusively trout (Glahn et al. 1999*b*). In a study at Arkansas golden shiner ponds, great blue herons and great egrets were responsible for consuming more minnows than little blue herons and snowy egrets, but all four species together were estimated to potentially cost between $1,800 and $55,800 in loss of baitfish, depending on the species, number, and span of time spent feeding (Hoy et al. 1989). Another Arkansas study determined that the cost of annual bird harassment programs at baitfish farms ranged from $11,580 to $104,560 depending on the size of the farm (Werner et al. 2005).

In one Alabama study, great blue herons preyed upon catfish and sunfish more often than on other species (Ross 1994). In tropical aquaculture facilities in central Florida, the snowy egret, green heron, tricolored heron, and little blue heron were the most frequently documented birds preying upon farm-raised tropical fish (Avery et al. 1999). Avery et al. (1999) recorded an 11.1% loss of tropical fish from ponds where the producer excluded those birds with netting versus a 37.6% loss of fish from ponds that had no netting. Great blue herons are also responsible for complaints to the WS program regarding loss of koi fish in backyard ponds. Both producers of koi fish and homeowners that stock them in shallow, garden ponds have requested assistance in reducing damage. Koi fish can cost over $100 per fish. In 1984, a survey of fish producing facilities identified 43 species of birds as foraging on fish at those facilities including mallards, osprey, red-tailed hawks, northern harriers, American crows, common grackles, brown-headed cowbirds, and various species of egrets, owls, gulls, terns, and mergansers (Parkhurst et al. 1987).

Aquaculture facilities have also identified mallards as posing a threat of economic loss from their foraging behavior (Parkhurst et al. 1987, Parkhurst et al. 1992). During a survey conducted in 1984 of fisheries primarily in the eastern United States, managers at 49 of 175 facilities reported mallards as feeding on fish at those facilities, which represented an increase in the number of facilities reporting mallards as feeding on fish when compared to prior surveys (Parkhurst et al. 1987). Parkhurst et al. (1992) found mallards foraging on trout fingerlings at facilities in Pennsylvania. Mallards selected trout ranging in size from 8.9 centimeters to 12.2 centimeters in length. Once trout fingerlings reached a mean length of approximately 14 centimeters in raceways, mallards present at facilities switched to other food sources (Parkhurst et al. 1992). Of those predatory birds observed by Parkhurst et al. (1992), mallards consumed the most fish at the facilities with a mean of 148,599 fish captured and had the highest mean economic loss per year per site based on mallards being present at those facilities for a longer period of time per year compared to other species.

During a survey of fisheries in 1984, osprey were ranked third highest among 43 species of birds identified as foraging on fish at aquaculture facilities in the United States (Parkhurst et al. 1987). Fish comprise the primary food source of osprey (Poole et al. 2002). Parkhurst et al. (1992) found that when ospreys were present at aquaculture facilities, over 60% of their mean time was devoted to foraging. The mean length of trout captured by osprey was 30.5 centimeters, which lead to a higher economic loss per captured fish compared to other observed species (Parkhurst et al. 1992).

Predation at aquaculture facilities can also occur from American crows (Parkhurst et al. 1987, Parkhurst et al. 1992). During a survey of ten fisheries in 1985 and 1986, American crows occurred at eight of the facilities in central Pennsylvania (Parkhurst et al. 1992). The mean size of trout captured by crows in one study was 22.5 centimeters with a range of 15.2 to 31.7 centimeters (Parkhurst et al. 1992). A study conducted in Pennsylvania during 1985 and 1986 found crows consumed a mean of 11,651 trout per year per site from ten trout hatcheries (Parkhurst et al. 1992). Because crows selected for larger fish classes at fish facilities, Parkhurst et al. (1992) determined economic losses from foraging by crows led to a higher mean economic impacts at facilities compared to other avian foragers based on the value of larger fish classes.

Although primarily insectivorous during the breeding season and granivorous during migration periods (Peer and Bollinger 1997), common grackles may also feed on fish (Hamilton 1951, Beeton and Wells 1957, Darden 1974, Zottoli 1976, Whoriskey and Fitzgerald 1985, Parkhurst et al. 1992). During a study of aquaculture facilities in central Pennsylvania, Parkhurst et al. (1992) found grackles feeding on trout fry at nine of the ten facilities observed. The mean length of trout captured by grackles was 7.6 centimeters with a range of 6.0 to 7.9 centimeters. Once fish reached a mean size of 14 centimeters, grackles switched to alternative food sources at those facilities (Parkhurst et al. 1992). Among all predatory bird species observed during the study conducted by Parkhurst et al. (1992), grackles captured and removed the most fish per day per site, which Parkhurst et al. (1992) estimated at 145,035 fish captured per year per site.

Also of concern at aquaculture facilities is the transmission of diseases by birds between impoundments and from facility to facility. Given the confinement of aquatic organisms inside impoundments at aquaculture facilities and the high densities of those organisms in those impoundments, the introduction of a disease could result in substantial economic losses. Although actual transmission of diseases through transport by birds is difficult to document, birds have been documented as having the capability of spreading diseases through fecal droppings and possibly through other mechanical means, such as on feathers, feet, and regurgitation.

Birds may be a possible source of transmission of Spring Viraemia of Carp, Viral Hemorrhagic Septicaemia, and Infectious Pancreatic Necrosis in Europe, which are fish viruses capable of causing severe damage (European Inland Fisheries Advisory Commission 1989). Viral Hemorrhagic Septicaemia and Infectious Pancreatic Necrosis now occur in North America (Price and Nickum 1995, Goodwin 2002). Spring Viraemia of Carp also occurs in North America (USDA 2003*a*). Peters and Neukirch (1986) found the Infectious Pancreatic Necrosis virus in the fecal droppings of herons when herons fed on trout infected with Infectious Pancreatic Necrosis. Olesen and Vestergard-Jorgensen (1982) found herons could transmit the Viral Hemorrhagic Septicaemia (Egtved virus) from beak to fish when the virus occurs on the beaks of herons. However, Eskildsen and Vestergard-Jorgensen (1973) found the Egtved virus did not pass through the digestive tracks into the fecal droppings of black-headed gulls (*Chroicocephalus ridibundus*) when artificially inserted into the esophagus of the gulls.

Birds may also be capable of passing bacterial pathogens through fecal droppings and on their feet (Price and Nickum 1995). The bacterial pathogen for the fish disease Enteric Septicemia of Catfish occurred within the intestines and rectal areas of great blue herons from aquaculture facilities in Mississippi (Taylor 1992). However, because Enteric Septicemia of Catfish is endemic in the region, Taylor (1992) did not consider birds as a primary vector of the disease. Birds also pose as primary hosts to several cestodes, nematodes, trematodes, and other parasites that can infect fish. Birds can also act as intermediate hosts of parasites that can infect fish after completing a portion of their life cycle in crustaceans or mollusks (Price and Nickum 1995).

Although documentation that birds, such as herons, can pose as vectors of diseases known to infect fish, the rate of transmission is currently unknown and is likely very low. Fish-eating birds can target fish that are diseased and less likely to escape predation at aquaculture facilities (Price and Nickum 1995, Glahn et al. 2002*b*). Since birds have the mobility to move from one impoundment or facility to another, the threat of disease transmission is a concern given the potential economic loss that could occur from extensive mortality of fish or other cultivated aquatic wildlife if a disease outbreak occurs.

Damage and Threats to Livestock Operations

Damage to livestock operations can occur from several bird species in North Carolina. Economic damage can occur from birds feeding on livestock feed, from birds feeding on livestock, from birds feeding on newly-planted seed for winter grazing, and from the increased risks of disease transmission associated with large concentrations of birds. Birds also defecate while feeding increasing the possibility of disease transmission through livestock directly contacting or consuming fecal droppings. Birds can also cause damage by defecating on fences, shade canopies, and other structures, which can accelerate corrosion of metal components and can be aesthetically displeasing. Large concentrations of birds at livestock feeding operations can also pose potential health hazards to feedlot/dairy operators and their personnel through directly contacting fecal droppings or by droppings creating unsafe working conditions.

Although damage and disease threats to livestock operations can occur throughout the year, damage can be highest during those periods when birds are concentrated into large flocks, such as during migration periods and during winter months when food sources are limited. For some bird species, high concentrations of birds can occur during the breeding season where suitable nesting habitat exists, such as barn swallows. Of primary concern to livestock feedlots and dairies in North Carolina are European starlings, house sparrows, rock pigeons, red-winged blackbirds, common grackles, brown-headed cowbirds, and to a lesser extent American crows, fish crows, and barn swallows. The flocking behavior of those species either from roosting and/or nesting behavior can lead to economic losses to agricultural producers from the consumption of livestock feed and from the increased risks associated with the transmission of diseases from fecal matter being deposited in feeding areas and in water used by livestock.

Economic damages associated with starlings and blackbirds feeding on livestock rations has been documented in France and Great Britain (Feare 1984), and in the United States (Besser et al. 1968, Dolbeer et al. 1978, Glahn and Otis 1981, Glahn 1983, Glahn and Otis 1986). Starlings damage an estimated $800 million worth of agricultural resources per year (Pimentel et al. 2005). Diet rations for cattle contain all of the nutrients and fiber that cattle need, and are so thoroughly mixed that cattle are unable to select any single component over others. Livestock feed and rations are often formulated to ensure proper health of the animal. Higher fiber roughage in livestock feed is often supplemented with corn, barley, and other grains to ensure weight gain, and in the case of dairies, for dairy cattle to produce milk. Livestock are unable to select for certain ingredients in livestock feed, while birds often can selectively choose to feed on the corn, barley, and other grains formulated in livestock feed. Livestock feed provided in open troughs is most vulnerable to feeding by birds. Birds often select for those components of feed that are most beneficial to the desired outcome of livestock. When large flocks of birds selectively forage for components in livestock feeds, the composition and the energy value of the feed can be altered, which can negatively affect the health and production of livestock. The removal of this high-energy source by European starlings is believed to reduce milk yields and weight gains, which is economically critical (Feare 1984). Glahn and Otis (1986) reported that starling damage was also associated with proximity to roosts, snow, freezing temperatures, and the number of livestock on feed.

The economic significance of feed losses to starlings and blackbirds has been demonstrated by Besser et al. (1968), who concluded that the value of losses in feedlots near Denver, Colorado was $84 per 1,000 starlings during the winter in 1967. Forbes (1990) reported European starlings consumed up to 50% of their body weight in feed each day. Glahn and Otis (1981) reported losses of 4.8 kg of pelletized feed consumed per 1,000 bird minutes. Glahn (1983) reported that 25.8% of farms in Tennessee experienced starling depredation problems, of which 6.3% experienced considerable economic loss. Williams (1983) estimated seasonal feed losses to five species of blackbirds (primarily brown-headed cowbirds) at one feedlot in south Texas at nearly 140 tons valued at $18,000. Depenbusch et al. (2011) estimated that feed consumption by European starlings increased the daily production cost by $0.92 per animal.

Damage and threats to livestock operations can also occur from the risk of or actual transmission of diseases from birds to livestock. Agricultural areas provide ideal habitat for many bird species, which can be attracted in large numbers to those locations. Large concentrations of birds feeding, roosting, or loafing in these areas increases the possibility of and the concern over the transmission of diseases from birds to livestock. This concern can have far-reaching implications (Daniels et al. 2003, Fraser and Fraser 2010, Miller et al. 2013). Birds feeding alongside livestock in open livestock feeding areas or feeding on stored livestock feed can leave fecal deposits, which can be consumed by livestock. Fecal matter can also be deposited in sources of water for livestock, which increases the likelihood of disease transmission and can contaminate other surface areas where livestock can encounter fecal matter deposited by birds. Many bird species, especially those encountered at livestock operations, are known to carry infectious diseases which can be excreted in fecal matter and pose not only a risk to individual livestock operations, but can be a source of transmission to other livestock operations as birds move from one area to another. The rate of transmission is likely very low; however, the threat of transmission exists because birds are known vectors of many diseases transmittable to livestock.

A number of diseases that affect livestock have been associated with rock pigeons, European starlings, and house sparrows (Weber 1979, Carlson et al. 2011*b*). Pigeons, starlings, and house sparrows have been identified as carriers of erysipeloid, salmonellosis, pasteurellosis, avian tuberculosis, streptococcosis, vibrosis, and listeriosis (Weber 1979, Gough and Beyer 1981). Weber (1979) also reported pigeons, starlings, and house sparrows as carriers of several viral, fungal, protozoal, and rickettsial diseases that are known to infect livestock and pets. Numerous studies have focused on starlings and the transmission of *Escherichia coli* (LeJeune et al. 2008, Gaukler et al. 2009, Cernicchiaro et al. 2012). LeJeune et al. (2008) found that starlings could play a role in the transmission of *E. coli* between dairy farms. Carlson et al. (2011*b*) found *Salmonella enterica* in the gastrointestinal tract of starlings at cattle feedlots in Texas and suggested starlings could contribute to the contamination of cattle feed and water. Salmonella contamination levels can be directly related to the number of European starlings present (Carlson et al. 2011*a*, Carlson et al. 2011*b*). Poultry operations can be highly susceptible to diseases spread by wild birds, including those from starlings and house sparrows. This includes salmonella, campylobacter, and clostridium (Craven et al. 2000).

Contamination of livestock facilities through fecal accumulation by various bird species has been identified as an important concern. Numerous diseases are spread through feces, with salmonellosis and *E. coli* being two diseases of concern. Salmonellosis is an infection with bacteria called *Salmonella* and numerous bird species have been documented as reservoirs for this bacterium (Friend and Franson 1999, Tizard 2004). *E. coli* is a fecal coliform bacteria associated with the fecal material of warm-blooded animals. Multiple studies have found that birds can be an important source of *E. coli* contamination of both land and water sources (Fallacara et al. 2001, Kullas et al. 2002, Hansen et al. 2009, Silva et al. 2009). Multiple species have been documented as carrying dangerous strains of *E. coli*, including gulls, geese, pigeons, and starlings (Pedersen and Clark 2007). European starlings have also been found to harbor various strains of *E. coli* (Gaukler et al. 2009), including O157:H7, a strain that has been documented as causing human mortalities (LeJeune et al. 2008, Cernicchiaro et al. 2012). *Salmonella* transmission by gulls to livestock can also be a concern (Williams et al. 1977, Johnston et al. 1979, Coulson et al. 1983). Williams et al. (1977) and Johnston et al. (1979) reported that gulls can transmit *salmonella* to livestock through droppings and contaminated drinking water. Pedersen and Clark (2007) did an extensive review of the literature and found Canada geese, gulls, pigeons, house sparrows, cowbirds, grackles, blackbirds and starlings have the potential to play a role in the direct transmission of *E. coli* and *S. enterica* among cattle at feedlots and dairies and from livestock operation to livestock operation. Migratory birds are capable of spreading diseases over a larger area, and domestic species might serve as reservoirs within farm operations. The birds also cause damage by defecating on fences, shade canopies, and other structures, which can accelerate corrosion of metal components and can be aesthetically displeasing. Large concentrations of birds at livestock feeding operations can also pose potential health hazards to feedlot/dairy operators and their personnel through directly contacting fecal droppings or by droppings creating unsafe working conditions.

Although it is difficult to document, there is a strong association of wild birds and the contamination of food and water sources at livestock facilities. The potential for introduction of *E. coli* or *salmonella* to a livestock operation or the transmission of these pathogens between sites by wild birds is a strong possibility (Pedersen and Clark 2007).

Starlings and gulls, as well as other species, have been documented as transferring species-specific diseases, such as transmittable gastroenteritis (Faulkner 1966, Gough et al. 1979). Many bird species that use barn areas, pastures, manure pits, or carcass disposal areas can directly or indirectly pick-up a disease and transfer it to another farm or to healthy animals at the same farm. In some cases, if carcasses were not disposed of correctly, then scavenging birds, such as vultures and crows, could infect healthy animals through droppings or by the transfer of disease carrying particles on their bodies. Due to the ability of those bird species to move large distances and from one facility to another, farm-to-farm transmission can be an important concern.

Waterfowl, including ducks, geese, and swans, can also be a concern to livestock producers. Fraser and Fraser (2010) provided a review of disease concerns to livestock from Canada geese, and highlighted 50 bacteria, viral, fungal diseases, and parasites that can infect livestock, including swine, cattle, and poultry. Waterfowl droppings in and around livestock ponds can affect water quality and can be a source of a number of different types of bacteria. The transmission of diseases through drinking water is one of the primary concerns for a safe water supply for livestock. Bacteria levels for livestock depend on the age of the animal because adults may be more tolerant of bacteria than young animals (Mancl 1989). The bacteria guidelines for livestock water supplies are <1000 fecal coliform/100 ml for adult animals and < 1 fecal coliform/100 ml for young animals (Mancl 1989). *Salmonella* causes shedding of the intestinal lining and severe diarrhea in cattle. If undetected and untreated, *salmonella* can kill cattle and calves. Additionally, the contamination of feed by waterfowl through droppings in pastures, crops, or harvested grasses can also be a method of disease transmission to livestock (Fraser and Fraser 2010).

Wild and domestic waterfowl, as well as a variety of other bird species, are the acknowledged natural reservoirs for a variety of avian influenza viruses (Davidson and Nettles 1997, Alexander 2000, Stallknecht 2003, Pedersen et al. 2010). Avian influenza (AI) circulates among these birds without clinical signs and is not an important mortality factor in wild waterfowl (Davidson and Nettles 1997, Clark and Hall 2006). However, the potential for AI to produce devastating disease in domestic poultry makes its occurrence in waterfowl an important issue (Davidson and Nettles 1997, Clark and Hall 2006, Gauthier-Clerc et al. 2007). Although low pathogenic strains of AI are often found in wild birds (Stallknecht 2003, Pedersen et al. 2010), high pathogenic strains have also been found to exist in wild waterfowl species (Brown et al. 2006, Keawcharoen et al. 2008). The ability for wild birds to carry these highly pathogenic strains increases the potential for transmission to domestic poultry facilities, which are highly susceptible to high pathogenic strains of AI (Nettles et al. 1985, Gauthier-Clerc et al. 2007, Pedersen et al. 2010). The potential impacts from a severe outbreak of high pathogenic AI in domestic poultry could be devastating, and possibly cripple the multi-billion dollar industry through losses in trade, consumer confidence, and eradication efforts (Pedersen et al. 2010).

Based on the value of agriculture sales in 2012, poultry and egg production was the largest portion of sales in the State (NASS 2017). In 2012, North Carolina ranked first in poultry and egg production within the United States (NASS 2017). Any disease introduction into domestic poultry could have economic impacts that are far-reaching. Some diseases that could affect the poultry industry in North Carolina and might originate in wild bird species include exotic Newcastle disease, chlamydiosis, high-pathogenic AI, low-pathogenic AI, salmonellosis, and pasteurellosis (Clark and McLean 2003). A single outbreak of high-pathogenic AI in 1984 cost the poultry industry $63 million in destroyed or sick birds and clean-up costs, and the price of poultry food products rose in the six months following the outbreak (Hahn and Clark 2002). When adjusted for inflation, those costs would be the equivalent to nearly $1 billion in 2003 (Clark 2003). Similarly, a low-pathogenic strain of AI virus was isolated in Virginia in March 2002. The control and containment efforts cost $13 million in destruction of flocks, $50 million in paid indemnities, and an overall cost of $129 million to the industry in an effort to minimize the trade impacts (Hahn and Clark 2002). Genetic evidence and documented temporal associations between AI prevalence in wild waterfowl and poultry flocks suggests that wild waterfowl can be a source of infection to poultry (Clark 2003, Clark and Hall 2006). In samples of over 260,000 wild birds, the prevalence of low-pathogenic AI across the United States in 2007 and 2008 was 9.7 and 11%, respectively and the prevalence of high-pathogenic AI in the same years was 0.5 and 0.06%, respectively (Deliberto et al. 2009). The majority of those wild birds were dabbling ducks, geese, swans, and shorebirds (Deliberto et al. 2009).

Newcastle disease is a contagious viral disease that can infect birds, which is caused by the virulent avian paramyxovirus serotype 1. More than 230 species of birds have been determined to be susceptible to natural or experimental infections with avian paramyxoviruses, but in most cases were asymptomatic. In wild birds, the effects appear to vary depending on the species of bird and the virulence of the particular strain of avian paramyxovirus. Newcastle disease can cause high rates of mortality in some bird populations but often show little effect on other species (Glaser et al. 1999), although poultry have been found to be highly susceptible (Docherty and Friend 1999, Alexander and Senne 2008). Other species may carry avian paramyxoviruses, including pigeons, which because of their use of agricultural settings and possible interactions with livestock, may pose a risk of transmission (Kommers et al. 2001).

Although birds are known to be carriers of diseases (vectors) that are transmissible to livestock, the rate that transmission occurs is unknown but is likely to be low. Because many sources of disease transmission exist, identifying a specific source can be difficult. Birds are known to be vectors of disease, which increases the threat of transmission when large numbers of birds are defecating and contacting surfaces and areas used by livestock. The rate of transmission is likely very low; however, the threat of transmission exists because birds are known vectors of many diseases transmittable to livestock.

Certain bird species are also known to prey upon livestock, which can result in economic losses to livestock producers. In North Carolina, direct damage to livestock occurs primarily from vultures, but can also include raptors. Vultures can prey upon newly born calves and harass adult cattle, especially during the birthing process. During 2010, the NASS reported livestock owners lost 11,900 head of cattle and calves from vultures in the United States valued at $4.6 million (NASS 2011). While both turkey vultures and black vultures have been documented harassing expectant cattle, damages are primarily attributed to black vultures. Vulture predation on livestock is distinctive. Lovell (1947, 1952) and Lowney (1999) reported that black vultures targeted the eyes and rectal area of vulnerable livestock. During a difficult birth, vultures can harass the mother and peck at the half-expunged calf. This predation behavior often results in serious injury to livestock, which can cause livestock to die from those injuries or require the livestock be euthanized due to the extent of the injuries. Reports of calf depredation by vultures occur but are not necessarily common in North Carolina. From federal fiscal year (FY) 2011 through FY 2016, there have been 18 reported predation occurrences by black vultures and turkey vultures resulting in the loss of 55 calves valued at $30,214. The actual number of predation events on livestock associated with vultures is likely higher because damage reported to and verified by WS is based only on those persons requesting assistance from WS.

In a study conducted by Milleson et al. (2006), Florida ranchers were surveyed to the extent and severity of cattle losses associated with vultures. Respondents of the survey reported that 82.4% of all livestock lost attributed to vultures were newborn calves, which exceeds the reported predation of all other livestock species and livestock age classes (Milleson et al. 2006). Ranchers reported during the survey period a total loss of 956 calves, 25 yearlings (cattle), and 101 adult cattle with a total value estimated at $316,570 and a mean value lost estimated at $2,595 (Milleson et al. 2006). Predation associated with vultures was reported to occur primarily from November through March, but could occur throughout the year (Milleson et al. 2006).

Direct damage can also result from raptors, particularly red-tailed hawks, preying on domestic fowl, such as chickens, quail, guineas, racing/show pigeons, and waterfowl (Hygnstrom and Craven 1994). Loss could also occur from Cooper's hawks, barn owls, and great horned owls. Free-ranging fowl or fowl allowed to range outside of confinement are particularly vulnerable to predation by raptors.

Damage to Agricultural Crops

Besser (1985) estimated damage to agricultural crops associated with birds exceeded $100 million annually in the United States. Bird damage to agricultural crops occurs primarily from consumption (loss of the crop and revenue), but also consists of trampling of emerging crops by waterfowl, damage to fruits associated with feeding, and fecal contamination. In 2014, cash receipts from farming totaled more than $13 billion. Livestock, dairy, and poultry accounted for nearly 67% of that total, and crops accounted for 33% in North Carolina (Long 2016). Of the agricultural crops produced in the State, tobacco brought in the most cash receipts, followed by soybeans, corn, and sweet potatoes (NASS 2017). Other crop commodities harvested in 2016 include hay, wheat, cotton, and peanuts. Nearly $435 million in cash receipts from the production of vegetables, melons, potatoes, and sweet potatoes occurred in the State during 2012. Cash receipts received from the production of fruits, nuts, and berries in the State during 2012 was nearly $85 million (NASS 2017). Damage to agricultural crops (*e.g.*, soybeans, wheat, and corn) reported to WS occurs primarily from American crows and Canada geese, red-winged blackbirds, grackles, cowbirds, and to a lesser extent mallards, woodpeckers, ravens, and American robins.

Several studies have shown that European starlings can pose a great economic threat to agricultural producers (Besser et al. 1968, Dolbeer et al. 1978, Feare 1984). Starlings and sparrows can also have a detrimental effect on agricultural food production by feeding at vineyards, orchards, gardens, crops, and feedlots (Weber 1979). For example, starlings feed on numerous types of fruits such as, cherries, figs, blueberries, apples, apricots, grapes, nectarines, peaches, plums, persimmons, strawberries, and olives (Weber 1979). Starlings were also found to damage ripening corn (Johnson and Glahn 1994) and are known to feed on the green, milk, and dough stage kernels of sorghum (Weber 1979). Additionally, starlings may pull sprouting grains, especially winter wheat, and feed on planted seed (Johnson and Glahn 1994). Sparrows damage crops by pecking seeds, seedlings, buds, flowers, vegetables, and maturing fruits, and localized damage can be considerable because sparrows often feed in large flocks on a small area (Fitzwater 1994).

Wildlife damage to apples, grapes, and blueberries has been estimated at $41 million annually, with most of the damage attributed to birds (USDA 1999). Fruit and nut crops can be damaged by crows, robins, red-winged blackbirds, grackles, parakeets, cowbirds, and American crows. Over 100 million pounds of apples and 5,000 tons of grapes were produced in North Carolina during 2016 (NASS 2017).

Crows, robins, red-winged blackbirds, grackles, cowbirds, and American crows can cause damage to fruit and nut crops. Besser (1985) estimated bird damage to grapes, cherries, and blueberries exceeded $1 million annually in the United States. In 1972, Mott and Stone (1973) estimated that birds caused $1.6 to $2.1 million in damage to the blueberry industry in the United States, with starlings, robins, and grackles causing the most damage. Red-winged blackbirds, cowbirds, woodpeckers, and crows may also cause damage to blueberries (Besser 1985). Damage to blueberries typically occurs from birds plucking and consuming the berry or from knocking the berries from the bushes (Besser 1985). During a survey conducted in 15 states and British Columbia, Avery et al. (1991) found that 84% of respondents to the survey considered bird damage to blueberries to be "*serious*" or "*moderately serious*". Respondents of the survey identified starlings, robins, and grackles as the primary cause of damage (Avery et al. 1991). House finches, crows, cedar waxwings, gulls, northern mockingbirds, and blue jays were also identified as causing damage to blueberries (Avery et al. 1991). Avery et al. (1991) estimated bird damage to blueberry production in the United States cost growers $8.5 million in 1989.

Damage to apples can occur from beak punctures, which makes the apples unmarketable (Besser 1985). Crows, robins, and starlings have been documented as causing damage to apples (Mitterling 1965). Damage is infrequently reported in apples because harvest of the crop typically occurs before apples reach a stage when damage is likely with damage being greatest during periods of drought (Mitterling 1965).

Bird damage to sweet corn can also result in economic losses to producers. Damage to sweet corn caused by birds can make the ear of corn unmarketable because the damage is unsightly to the consumer (Besser 1985). Large flocks of red-winged blackbirds are responsible for most of the damage reported to sweet corn with damage also occurring from grackles and starlings (Besser 1985). Damage occurs when birds rip or pull back the husk exposing the ear for consumption. Most bird damage occurs during the development stage known as the milk and dough stage when the kernels are soft and filled with a milky liquid. Birds will puncture the kernel to ingest the contents. Once punctured, the area of the ear damaged often discolors and is susceptible to disease introduction into the ear (Besser 1985). Damage usually begins at the tip of the ear as the husk is ripped and pulled back, but can occur anywhere on the ear (Besser 1985).

Damage can also occur to sprouting corn as birds pull out the sprout or dig the sprout up to feed on the seed kernel (Besser 1985). Damage to sprouting corn occurs primarily from grackles and crows but red-winged blackbirds are also known to cause damage to sprouting corn (Stone and Mott 1973). Additionally, starlings may pull sprouting grains and feed on planted seed (Johnson and Glahn 1994). Damage to sprouting corn is likely localized and highest in areas where breeding colonies of grackles exist in close proximity to agricultural fields planted with corn (Stone and Mott 1973, Rogers and Linehan 1977). Rogers and Linehan (1977) found grackles damaged two corn sprouts per minute on average when present at a field planted near a breeding colony of grackles. In 2016, agricultural producers in North Carolina sold over $491 million in corn (NASS 2017).

The most common waterfowl damage to agricultural resources is crop consumption, but also consists of unacceptable accumulations of feces on pastures, trampling of emerging crops, and increased erosion and runoff from fields where the cover crop has been grazed. Canada geese and other waterfowl can graze a variety of crops, including alfalfa, barley, beans, corn, soybeans, wheat, rye, oats, spinach, and peanuts (Cleary 1994, Atlantic Flyway Council 2011). For example, a single intense grazing event by Canada geese in fall, winter, or spring can reduce the yield of winter wheat by 16% to 30% (Fledger et al. 1987), and reduce growth of rye plants by more than 40% (Conover 1988). However, some research has reported that grazing by geese during the winter may increase rye or wheat seed yields (Clark and Jarvis 1978, Allen et al. 1985). During 2016, North Carolina produced 14.5 million bushels of winter wheat yielding nearly $67 million in cash receipts (NASS 2017). Agricultural producers in North Carolina have reported loss of crops such as soybeans, wheat, corn, grasses/sod, and pasture due to Canada geese. Hunters and land managers also report losses of wheat seed to geese on top-sewn wildlife food plots. Associated costs with agricultural damage involving waterfowl include costs to replant grazed crops, implementing wildlife damage management practices, purchasing replacement food sources, and decreased yields.

Need to Resolve Threats that Birds Pose to Human Safety

Several bird species listed in Table 1.1 can be closely associated with human habitation and often exhibit gregarious roosting or flocking behavior, such as vultures, Canada geese, pigeons, sparrows, starlings, waterfowl, crows, swallows, grackles, cowbirds, and red-winged blackbirds. The close association of those bird species with human activity can pose threats to human safety from disease transmission and threaten the safety of air passengers if birds were struck by aircraft. In addition, excessive droppings can be aesthetically displeasing, accumulations of nesting material can pose a fire risk in buildings and on electrical transmission structures, and aggressive behavior, primarily from waterfowl and raptors, can pose risks to human safety.

Threat of Disease Transmission

Birds can play a role in the transmission of zoonotic diseases (*i.e*., diseases that can be transmitted between humans and animals) (Conover 2002). As many as 65 different diseases transmittable to humans or domestic animals have been associated with pigeons, European starlings, and house sparrows (Weber 1979). However, few studies are available on the occurrence of zoonotic diseases in wild birds and on the risks to people or domestic animals from transmission of those diseases (Clark and McLean 2003). Study of this issue is complicated by the fact that some disease-causing agents associated with birds may also be contracted from other sources. Although many people are concerned about disease transmission from birds, the probability of contracting a disease indirectly (when no physical contact occurs) is believed to be small. However, direct contact with birds, nesting material, fecal droppings, or the inhalation of fecal particles from accumulations of droppings increases the likelihood of disease transmission.

The gregarious behavior of bird species leads to accumulations of fecal droppings that can be considered a threat to human health and safety due to the close association of those species of birds with human activity. Accumulations of bird droppings in public areas are aesthetically displeasing and are often in areas where humans may come in direct contact with fecal droppings. Fecal droppings in and around water resources can affect water quality and can be a source of a number of different types of pathogens and contaminants. For example, Fleming et al. (2001) reviewed the impacts of Canada geese on water quality by addressing pathogens and nutrient loading and identified a number of hazards that are associated with geese. Waterbird excrement can contain coliform bacteria, streptococcus bacteria, *Salmonella*, toxic chemicals, and nutrients, and it is known to compromise water quality, depending on the number of birds, the amount of excrement, and the size of the water body. Elevated contaminant levels associated with breeding and/or roosting concentrations of birds and their potential effects on water supplies can be concerns.

Birds can play a role in the transmission of diseases to humans such as encephalitis, West Nile virus, psittacosis, and histoplasmosis. Birds may also play a direct and indirect role in transmission of *E. coli* and *S. enterica* to humans through contact with infected cattle feces, watering troughs, and agriculture fields fertilized with manure slurries (Pedersen and Clark 2007). For example, as many as 65 different diseases transmittable to humans or domestic animals have been associated with pigeons, European starlings, and house sparrows (Weber 1979). Public health officials and residents at such sites express concerns for human health related to the potential for disease transmission where fecal droppings accumulate. Fecal droppings that accumulate from large communal bird roosts can facilitate the growth of disease organisms, which grow in soils enriched by bird excrement, such as the fungus *Histoplasma capsulatum*, which causes the disease histoplasmosis in humans (Weeks and Stickley 1984).
In North Carolina, crows, blackbirds, and starlings can form large communal roosts of the kind associated with disease organisms, such as *H. capsulatum* (Weeks and Stickley 1984). The disturbance of soil or fecal droppings under bird roosts where fecal droppings have accumulated can cause *H. capsulatum* to become airborne. Once airborne, the fungus could be inhaled by people in the area. For example, two siblings contracted pneumonia in Arkansas in 2011, and additional family members suffered from respiratory disease, after burning bamboo that was harvested from a red-winged blackbird roost (Haselow et al. 2014). The children were transferred to a high-level care center and treated with antifungal medicines before they remarkably improved. They remained on antifungal medication for months. *H. capsulatum* remains in the soil and can be contracted several years after a roost is abandoned (Clark and McLean 2003). In most cases in which human health concerns are a major reason for requesting assistance, no actual cases of bird transmission of disease to humans have been proven to occur. Thus, it is the risk of disease transmission that is the primary reason for those persons to request assistance from WS.

Ornithosis (*Chlamydia psittaci*) is another respiratory disease that can be contracted by people, livestock, and pets that can be associated with accumulations of bird droppings. Waterfowl, herons, and rock pigeons are the most commonly infected wild birds in North America (Locke 1987). Pigeons are most commonly associated with the spread of Ornithosis to people. Ornithosis is a virus that is spread through infected bird droppings when viral particles become airborne after infected bird droppings are disturbed.

Waterfowl may affect human health through the distribution and incubation of various pathogens and through nutrient loading. For instance, a foraging Canada goose defecates between 5.2 and 8.8 times per hour (Bedard and Gauthier 1986). Kear (1963) recorded a maximum fecal deposition rate for Canada geese of 0.39 pounds per day (dry weight). Public swimming beaches, private ponds, and lakes can be affected by goose droppings. There are several pathogens involving waterfowl that may be contracted by people; however, the Centers for Disease Control and Prevention (CDC) states the risk of infection is likely low (CDC 1998). The primary route of infection would be through incidental contact with contaminated material. Direct contact with fecal matter would not be a likely route of disease unless ingested directly. Although intentional contact with feces is not likely, transmission can occur when people unknowingly contact and ingest contaminated material. Therefore, the risk to human health from waterfowl zoonoses is low and a direct link of transmission from waterfowl to humans can be difficult to determine. Linking the transmission of diseases from waterfowl to people can be especially difficult since many pathogens occur naturally in the environment and pathogens can be attributed to contamination from other sources. However, the presence of disease causing organisms in waterfowl feces can increase the risk of exposure and transmission of zoonoses wherever people may encounter large accumulations of feces from waterfowl. Fleming et al. (2001) reviewed the impacts of Canada geese on water quality by addressing pathogens and nutrient loading and identified a number of hazards that are associated with geese.

Cryptosporidium and *Giardia* are intestinal parasites that infect a wide range of vertebrate hosts, including birds. In people, those organisms can cause persistent diarrhea for 1 to 3 weeks. One of the most common modes of transmission of those parasites is consumption of feces-contaminated water. It is estimated that 80 to 96% of surface waters in the United States are contaminated with *Cryptosporidium* and *Giardia* (Hansen and Ongerth 1991, Moore et al. 1994). Kuhn et al. (2002) found that cryptosporidium was present in 49% and Giardia in 29% of wild duck species. Graczyk et al. (1998) found cysts of both parasites in Canada geese from Maryland. With increases in waterfowl populations and their use of drinking water reservoirs there is an increased potential for contamination from these parasites and therefore an increased human health risk due to the ability of the cysts to survive most water treatment programs (Brown et al. 1999).

Cryptosporidiosis is an illness caused by *Cryptosporidium* spp. Many species of *Cryptosporidium* can infect people and animals. A person can be infected by drinking contaminated water or by direct contact with the fecal material of infected animals (CDC 2015). Exposure can occur from swimming in lakes, ponds, streams, and pools, and from swallowing water while swimming (Colley 1995, CDC 2015). *Cryptosporidium* can cause gastrointestinal disorders (CDC 2015) and can produce life-threatening infections, especially in people with compromised or suppressed immune systems (Roffe 1987, Graczyk et al. 1998). Cryptosporidiosis has been recognized as a disease with implications for human health (Smith et al. 1997). Canada geese in Maryland were shown with molecular techniques to disseminate infectious *C. parvum* oocysts in the environment (Graczyk et al. 1998). Kassa et al. (2001) found that *Cryptosporidium* was the most common infectious organism found in 77.8% of sample sites comprised primarily of parks and golf courses indicating that occupational exposure to this pathogen is very plausible although the risk to humans is relatively low.

Giardiasis (*Giardia lambia*) is an illness caused by a microscopic parasite that has become recognized as one of the most common causes of waterborne disease in humans in the United States during the last 15 years (CDC 2012). Giardiasis is contracted by swallowing contaminated water or putting anything in your mouth that has touched the fecal matter of an infected animal or person. Symptoms of giardiasis include diarrhea, cramps, and nausea (CDC 2012). Canada geese in Maryland were shown with molecular techniques to disseminate infectious *Giardia* spp. cysts in the environment (Graczyk et al. 1998). Kassa et al. (2001) also found *Giardia* in goose feces at numerous urban sites.

Avian botulism is produced by the bacteria *Clostridium botulinum* type C, which occurs naturally in wild bird populations across North America. Ducks are most often affected by this disease, but it can also affect Canada geese. Avian botulism is the most common disease of waterfowl. Increased numbers of Canada geese using recreational areas increases the risk to the public (McLean 2003).

Salmonella (*Salmonella* spp.) may be contracted by people from handling materials soiled with bird feces (Stroud and Friend 1987). Several types of the Salmonella bacteria are carried by wild birds with varying degrees of impact on people and livestock. Salmonella has been isolated from the gastrointestinal tract of starlings (Carlson et al. 2011*b*). Friend and Franson (1999) reported relative rates of detection of *Salmonella* spp. in free ranging birds. *Salmonella* spp. isolates were frequent in songbirds, common in doves and pigeons, occasional in starlings, blackbirds and cowbirds, and infrequent in crows. Salmonella causes gastrointestinal illness, including diarrhea. Public health concerns often arise when gulls feed and loaf near fast food restaurants, and picnic facilities; deposit waste from landfills in urban areas and drinking water reservoirs; and contaminate industrial facility ventilation systems with feathers, nesting debris, and droppings. Gulls feeding on vegetable crops and livestock feed can potentially aid in the transmission of *Salmonella*.

Chlamydiosis (*Chalmydiosis psitticai*) is a common infection in birds. However, when it infects people, the disease is referred to as psitticosis and can be transmitted to people via a variety of birds (Bonner et al. 2004). Canada geese can transmit this disease to people and the agent is viable in goose eggs (Bonner et al. 2004). Severe cases of chlamydiosis have occurred among people handling waterfowl, pigeons, and other birds (Wobeser and Brand 1982, Locke 1987). Infected birds shed the bacteria through feces and nasal discharge (Locke 1987). Chlamydiosis can be fatal to humans if not treated with antibiotics. Humans normally manifest infection by pneumonia (Johnston et al. 2000). However, unless people are working with Canada geese or involved in the removal or cleaning of bird feces, the risk of infection is quite low (Bradshaw and Trainer 1966, Palmer and Trainer 1969). Waterfowl, herons, and rock pigeons are the most commonly infected wild birds in North America (Locke 1987).

Campylobacteriosis is an infectious disease caused by bacteria of the genus *Campylobacter*. *Campylobacter jejuni* is a bacterium usually associated with food-borne pathogens (Center for Food Safety and Applied Nutrition 2012). Findings have demonstrated that geese can be important carriers of *C. jejuni* (Pacha et al. 1988, Fallacara et al. 2004, Rutledge et al. 2013). French et al. (2009) examined *Campylobacter* occurrence at playgrounds and found that 6% of dry and 12% of fresh feces contained this bacteria, indicating that there is a risk of transmission to young children, a population with higher than average susceptibility. In the mid-Atlantic, Keller et al. (2011) found *Campylobacter* in multiple bird species, with gulls and crows having prevalence rates over 20%. Although it is unknown what role that wild birds play in the transmission of this bacterium, its presence in bird species, especially geese, crows, and gull species, which all have increased contact with people, increases the potential for transmission. In persons with compromised immune systems, *Campylobacter* occasionally spreads to the bloodstream and causes a serious life-threatening infection, but normally causes diarrhea and is one of the most common diarrhea illnesses in the United States (CDC 2014). Canada geese have been found to be a carrier of *Campylobacter* and can spread the bacteria in their feces (Kassa et al. 2001).

E. coli are fecal coliform bacteria associated with fecal material of warm-blooded animals. There are over 200 specific serological types of *E. coli* with the majority of serological types being harmless (Sterritt and Lester 1988). The serological type of *E. coli* that is best known is *E. coli* O157:H7, which is usually associated with cattle (Gallien and Hartung 1994). Recent research has demonstrated that Canada geese can disseminate *E. coli* into the environment, which can elevate fecal coliform densities in the water column (Hussong et al. 1979, Alderisio and DeLuca 1999, Cole et al. 2005). Many communities monitor water quality at swimming beaches and lakes, but lack the financial resources to pinpoint the source of elevated fecal coliform counts. When fecal coliform counts at swimming beaches exceed established standards, the beaches are often temporarily closed, which can adversely affect the enjoyment of those areas by the public, even though the serological type of the *E. coli* is unknown.

Unfortunately, linking the elevated bacterial counts to the frequency of waterfowl use and attributing the elevated levels to human health threats has been problematic until recently. Advances in genetic engineering have allowed microbiologists to match genetic code of coliform bacteria to specific animal species and link those animal sources of coliform bacteria to fecal contamination (Simmons et al. 1995, Jamieson 1998). For example, Simmons et al. (1995) used genetic fingerprinting to link fecal contamination of small ponds on Fisherman Island, Virginia to waterfowl. Microbiologists were able to implicate waterfowl and gulls as the source of fecal coliform bacteria at the Kensico Watershed, a water supply for New York City (Klett et al. 1998, Alderisio and DeLuca 1999). In addition, fecal coliform bacteria counts coincided with the number of Canada geese and gulls roosting at the reservoir. Cole et al. (2005) found that geese might serve as a vector of antimicrobial resistance genes, indicating that they not only harbor and spread zoonotic diseases like *E. coli* but also may spread strains that are resistant to current control measures. Financial costs related to human health threats involving birds may include testing of water for coliform bacteria, cleaning and sanitizing beaches regularly of feces, contacting and obtaining assistance from public health officials, and implementing non-lethal and lethal methods of wildlife damage management.

Roscoe (1999) conducted a survey to estimate the prevalence of pathogenic bacteria and protozoa in resident Canada geese in New Jersey and found no *Salmonella* spp., *Shigella* spp., or *Yersinia* spp.

isolated from any of the 500 Canada goose samples. However, Roscoe (1999) did report finding *Cryptosporidium* spp. in 49 (10%) of the 500 geese, and *Giardia* spp. in 75 (15%) of the geese. Additionally, the United States Geological Survey (USGS) conducted field studies in New Jersey, Virginia, and Massachusetts to determine the presence of organisms that could cause disease in humans exposed to feces of Canada geese at sites with a history of high public use and daily use by geese (USGS 2000). *Salmonella* spp., *Listeria* spp., *Chlamydia* spp., and *Giardia* spp. were isolated from goose feces from those sites in New Jersey (USGS 2000).

Research has shown that gulls carry various species of bacteria such as *Bacillus* spp., *Clostridium* spp., *Campylobacter* spp., *E. coli*, *Listeria* spp., and *Salmonella* spp. (MacDonald and Brown 1974, Fenlon 1981, Butterfield et al. 1983, Monaghan et al. 1985, Norton 1986, Quessey and Messier 1992). Transmission of bacteria from gulls to humans is difficult to document; however, Reilly et al. (1981) and Monaghan et al. (1985) both suggested that gulls were the source of contamination for cases of human salmonellosis. Gulls can threaten the safety of municipal drinking water sources by potentially causing dangerously high levels of coliform bacteria from their fecal matter. Contamination of public water supplies by gull feces has been stated as the most plausible source for disease transmission (*e.g*., see Jones et al. 1978, Hatch 1996). Gull feces has also been implicated in accelerated nutrient loading of aquatic systems (Portnoy 1990), which could have serious implications for municipal drinking water sources.

Public health concerns often arise when gulls feed and loaf near fast food restaurants, and picnic facilities; deposit waste from landfills in urban areas and drinking water reservoirs; and contaminate industrial facility ventilation systems with feathers, nesting debris, and droppings. Gulls feeding on vegetable crops and livestock feed can potentially aid in the transmission of salmonella.

Wild and domestic waterfowl are the acknowledged natural reservoirs for a variety of avian influenza viruses (Davidson and Nettles 1997, Pedersen et al. 2010). However, avian influenza viruses can be found amongst a variety of other bird species (Alexander 2000, Stallknecht 2003). Avian influenza can circulate among those birds without clinical signs and is not an important mortality factor in wild waterfowl (Davidson and Nettles 1997, Clark and Hall 2006). However, the potential for avian influenza to produce devastating disease in domestic poultry makes its occurrence in waterfowl an important issue (Davidson and Nettles 1997, Clark and Hall 2006, Gauthier-Clerc et al. 2007). The most common strains of avian influenza found in wild birds are low pathogenic strains (Stallknecht 2003, Pedersen et al. 2010), but high pathogenic strains have also been found to exist in wild waterfowl species (Brown et al. 2006, Keawcharoen et al. 2008). Although avian influenza is primarily a disease of birds, there can be concerns over the spread of the H5N1 highly pathogenic strain that has shown transmission potential to humans with potential for mortalities (Gauthier-Clerc et al. 2007, Peiris et al. 2007, Majumdar et al. 2011). Outbreaks of other avian influenza strains have also shown the potential to be transmissible to people during severe outbreaks when people handle infected poultry (Koopmans et al. 2004, Tweed et al. 2004). A pandemic outbreak of avian influenza could have impacts on human health and economies (World Health Organization 2005, Peiris et al. 2007).

While transmission of diseases or parasites from birds to people has not been well documented, the potential exists (Luechtefeld et al. 1980, Wobeser and Brand 1982, Hill and Grimes 1984, Pacha et al. 1988, Hatch 1996, Graczyk et al. 1997, Saltoun et al. 2000, Kassa et al. 2001). In some cases, infections may even be life threatening for people with suppressed or compromised immune systems (Roffe 1987, Graczyk et al. 1998). Even though many people are concerned about disease transmission from feces, the probability of contracting a disease from feces is believed to be small. However, human exposure to fecal droppings through direct contact or through the disturbance of accumulations of fecal droppings where disease organisms are known to occur increases the likelihood of disease transmission. Several of the bird species addressed in this EA are closely associated with the activities of people and they often exhibit gregarious roosting and nesting behavior. This gregarious behavior can lead to accumulations of fecal droppings that could be considered a threat to human health and safety due to the close association of those species of birds with people. Accumulations of bird droppings in public areas are aesthetically displeasing and are often in areas where people may come in direct contact with fecal droppings. In most cases in which human health concerns are a major reason for requesting assistance, no actual cases of bird transmission of disease to humans have been proven to occur. Thus, the risk of disease transmission would be the primary reason people request assistance. WS recognizes and defers to the authority and expertise of local and state health officials in determining what does or does not constitute a threat to public health.

The WS program in North Carolina has been requested to assist in the reduction of disease threats to human safety, usually involving the exposure of people to roosting sites or loafing sites where large accumulations of fecal droppings have accumulated, either in a residential or industrial area. Those areas of accumulated droppings have been associated with the nesting, loafing, and/or roosting European starlings, blackbirds, rock pigeons, Canada geese, feral waterfowl, purple martins, gulls, vultures, or house sparrows. Situations in North Carolina where the threat of disease associated with birds might occur could be: exposure of residents to a bird roost which has been in a residential area for more than three years; disturbance of a large deposit of droppings in an attic where a flock of birds routinely roosts or nests; accumulated droppings from roosting birds on structures at an industrial site where employees must work in areas of fecal accumulation; birds nesting or loafing around a food court area of a recreational facility or other site where humans eat in close proximity to concentrated numbers of birds; or birds depositing waste from landfills in urban, suburban, and other nearby areas.

Threat of Aircraft Striking Wildlife at Airports and Military Bases

In addition to threats of zoonotic diseases, birds also pose a threat to human safety from being struck by aircraft. When aircraft strike birds, especially when birds enter or are ingested into engines, structural damage to the aircraft and catastrophic engine failure can occur. The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with wildlife is increasing (Dolbeer 2000, MacKinnon et al. 2004). However, it is more common for wildlife-aircraft strikes to result in expensive repairs, flight delays, or aborted aircraft movements than in injury or loss of human life.

While bird strikes that result in human fatalities are rare, the consequences can be catastrophic. The worst strike on record for loss of human lives in the United States occurred in Boston during 1960 when 62 people were killed in the crash of an airliner that collided with a flock of European starlings (Terres 1980, Dolbeer and Wright 2008). In 1995, 24 lives were lost when a military aircraft struck a flock of Canada geese at Elmendorf, Alaska. In addition, a $190 million plane was lost (Dolbeer 1997). A recent example occurred in Oklahoma where an aircraft struck American white pelicans (*Pelecanus erythrorhynchos*) causing the plane to crash killing all five people aboard (Dove et al. 2009). Injuries can also occur to pilots and passengers from bird strikes. Between 1990 and 2014, 198 bird strikes involving civil aircraft have caused 352 injuries to people in the United States, including strikes with vultures, waterfowl, gulls, raptors, egrets, pigeons, robins, doves, blackbirds, sparrows, and owls (Dolbeer et al. 2015). Since 1988, wildlife strikes have killed more than 258 people and destroyed over 245 aircraft globally (Dolbeer et al. 2015).

Additional Human Safety Concerns Associated with Birds

As people are increasingly living with wildlife, the lack of harassing and threatening behavior by people toward many species of wildlife, especially around urban areas, has led to a decline in the fear wildlife have toward people. When wildlife species begin to habituate to the presence of people and human activity, a loss of apprehension can occur, which can lead those species to exhibit threatening or abnormal behavior toward people. This behavior continues to increase as human populations expand and the populations of those species that adapt to human activity increase. Threatening behavior can occur in the form of aggressive posturing, a general lack of apprehension toward people, or abnormal behavior. Although birds attacking people occurs rarely, aggressive behavior by birds does occur, especially during nest building and the rearing of eggs and chicks. Raptors can aggressively defend their nests, nesting areas, and young, and may swoop and strike at pets, children, and adults.

In addition to raptors, waterfowl can also aggressively defend their nests and nestlings during the nesting season. In April 2012, a man drowned in Des Plains, Illinois, when he was attacked by a mute swan (*Cygnus olor*) that knocked him out of his kayak (Golab 2012). Canada geese can aggressively defend their nests, nesting areas, and young, and may attack or threaten pets, children, and adults (Smith et al. 1999). This can be a threat because resident Canada geese often nest in high densities in areas used by people, such as industrial areas, parks, beaches, and sports fields (VerCauteren and Marks 2004). If people or their pets unknowingly approach waterfowl or their nests at those locations, injuries could occur if waterfowl react aggressively to the presence of those people or pets (Conover 2002). Additionally, slipping hazards can be created by the buildup of feces from birds on docks, walkways, and other foot traffic areas. To avoid those conditions, regular cleanup is often required to alleviate threats of slipping on fecal matter, which can be economically burdensome.

Need to Resolve Bird Damage Occurring to Property

As shown in Table 1.1 and Appendix B, all of the bird species addressed in this EA can cause damage to property in North Carolina. Property damage can occur in a variety of ways and can result in costly repairs and clean-up. Bird damage to property can occur through direct damage to structures, through roosting behavior, and through their nesting activities. One example of direct damage to property occurs when vultures tear roofing shingles or pull out latex caulking around windows. Accumulations of fecal droppings can cause damage to buildings and statues. Woodpeckers can also cause direct damage to property when they excavate holes in buildings either for nesting purposes, attracting a mate, or to locate food, which can remove insulation and allows water and other wildlife to enter the building (Marsh 1994). Aircraft striking birds can also cause substantial damage requiring costly repairs and aircraft downtime. Direct damage can also result from birds that act aggressively toward their reflection in mirrors and windows, which can scratch paint and siding.

Property Damage to Aircraft from Bird Strikes

Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996). Aircraft collisions with wildlife can also erode public confidence in the air transportation industry as a whole (Conover et al. 1995). Wildlife strikes pose increasing risks and economic losses to the aviation industry worldwide. Annual economic losses from wildlife strikes with civil aircraft are conservatively estimated to exceed $1.2 billion worldwide (Allan 2002). Direct costs include damage to aircraft, aircraft downtime, and medical expenses of injured personnel and passengers. Indirect costs can include lost revenue from the flight, cost of housing delayed passengers, rescheduling aircraft, and flight cancellations.

From 1990 to 2014, Federal Aviation Administration (FAA) records indicate total reported losses from bird strikes cost the civil aviation industry nearly $644 million in monetary losses and 665,861 hours of aircraft downtime (Dolbeer et al. 2015). These figures may be an underestimate of total damage because the number of actual bird strikes is likely to be much greater than that reported. An estimated 80% of civil bird strikes may go unreported (Linnell et al. 1999, Wright and Dolbeer 2005). Between 2004 and 2008, Dolbeer (2009) estimated the FAA received reports on only 39% of the actual aircraft strikes;

therefore, 61% of aircraft strikes went unreported. Not all reports provide notation as to whether or not there was damage and some strike reports to the FAA that indicate there was an adverse impact on the aircraft from the strike do not include a monetary estimate of the damage caused. Additionally, most reports indicating damage to aircraft report direct damages and do not include indirect damage, such as lost revenue, cost of putting passengers in hotels, rescheduling aircraft, and flight cancellations. Dolbeer et al. (2014) estimated that the actual annual costs to the United States civil aviation industry from wildlife strikes (includes mammal strikes) to be over 588,699 hours of aircraft downtime and $937 million in losses.

Birds can present a safety threat to aviation when those species occur in areas on and around airports. Species of birds that occur in large flocks or flight lines entering or exiting a roost at or near airports or when present in large flocks foraging on airport property can result in aircraft strikes involving several individuals of a bird species, which can increase damage and increase the risks of catastrophic failure of the aircraft. A high percentage of bird strikes occur during peak migration periods, but dangerous situations can develop during any season. Aircraft are most vulnerable to bird strikes while at low altitudes, generally related to landing and taking off. Dolbeer et al. (2013) found that 72% of commercial aircraft strikes and 74% of general aviation aircraft strikes occurred at less than 500 feet above ground level, which is why management of the area immediately surrounding taxiways, runways, and runway approaches is important.

Dolbeer et al. (2015) found the most common bird species involved in strikes reported to the FAA (when identification of the bird species occurred) from 1990 to 2014 were pigeons/doves (14%), followed by gulls (13%), raptors (13%), shorebirds (8%), and waterfowl (6%). Waterfowl were responsible for 29% of the damage occurring in which the bird type was identified (Dolbeer et al. 2015). From January 1990 through August 2016, the FAA (2017) has reports of aircraft striking up to 3,234 birds in North Carolina. In North Carolina, over 96% of the reported aircraft strikes from January 1990 through August 2016 involved birds (FAA 2017). Aircraft in North Carolina have struck at least 106 species of birds (FAA 2017).

Bird species included in this analysis that were reported as being involved in airstrikes from January 1990 through August 2016 in North Carolina include Canada geese, mallards, wild turkeys, rock pigeons, mourning doves, killdeer, upland sandpipers, laughing gulls, ring-billed gulls, herring gulls, great blue herons, black vultures, turkey vultures, osprey, American crows, barn swallows, Northern mockingbirds, European starlings, house finches, red-winged blackbirds, Eastern meadowlarks, and brown-headed cowbirds (FAA 2017). However, many bird species involved in strikes are not or cannot be identified and up to 80% of bird strikes may go unreported (Linnell et al. 1999, Wright and Dolbeer 2005). In addition, 1,903 aircraft strike reports in North Carolina from January 1990 through August 2016 indicated the aircraft struck an "*unknown bird*" species (also identified as small, medium, and large unknown birds), and some reports provide limited identification information, such as aircraft striking "*plovers*" or "*hawks*" (FAA 2017). Therefore, additional species were likely involved in airstrikes in North Carolina during this period.

Doves, pigeons, gulls, raptors, and waterfowl are the most frequently struck bird groups in the United States (Dolbeer et al. 2015). DeVault et al. (2011) concluded that snow geese (*Anser caerulescens*), duck species, Canada geese, turkey vultures, great-horned owls (*Bubo virginianus*), double-crested cormorants, brown pelicans, Sandhill cranes (*Antigone canadensis*), and wild turkeys were the top nine most hazardous birds to aircraft. Those hazards were based upon the number of strikes involving those birds, the amount of damage strikes involving those birds have caused to aircraft, the effect on the flight after the strike, and the body mass the bird (DeVault et al. 2011). When struck, 25% of the reported gull strikes resulted in damage to the aircraft or had a negative effect on the flight while 62% of the reported waterfowl strikes resulted in damage or negative effects on the flight compared to 40% of strikes involving raptors/vultures and 10% of strikes involving pigeons and doves (Dolbeer et al. 2015).

Between 1990 and 2014, nearly $234 million in damages to civil aircraft have been reported from strikes involving waterfowl (Dolbeer et al. 2015). Aircraft strikes involving herons, bitterns, and egrets have resulted in nearly $15 million in damages to aircraft (Dolbeer et al. 2015). Strikes involving great blue herons have caused nearly $7 million in damages to aircraft and nearly 3,822 hours in aircraft downtime (Dolbeer et al. 2015). Between 1990 and 2014, Dolbeer et al. (2015) reported 1,527 aircraft strikes in the United States that involved Canada geese with nearly $126 million in damages to aircraft reported from those strikes. Nationally, the resident Canada goose population probably represents the single most serious bird threat to aircraft safety (Alge 1999, Seubert and Dolbeer 2004, Dolbeer and Seubert 2006).

Resident Canada geese are of particular concern to aviation because of their large size (typically 8 to 15 pounds, which exceeds the four pound bird certification standard for engines and airframes); flocking behavior (which increases the likelihood of multiple bird strikes); attraction to airports for grazing; and year-around presence in urban environments near airports (Seubert and Dolbeer 2004). From 1990 through 2014, there were 1,527 reported strikes involving Canada geese in the United States, including North Carolina, resulting in over $125 million in damage and associated costs to civil aircraft (Dolbeer et al. 2015). The threat that Canada geese pose to aircraft safety was dramatically demonstrated in January 2009 when United States Airways Flight 1549 made an emergency landing in the Hudson River after ingesting multiple Canada geese into both engines shortly after takeoff from New York's LaGuardia Airport (Marra et al. 2009, Wright 2014, Dolbeer et al. 2015). Although the aircraft was destroyed after sinking in the river, all 150 passengers and 5 crewmembers survived (Wright 2014). In addition to civil aviation, the United States Air Force (USAF) reports that Canada geese have caused over $80 million in damage to aircraft (USAF 2015).

Raptors, as well as vultures, present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Of the total known birds struck in the United States from 1990 through 2014, raptors accounted for 13% of reported strikes and 21% of the damage (Dolbeer et al. 2015). Aircraft have struck numerous raptors and vultures in the State from January 1990 through August 2016, including American kestrels, bald eagles, northern harriers, osprey, red-shouldered hawks, Cooper's hawks, red-tailed hawks, black vultures, and turkey vultures (FAA 2017). Raptors and vultures have a large body size making them capable of causing substantial damage to aircraft. Vultures are one of the most hazardous bird groups for an aircraft to strike based on the frequency of strikes, effect on flight, and amount of damage caused by vultures throughout the country (DeVault et al. 2011, Dolbeer et al. 2015).

Starlings and blackbirds, when in large flocks or flight lines entering or exiting a winter roost at or near airports, present a safety threat to aviation. Starlings and blackbirds are particularly dangerous birds to aircraft during take-offs and landings because of their high body density and tendency to travel in large flocks of hundreds to thousands of birds (Seamans et al. 1995). Mourning doves also present similar risks when their late summer behaviors include creating large roosting and loafing flocks. Their feeding, watering, and gritting behavior on airport turf and runways further increase the risks of bird-aircraft collisions.

Gulls also present a strike risk to aircraft and are responsible for most of the damaging strikes reported in coastal areas. From January 1990 through August 2016, there have been 142 reports of aircraft striking gulls at airports in North Carolina (FAA 2017).

Other Property Damage Associated with Birds

Damage to property can occur from accumulations of droppings and feather debris associated with large concentrations of birds, such as blackbirds, cormorants, crows, gulls, pigeons, swallows, vultures, and waterfowl. Although damage and threats can occur throughout the year, damage can be highest during those periods when birds are concentrated into large flocks, such as migration periods and during winter months when food sources are limited. Birds that routinely nest, roost, and/or loaf in the same areas often leave large accumulations of droppings and feather debris, which can be aesthetically displeasing and can cause damage to property. The reoccurring presence of fecal droppings under bird roosts can lead to constant cleaning costs for property owners.

From FY 2011 through FY 2016, damage to property by birds reported to WS by persons requesting assistance has totaled $1,116,620, which is an average of $223,324 annually. Requests for assistance were primarily associated with Canada geese damaging golf courses and recreational areas with grazing and droppings, pigeons damaging non-residential buildings with nesting materials and droppings, great blue herons, pigeons, and black vultures damaging electrical utilities by roosting activities. In addition, requests for assistance were received associated with black vultures damaging equipment and machinery, hawks perceived to be threatening companion animals, and American coots grazing vegetation along dams and dikes, leading to erosion problems.

Canada geese and other waterfowl species may cause damage to aircraft, landscaping, piers, yards, boats, beaches, shorelines, parks, golf courses, driveways, athletic fields, ponds, lakes, rafts, porches, patios, gardens, footpaths, swimming pools, playgrounds, school grounds, and cemeteries (Conover and Chasko 1985, Conover 1991, Atlantic Flyway Council 1999, Atlantic Flyway Council 2011, Cummings 2016). The presence of high numbers of waterfowl can cause damage by grazing on turf and by depositing fecal droppings. Economic damage can occur from the need to cleanup parking lots, public use areas, sidewalks, patios, and lawns at business, residential, and recreational locations. For example, costs can be associated with restoration of greens and other turf areas, cleanup of human use areas, and lost revenue from the loss of memberships at a golf course. Members and the club's management can also be concerned about the possible health hazards from exposure to fecal droppings. The accumulation of fecal matter from birds can also negatively affect landscaping and walkways, often at golf courses and water front property (Conover and Chasko 1985). The costs of reestablishing overgrazed lawns and cleaning waterfowl feces from sidewalks have been estimated at more than $60 per bird (Allan et al. 1995).

Fecal droppings and the overgrazing of vegetation can be aesthetically displeasing (*e.g*. see Fitzwater 1994, Gorenzel and Salmon 1994, Johnson 1994, Johnson and Glahn 1994, Williams and Corrigan 1994). Businesses may be concerned about the negative aesthetic appearance of their property caused by excessive droppings and excessive grazing, and are sensitive to comments by clients and guests. Costs associated with property damage include labor and disinfectants to clean and sanitize fecal droppings, implementation of wildlife management methods, loss of property use, loss of aesthetic value of flowers, gardens, and lawns consumed by geese, loss of customers or visitors irritated by walking in fecal droppings, repair of golf greens, and replacing grazed turf. The reoccurring presence of fecal droppings can lead to constant cleaning costs for property owners.

Accumulated bird droppings can reduce the functional life of some building roofs by 50% (Weber 1979). Corrosion damage to metal structures and painted finishes, including those on automobiles, can occur because of uric acid from bird droppings (Johnson and Glahn 1994). Electrical utility companies frequently have problems with birds and bird droppings causing power outages by shorting out transformers and substations. This has resulted in outage time for power companies and consumers. Damage can also occur from droppings entering into food items or contaminating surfaces used to prepare food items at manufacturing facilities and can introduce undesirable components into the materials used in manufacturing processes.

In addition to damage caused by the accumulation of droppings, damage can also occur in other ways. Electrical utility companies frequently have problems with birds and bird droppings causing power outages by shorting out transformers and substations. The nesting behavior of some bird species can also cause damage to property. Nesting material can be aesthetically displeasing and fecal droppings often accumulate near nests, which can also be aesthetically displeasing.

When gulls, European starlings, house sparrows, raptors, rock pigeons, swallows and other birds nest on or in buildings or other structures they transport large amounts of nest material and food debris to the area. Many bird species are colonial nesters meaning they nest together in large numbers. Many of the gull, egret, and heron species addressed in this assessment nest in large colonies. Swallows can also nest in large colonies. For example, rooftop colonies of nesting gulls can cause damage to urban and industrial structures. Nesting gulls peck at spray-on-foam roofing and rubber roofing material, including caulking. This creates holes that must be repaired or leaks in the roof can result. Gulls transport large amounts of nest material and food remains to the rooftops, which can obstruct roof drainage systems and lead to structural damage or roof failure if clogged drains result in rooftop flooding (Vermeer et al. 1988, Blokpoel and Scharf 1991, Belant 1993).

Pigeons, starlings, and sparrows can cause economic damage to aircraft in hangars. Accumulations of fecal droppings on planes, helicopters, maintenance equipment, and hangar floors result in unscheduled maintenance to clean planes and buildings to protect painted surfaces from acidic fecal droppings and maintain a sanitary work environment. Furthermore, birds may build nests in engines of idle aircraft, which may cause engine damage or cause a fire.

Nesting material and feathers can also clog ventilation systems or fall onto or into equipment or goods (Gorenzel and Salmon 1994, Hygnstrom and Craven 1994). Electrical utility companies frequently have problems with bird nests causing power outages when they short out transformers and substations (USGS 2005, Pruett-Jones et al. 2007). Nesting material can also create a fire hazard (Fitzwater 1994). Additionally, because the active nests of most species are protected under the MBTA, problems arise when birds nest in areas where new construction or maintenance is scheduled to occur (Coates et al. 2012).

Osprey nests are often constructed of large sticks, twigs, and other building materials that can cause damage and prevent access to critical areas when those nests are built on man-made structures (*e.g.*, power lines, cell towers, boats). Disruptions in the electrical power supply can occur when nests are located on utility structures and can inhibit access to utility structures for maintenance by creating obstacles to workers. For example, the average Osprey nest size in Corvallis, Oregon weighed 264 pounds and was 41-inches in diameter (USGS 2005). In 2001, 74% of occupied Osprey nests along the Willamette River in Oregon occurred on power pole sites (USGS 2005).

Large numbers of gulls can be attracted to landfills as they often use landfills as feeding and loafing areas throughout the year, while attracting larger populations of gulls during migration periods (Mudge and Ferns 1982, Patton 1988, Belant et al. 1995, Gabrey 1997, Belant et al. 1998, Bruleigh et al. 1998). Landfills have even been suggested as contributing to the increase in gull populations (Verbeek 1977, Patton 1988, Belant and Dolbeer 1993*a*). Gulls that visit landfills may loaf and nest on nearby rooftops, causing health concerns and structural damage to buildings and equipment. Bird conflicts associated with landfills include accumulation of feces on equipment and buildings, distraction of heavy machinery operators, and the potential for birds to transmit disease to workers on the site. The tendency for gulls to carry waste off site results in accumulation of feces and deposition of garbage in surrounding industrial and residential areas which creates a nuisance, as well as generates the potential for birds to transmit disease to neighboring residents.

Other examples of property damage include black vultures tearing and consuming latex window caulking or rubber gaskets sealing windowpanes, asphalt and cedar roof shingles, vinyl seat covers from boats, patio furniture, and ATV seats. Black vultures and turkey vultures also cause damage to cell phone and radio towers by roosting on critical tower infrastructure. Birds, including wild turkeys, can also cause damage to windows, siding, vehicles, and other property when they mistake their reflection as another bird and attack the image. Additionally, woodpeckers also cause direct damage to property when they chisel holes in the wooden siding, eves, or trim of buildings (Evans et al. 1984, Marsh 1994). Woodpeckers can remove insulation from buildings, which can allow water and other wildlife to enter the building.

Need to Resolve Bird Damage Occurring to Natural Resources

Birds can also negatively affect natural resources through habitat degradation, competition with other wildlife, and through direct depredation on natural resources. Habitat degradation can occur when large concentrations of birds in a localized area negatively affect characteristics of the surrounding habitat, which can adversely affect other wildlife species and can be aesthetically displeasing. Direct depredation occurs when predatory bird species feed on other wildlife species, which can negatively influence those species' populations, especially when depredation occurs on threatened and endangered (T&E) species. Competition can occur when two species compete (usually to the detriment of one species) for available resources, such as food or nesting sites.

For example, brood parasitism by brown-headed cowbirds has become a concern for many wildlife professionals where those birds are plentiful. Somewhat unique in their breeding habits, brown-headed cowbirds are known as brood parasites, meaning they lay their eggs in the nests of other bird species (Lowther 1993). Female cowbirds can lay up to 40 eggs per season with eggs reportedly being laid in the nests of over 220 species of birds (Lowther 1993). No parental care is provided by cowbirds with the raising of cowbird young occurring by the host species. Young cowbirds often out-compete the young of the host species (Lowther 1993). Due to this, brown-headed cowbirds can have adverse effects on the reproductive success of other species (Lowther 1993) and can threaten the viability of a population or even the survival of a host species (Trail and Baptista 1993).

European starlings and house sparrows can be aggressive and often out-compete native species, destroying their eggs, and killing nestlings (Cabe 1993, Lowther and Cink 2006). Miller (1975) and Barnes (1991) reported European starlings were responsible for a severe depletion of the eastern bluebird (*Sialis sialis*) population due to nest competition. Nest competition by European starlings has been known to displace American kestrels (von Jarchow 1943, Nickell 1967, Wilmers 1987, Bechard and Bechard 1996), red-bellied woodpeckers (*Melanerpes carolinus*), Gila woodpeckers (*Melanerpes uropygialis*) (Kerpez and Smith 1990, Ingold 1994), northern flickers (*Colaptes auratus*), purple martins (Allen and Nice 1952), and wood ducks (*Aix sponsa*) (Shake 1967, McGilvery and Uhler 1971, Grabill 1977, Heusmann et al. 1977). Weitzel (1988) reported nine native species of birds in Nevada had been displaced by starling nest competition, and Mason et al. (1972) reported European starlings evicting bats from nest holes.

Crows and gulls will consume a variety of food items, including the eggs and chicks of other birds (Pierotti and Good 1994, Good 1998, Verbeek and Caffrey 2002, Pollet et al. 2012, Burger 2015). Those species in particular are among the most frequently reported avian predator of colonial nesting waterbirds in the United States (Frederick and Collopy 1989). Predation is a naturally occurring event but can become a management concern when predation occurs on species experiencing severe population declines or during the restoration of waterbird breeding sites (Hunter et al. 2006). Fish eating birds, such as cormorants, egrets, herons, and osprey, also have the potential to impact fish and amphibian populations, especially those of T&E species. Impacts on the productivity and survivorship of rare or threatened wildlife can be severe when they become targets of avian predators. Some of the species listed as threatened or endangered under the Endangered Species Act of 1973 (ESA) are preyed upon or otherwise could be adversely affected by certain bird species.

For example, herring gulls and great black-backed gulls are aggressive predators on many species (Guillemette and Brousseau 2001, Hunter et al. 2006), including being major predators of tern, skimmers, and oystercatchers (Hunter et al. 2006). Studies conducted in Virginia found herring gulls and great black-backed gulls to be efficient predators on tern and black skimmer (*Rynchops niger*) eggs, chicks, and fledglings (Becker 1995, O'Connell and Beck 2003). Fledgling success rates for common terns (*Sterna hirundo*) ranged from zero to 19% when nesting adjacent to a herring gull colony because gulls preyed on 44% to 94% of the chicks (Becker 1995). In another study, herring gulls preyed on 61% to 66% of common tern chicks in a colony (O'Connell and Beck 2003). Common grackles, red-winged blackbirds, northern harriers, and American kestrels are also known to feed on nesting colonial water birds and shorebirds, their chicks and/or eggs (Hunter and Morris 1976, Farraway et al. 1986, Rimmer and Deblinger 1990, Ivan and Murphy 2005, United States Army Corps of Engineers 2009).

Colonial nesting species can also compete with other bird species for nest sites. For example, gulls and cormorants can displace other colonial nesting birds (Gochfeld and Burger 1994, Hunter et al. 2006). Biologists monitoring nesting colonial waterbirds and shorebirds in North Carolina have noted the loss of tern, skimmer, and shorebird eggs and chicks to gulls, and have found that some of these species are not nesting on previously used sites, possibly due to gulls assuming nesting territories on the sites (Schweitzer 2011). Of particular concern is the decline in numbers of nesting piping plovers (*Charadrius melodus*), Wilson's plovers (*C. wilsonia*), American oystercatchers (*Haematopus palliatus*), gull-billed terns (*Gelochelidon nilotica*), common terns (*Sterna hirundo*), Caspian terns (*Hydroprogne caspia*), and black skimmers. The USFWS considers piping plovers to be a threatened species in the State. The NCWRC considers gull-billed terns to be a threatened species in the State and the NCWRC considers American oystercatchers, black skimmers, and common terns as species of special concern in the State.

Kress et al. (1983) found that efforts to remove herring gulls and great black-backed gulls in the northeastern United States were successful in restoring tern nesting sites and increasing productivity at active tern nesting sites. The Southeastern United States Regional Waterbird Conservation Plan stated that herring gulls and great black-backed gulls "*...have increased dramatically in the Southeast U.S. and* [herring gulls and great black-backed gulls] *are considered to be important predators on other coastal nesting waterbirds*..." (Hunter et al 2006).

Additionally, degradation of vegetation due to the presence of colonial nesting birds can reduce nesting habitat for other birds (Jarvie et al. 1997, Shieldcastle and Martin 1999) and wildlife, including T&E species (Korfanty et al. 1999). In some cases, the establishment of colonial waterbird nesting colonies on islands has led to the complete denuding of vegetation within three to 10 years of areas being occupied (Lewis 1929, Lemmon et al. 1994, Weseloh and Ewins 1994, Bédard et al. 1995, Weseloh and Collier 1995, Weseloh et al. 1995, Korfanty et al. 1999, Hebert et al. 2005). Cormorants can have a negative effect on vegetation that provides nesting habitat for other birds (Jarvie et al. 1997, Shieldcastle and Martin 1999) and wildlife, including state and federally listed T&E species (Korfanty et al. 1999). Although loss of vegetation can have an adverse effect on many species, some colonial waterbirds such as pelicans and terns prefer sparsely vegetated substrates.

Damage to vegetation can also occur when birds strip leaves for nesting material or when the weight of many nests, especially those of colonial nesting waterbirds breaks branches (Weseloh and Ewins 1994).

In some cases, those effects can be so severe on islands that all woody vegetation is eliminated, which can leave those islands completely denuded of vegetation (Cuthbert et al. 2002). Lewis (1929) considered the killing of trees by nesting cormorants to be local and limited, with most trees having no commercial timber value. However, tree damage may be perceived as a problem if those trees are rare species, or aesthetically valued (Bédard et al. 1999, Dorr et al. 2014).

Degradation of habitat can also occur when large concentrations of Canada geese remove shoreline vegetation resulting in erosion (Atlantic Flyway Council 2011). Severe grazing can result in the loss of turf that stabilizes soil on manmade levees. Heavy rains on the bare soil of levees can result in erosion, which would not have occurred if the levee had been vegetated. Large accumulations of fecal droppings under crow roosts could have a detrimental impact on desirable vegetation. A study conducted in Oklahoma found fewer annual and perennial plants in locations where crows roosted over several years (Hicks 1979).

Large concentrations of waterfowl may affect water quality around beaches and in wetlands by acting as nonpoint source pollution. For example, nutrient loading has been found to increase in wetlands in proportion to increases in the numbers of roosting geese (Manny et al. 1994, Kitchell et al. 1999). In studying the relationship between bird density and phosphorus and nitrogen levels in Bosque Del Apache National Wildlife Refuge in New Mexico, Kitchell et al. (1999) found an increase in the concentration of both phosphorus and nitrogen correlated with an increase in bird density. Scherer et al. (1995) stated that waterfowl metabolize food very rapidly and most of the phosphorus contributed by bird feces into water bodies probably originates from sources within a lake being studied. In addition, assimilation and defecation converted the phosphorus into a more soluble form; therefore, the phosphorus from fecal droppings was considered a form of internal loading. Waterfowl can contribute substantial amounts of phosphorus and nitrogen into lakes through feces, which can cause excessive aquatic macrophyte growth and algae blooms (Scherer et al. 1995) and accelerated eutrophication through nutrient loading (Harris et al. 1981).

Canada geese and other waterfowl can be attracted to waste water treatment plants because of the water and available vegetation. Sewage treatment plants are often required to test water quality of effluents before release from finishing ponds into the environment. Coliform bacteria causes acidic pH levels in the water and lowers dissolved oxygen, which can kill aquatic organisms (Cagle 1998). In addition, fecal contamination increases nitrogen levels in the pond resulting in algae blooms. Oxygen levels are depleted when the algae dies resulting in the death of aquatic invertebrates and vertebrates.

It has been well documented that birds can carry a wide range of bacterial, viral, fungal, and protozoan diseases that can affect other bird species, as well as mammals. A variety of diseases that birds can carry can affect natural resources (*e.g.,* see Friend and Franson 1999, Forrester and Spalding 2003, Thomas et al. 2007). Potential impacts from diseases found in wild birds may include transmission to a single individual or a local population, transmission to a new habitat, and transmission to other species of wildlife including birds, mammals, reptiles, amphibians, and fish species. Birds may also act as a vector, reservoir, or intermediate host as it relates to diseases and parasites. Diseases like avian botulism, avian cholera, and Newcastle disease can account for the death of hundreds to thousands of bird species across the natural landscape (Friend et al. 2001). For example, an avian botulism outbreak in Lake Erie was responsible for a mass die-off of common loons (*Gavia immer*) (Campbell et al. 2001) as well as other species that may have fed on the carcasses or on fly larva associated with the carcasses (Duncan and Jensen 1976). Although diseases spread through populations of birds, it is often difficult to determine the potential impacts they will have on other wildlife species due to the range of variables that are involved in a disease outbreak (Friend et al. 2001).

The WS program in North Carolina has participated in interagency meetings to address the need for managing predation on T&E species inhabiting the coastal beach ecosystems of North Carolina. The coastal beach ecosystems of North Carolina support a variety of State and federally-listed species. Those species are protected under the ESA and include four species of nesting sea turtles (although only three actively nest in the State), three species of nesting shorebirds, various colonial birds, and one species of wintering shorebird. Predation on T&E species nests and nestlings lowers the reproductive success of those species, which in combination with other factors can inhibit the recovery of those species.

Need to Protect Birds from Oil Spill Hazards

WS could receive requests for assistance to help recover birds from areas affected by oil spills and/or other chemical spills. WS could also receive requests to assist with harassing birds away from oil and/or other chemical spills to deter birds from coming into contact with the released oil and/or chemical. Exposure to oil, both chronic and acute, such as that from an oil spill, can adversely affect bird species (Szaro 1977, Flickinger 1981, Albers 1984, Albers 1991). Petroleum in all of its forms can affect birds through external oiling of feathers (which causes loss of buoyancy and waterproofing properties), ingestion, oiling of eggs, and habitat alteration (Albers 1991). Death of individual birds often occurs from exposure or drowning, or sometimes indirectly from disease, malnutrition, and predation that results from ingesting oil.

1.3 NATIONAL ENVIRONMENTAL POLICY ACT AND WS' DECISION-MAKING

All federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.), including the actions of WS[7]. The NEPA sets forth the requirement that all federal actions be evaluated in terms of their potential to significantly affect the quality of the human environment for the purpose of avoiding or, where possible, mitigating and minimizing adverse impacts. In part, the Council of Environmental Quality (CEQ) regulates federal activities affecting the physical and biological environment through regulations in 40 CFR 1500-1508. The NEPA and the CEQ guidelines generally outline five broad types of activities that a federal agency must accomplish as part of projects they conduct. Those five types of activities are public involvement, analysis, documentation, implementation, and monitoring.

Pursuant to the NEPA and the CEQ regulations, WS is preparing this EA[8] to document the analyses associated with proposed federal actions and to inform decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse effects. This EA will serve as a decision-aiding mechanism to ensure that WS infuses the policies and goals of the NEPA and the CEQ into the actions of the WS program in North Carolina. This EA will also aid WS with clearly communicating the analysis of individual and cumulative impacts of proposed activities to the public. In addition, the EA will facilitate planning, promote interagency coordination, and streamline program management analyses between WS, the United States Fish and Wildlife Service (USFWS), the NCWRC, and the North Carolina Department of Agriculture and Consumer Services (NCDACS)[9].

Individual wildlife damage management projects conducted by the WS program could be categorically excluded from further analysis under the NEPA, in accordance with APHIS implementing regulations for the NEPA (7 CFR 372.5(c), 60 FR 6000-6003). However, the purpose of this EA is to evaluate

[7]The WS program follows the CEQ regulations implementing the NEPA (40 CFR 1500 et seq.) along with USDA (7 CFR 1b) and APHIS Implementing Guidelines (7 CFR 372) as part of the decision-making process.

[8]The CEQ defines an EA as documentation that "...*(1) briefly provides sufficient evidence and analysis for determining whether to prepare an* [Environmental Impact Statement]; *(2) aids an agency's compliance with NEPA when no environmental impact statement is necessary; and (3) facilitates preparation of an Environmental Impact Statement when one is necessary*" (CEQ 2007).

[9]Section 1.6 of this EA discusses the roles, responsibilities, and the authorities of each agency.

cumulatively the individual projects that WS could conduct to manage the damage and threats that birds cause. More specifically, the EA will assist WS with determining if alternative approaches to managing bird damage could potentially have significant individual and/or cumulative effects on the quality of the human environment that would warrant the preparation of an Environmental Impact Statement (EIS)[10] in compliance with the NEPA and CEQ regulations.

1.4 DECISIONS THAT THE WS PROGRAM MUST MAKE

Management of migratory birds is the responsibility of the USFWS. As the authority for the overall management of migratory bird populations, the USFWS was involved in the development of the EA and provided information during the EA preparation process to ensure an interdisciplinary approach according to the NEPA and agency mandates, policies, and regulations. The NCWRC is responsible for managing wildlife in the State of North Carolina, including birds. The NCWRC establishes and enforces regulated hunting seasons in the State, including the establishment of hunting seasons that allow the harvest of some of the bird species addressed in this EA. For some migratory bird species (*e.g.*, waterfowl), the NCWRC can establish hunting seasons for those species under frameworks determined by the USFWS.

WS' activities to reduce and/or prevent bird damage in the State would be coordinated with the USFWS and the NCWRC, which would give those agencies an opportunity to incorporate WS' actions into population objectives established by those agencies for bird populations in the State. The take of many of the bird species addressed in this EA could only occur when authorized by a depredation permit issued by the USFWS and/or the NCWRC; therefore, the take of those bird species to alleviate damage or reduce threats of damage would only occur at the discretion of the USFWS and/or the NCWRC.

Based on the scope of this EA, the decisions are:

- How should WS respond to the need for action to manage damage caused by bird species in the State?
- Would implementation of the alternatives cause effects to the human environment requiring the preparation of an EIS?

1.5 SCOPE OF ANALYSIS

Actions Analyzed

This EA evaluates the need for bird damage management to reduce threats to human safety and to resolve damage to property, natural resources (including protection of birds from oil and chemical spill hazards), and agricultural resources on federal, state, tribal, municipal, and private land within the State of North Carolina wherever such management is requested by a cooperator. This EA discusses the issues associated with conducting damage management activities in the State to meet the need for action and evaluates different alternatives to meet that need while addressing those issues.

Appendix C discusses the methods that WS is considering for use when conducting the alternative approaches to manage bird damage. The alternatives and Appendix C also discuss how WS would employ methods to manage damage and threats associated with birds. Therefore, the actions evaluated in this EA are the use of those methods available under the alternatives and the employment of those methods by WS to manage or prevent damage and threats associated with birds from occurring when

[10]The EA process concludes with either a Finding of No Significant Impact or a determination to prepare an EIS. The CEQ states, "*A Federal agency must prepare an EIS if it is proposing a major federal action significantly affecting the quality of the human environment*" (CEQ 2007).

permitted by the USFWS pursuant to the Migratory Bird Treaty Act (MBTA) and/or when permitted by the NCWRC.

The MBTA makes it unlawful to pursue, hunt, take, capture, kill, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or their parts, nests, or eggs (16 USC 703-711). A list of migratory bird species protected under the MBTA can be found in 50 CFR 10.13.

The MBTA does allow for the lethal take of those bird species listed in 50 CFR 10.13 when depredation occurs through the issuance of depredation permits or the establishment of depredation/control orders. Under authorities in the MBTA, the USFWS is the federal agency responsible for the issuance of depredation permits or the establishment of depredation/control orders for the take of those protected bird species when damage or threats of damage are occurring. Information regarding migratory bird permits can be found in 50 CFR 13 and 50 CFR 21.

In North Carolina, the NCWRC also requires a depredation permit for the take of all wild birds, which includes migratory birds and resident bird species that are not migratory (*e.g*., wild turkeys). The exception is five species that the NCWRC no longer classifies as wild birds, which includes the mute swan, Eurasian collared-dove, rock pigeon, European starling, and the house sparrow. As such, those five bird species do not require a depredation permit from the NCWRC. If the USFWS requires a depredation permit to take a bird species, a person must acquire a depredation permit from the USFWS first before applying for a depredation from the NCWRC because the NCWRC may impose further restrictions on the take of birds if needed.

Native American Lands and Tribes

The WS program in North Carolina would only conduct damage management activities on Native American lands when requested by a Native American Tribe. WS would only conduct activities after WS and the Tribe requesting assistance signed a Memorandum of Understanding (MOU), work initiation document, or another similar document. Therefore, the Tribe would determine when WS' assistance was required and what activities the Tribe would allow. Because Tribal officials would be responsible for requesting assistance from WS and determining what methods would be available to alleviate damage, no conflict with traditional cultural properties or beliefs would be anticipated. Those methods available to alleviate damage associated with birds on federal, state, county, municipal, and private properties under the alternatives analyzed in this EA would be available for use to alleviate damage on Tribal properties when the use of those methods had been approved for use by the Tribe requesting WS' assistance. Therefore, the activities and methods addressed under the alternatives would include those activities that could be employed on Native American lands, when requested and when agreed upon by the Tribe and WS.

Period for which this EA is Valid

If the analyses in this EA indicates an EIS is not warranted, this EA would remain valid until WS determines that new needs for action, changed conditions, new issues, or new alternatives having different environmental impacts must be analyzed. At that time, this analysis and document would be reviewed and, if appropriate, supplemented pursuant to the NEPA. Review of the EA would be conducted to ensure that activities implemented under the selected alternative occur within the parameters evaluated in the EA. If the alternative analyzing no involvement in damage management activities by WS were selected, no additional analyses by WS would occur based on the lack of involvement by WS. The monitoring of activities by WS would ensure the EA remained appropriate to the scope of activities conducted by WS in North Carolina.

Site Specificity

Many of the bird species addressed in this EA occur statewide and throughout the year; therefore, damage or threats of damage associated with those bird species could occur wherever those birds occur. Managing damage caused by birds falls within a category of agency actions in which the exact timing or location of individual activities cannot usually be predicted well enough ahead of time to describe accurately such locations or times in an EA or EIS. Although WS can predict some of the possible locations or types of situations where bird damage might occur, WS cannot predict specific locations or times where such damage would occur in any given year. The threshold triggering an entity to request assistance from WS to manage damage associated with birds is often unique to the individual; therefore, predicting where and when such a request for assistance will be received would be difficult.

In addition, the WS program would not be able to prevent such damage in all areas where it might occur without resorting to destruction of bird populations over broad areas at a much more intensive level than would be desired by most people, including WS and other agencies. Such broad scale population management would also be impractical or impossible to achieve within WS' policies and professional philosophies. As mentioned previously, WS would only conduct damage management activities when requested by the appropriate resource owner or manager. Therefore, this EA analyzes the potential effects of alternative approaches to managing damage associated with birds that WS could conduct in North Carolina where WS and the appropriate entities have entered into an agreement through the signing of a MOU, work initiation document, or another comparable document. This EA also addresses the potential effects of conducting damage management approaches in areas where WS and an entity requesting assistance sign additional MOUs, work initiation documents, or another comparable document in the future. Because the need for action is to reduce damage and because the goals and directives of WS are to provide assistance when requested, within the constraints of available funding and workforce, it is conceivable that additional efforts could occur. This EA anticipates those additional efforts and analyzes the impacts of such efforts as part of the alternatives. Thus, the analyses in this EA are intended to apply to any action that may occur in any locale and at any time within North Carolina.

Chapter 2 of this EA identifies and discusses issues relating to bird damage management in North Carolina. WS' EA development process is issue driven, meaning issues that were identified during the interdisciplinary process and substantive issues identified during the public involvement process, are used to drive the analysis and determine the significance of the environmental impacts of the alternative approaches. Therefore, the level of site specificity must be appropriate to the issues listed. The issues raised during the scoping process of the EA drove the analysis in this EA. This EA emphasizes major issues as those issues relate to specific areas whenever possible; however, many issues apply wherever bird damage occurs and those issues are treated as such in this EA.

The standard WS Decision Model (see WS Directive 2.201; Slate et al. 1992) would be the site-specific procedure for individual actions conducted by WS in the State (see Chapter 3 for a description of the Decision Model and its application). The WS Decision Model is an analytical thought process used by WS' personnel for evaluating and responding to requests for assistance. Decisions made using the model would be in accordance with WS' directives and Standard Operating Procedures (SOPs) described in this EA as well as relevant laws and regulations. In this way, WS believes it meets the intent of the NEPA with regard to site-specific analysis and that this is the only practical way for WS to comply with the NEPA and still be able to address damage and threats associated with birds.

1.6 AUTHORITY OF FEDERAL AND STATE AGENCIES

Below are brief discussions of the authorities of WS and other agencies, as those authorities relate to conducting wildlife damage management.

WS' Legislative Authority

The primary statutory authorities for the WS program are the Act of March 2, 1931 (46 Stat. 1468; 7 USC 8351-8352) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 8353). The WS program is the lead federal authority in managing damage to agricultural resources, natural resources, property, and threats to human safety associated with animals. WS' directives define program objectives and guide WS' activities with managing animal damage and threats.

United States Fish and Wildlife Service Authority

The USFWS is the primary federal agency responsible for conserving, protecting, and enhancing the nation's fish and wildlife resources and their habitats for the continuing benefit of the American people. Responsibilities are shared with other federal, state, tribal, and local entities; however, the USFWS has specific responsibilities for the protection of T&E species under the ESA, migratory birds, inter-jurisdictional fish, and certain marine mammals, as well as for lands and waters that the USFWS administers for the management and protection of those resources, such as the National Wildlife Refuge System.

The USFWS is responsible for managing and regulating take of bird species that are listed as migratory under the MBTA and those species that are listed as threatened or endangered under the ESA. The take of migratory birds is prohibited by the MBTA. However, the USFWS can issue depredation permits for the take of migratory birds when certain criteria are met pursuant to the MBTA. Depredation permits are issued to take migratory birds to alleviate damage and threats of damage. Under the permitting application process, the USFWS requires applicants to describe prior non-lethal damage management techniques that have been used. In addition, the USFWS can establish depredation/control orders that allow for the take of migratory birds. Under depredation/control orders, lethal removal can occur when those bird species are causing damage without the need for a depredation permit.

The USFWS authority for migratory bird management is based on the MBTA of 1918 (as amended), which implements treaties with the United States, Great Britain (for Canada), the United Mexican States, Japan, and the former Soviet Union. Section 3 of this Act authorized the Secretary of Agriculture:

"*From time to time, having due regard to the zones of temperature and distribution, abundance, economic value, breeding habits, and times and lines of migratory flight of such birds, to determine when, to what extent, if at all, and by what means, it is compatible with the terms of the convention to allow hunting, taking, capture, killing, possession, sale, purchase, shipment, transportation, carriage, or export of any such bird, or any part, nest, or egg thereof, and to adopt suitable regulations permitting and governing the same, in accordance with such determinations, which regulations shall become effective when approved by the President*."

The authority of the Secretary of Agriculture, with respect to the MBTA, was transferred to the Secretary of the Interior in 1939 pursuant to Reorganization Plan No. II. Section 4(f), 4 FR 2731, 53 Stat. 1433.

United States Environmental Protection Agency (EPA)

The EPA is responsible for implementing and enforcing the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which regulates the registration and use of pesticides, including avicides and repellents available for use to manage bird damage.

United States Food and Drug Administration (FDA)

The FDA is responsible for protecting public health by assuring the safety, efficacy, and security of human and veterinary drugs, biological products, medical devices, our nation's food supply, cosmetics, and products that emit radiation. The FDA is also responsible for advancing the public health by helping to speed innovations that make medicines and foods more effective, safer, and more affordable; and helping the public get the accurate, science-based information they need to use medicines and foods to improve their health.

North Carolina Wildlife Resources Commission

The NCWRC was established by Article 24 of Chapter 143 of the General Statutes and Part 3 of Article 7 of Chapter 143B of the General Statutes (1965, c. 957, s. 2; 1973, c. 1262, s. 28; 1977, c. 512, s. 5; c. 771, s. 4; 1979, c. 388, s. 1; c. 830, s. 1; 1987, c. 641, s. 4; 1989, c. 727, s. 218(57); 1997-443, s. 11A.119(a); 1998-225, s. 1.1.). Under Chapter 143, Article 24, Section 143-239, "[t]*he purpose of...the North Carolina Wildlife Resources Commission,...shall be to manage, restore, develop, cultivate, conserve, protect, and regulate the wildlife resources of the State of North Carolina, and to administer the laws relating to game, game and freshwater fishes, and other wildlife*... (1947, c. 263, s. 3; 1965, c. 957, s. 13.)".

North Carolina Department of Agriculture and Consumer Services

The Pesticide Section of the Structural Pest Control and Pesticide Division within the NCDACS enforces state laws pertaining to the use and application of pesticides. The North Carolina Pesticide Law of 1971 requires the registration of pesticide products in the state, the licensing and certification of commercial and private applicators and pest control consultants, the proper handling, transportation, storage, and disposal of pesticides, and the licensing of dealers selling restricted use pesticides. The purpose of the Law is to protect the health, safety, and welfare of the people of this State, and to promote a more secure, healthy and safe environment for all people of the state. This is accomplished by regulation in the public interest of the use, application, sale, disposal, and registration of pesticides.

1.7 DOCUMENTS RELATED TO THIS EA

Additional environmental documents relate to activities that WS could conduct to manage damage or threats of damage associated with bird species in the State. The relationship of those documents to this EA occurs below for each of those documents.

Final Environmental Impact Statement: Programmatic Environmental Impact Statement for the Eagle Rule Revision

Developed by the USFWS, this EIS evaluated the issues and alternatives associated with the promulgation of new regulations to authorize the "*take*" of bald eagles and golden eagles as defined under the Bald and Golden Eagle Protection Act. The preferred alternative in the EIS evaluated the management on an eagle management unit level (similar to the migratory bird flyways) to establish limits on the amount of eagle take that the USFWS could authorize in order to maintain stable or increasing populations. This alternative further establishes a maximum duration for permits of 30 years with evaluations in five-year increments (USFWS 2016). A Record of Decision was issued for the preferred alternative in the EIS. The selected alternative revised the permit regulations for the "*take*" of eagles (see 50 CFR 22.26 as amended) and a provision to authorize the removal of eagle nests (see 50 CFR 22.27 as amended). The USFWS published a Final Rule on December 16, 2016 (81 FR 91551-91553).

Final Environmental Impact Statement: Resident Canada Goose Management in the United States

The USFWS, in cooperation with WS, has issued a Final Environmental Impact Statement (FEIS) addressing the need for and potential environmental impacts associated with managing resident Canada goose populations (USFWS 2005). The FEIS also contains detailed analyses of the issues and methods used to manage Canada goose damage. A Record of Decision (ROD) and Final Rule were published by the USFWS on August 10, 2006 (71 FR 45964- 45993). On June 27, 2007, WS issued a ROD and adopted the FEIS (72 FR 35217).

Final Environmental Impact Statement: Light Goose Management

The USFWS has issued a FEIS that analyzes the potential environmental impacts of management alternatives for addressing problems associated with overabundant light goose populations (USFWS 2007). The light geese referred to in the FEIS include snow geese (*Anser caerulescens*) and Ross's geese (*Anser rossii*) that nest in Arctic and sub-Arctic regions of Canada and migrate and winter throughout the United States. A ROD and Final Rule were published by the USFWS and the Final Rule went into effect on December 5, 2008.

Southeast United States Waterbird Conservation Plan

The USFWS and their partners developed a regional waterbird conservation plan for the southeastern region of the United States to assist with the recovery of high priority waterbird species (Hunter et al. 2006). The Plan addresses waterbirds from eastern Texas and Oklahoma, through Florida, and northward into eastern North Carolina and Virginia, which includes 10 Bird Conservation Regions and 2 pelagic Bird Conservation Regions (Hunter et al. 2006). The plan addresses several overarching conservation goals including the recovery of high priority species, maintaining healthy populations of waterbirds, restoring and protecting essential habitats, and developing science-based approaches to resolving human interactions with waterbirds (Hunter et al 2006). Information in the Plan on waterbirds and their habitats provide a regional perspective for local conservation action.

WS' Environmental Assessments

WS previously developed EAs that analyzed the need for action to manage damage associated with several bird species. Those EAs evaluated alternative approaches to managing damage associated with Canada geese (USDA 2003*b*) and rock pigeons, European starlings, and house sparrows (USDA 2003*c*). In addition, WS developed an EA that evaluated alternative approaches to managing damage associated with several additional bird species (USDA 2010). Those EAs identified the issues associated with managing damage in the State caused by Canada geese, pigeons, starlings, house sparrows, and several other bird species. Those EAs analyzed alternative approaches to meet the specific need identified in each of those EAs while addressing the identified issues. Changes in the need for action and the affected environment have prompted WS to initiate this new analysis to address damage management activities in the State. This EA will address more recently identified changes and will assess the potential environmental effects of program alternatives based on a new need for action, primarily a need to address damage and threats of damage associated with several additional species of birds. Because this EA will re-evaluate those activities that WS evaluated in the previous EAs, the outcome of the Decision issued for this EA will supersede the previous EAs that addressed the need to manage damage caused by bird species in the State.

North Carolina Wildlife Action Plan

The NCWRC has developed an extensive wildlife action plan that evaluates all species of plant and animal known to exist within the State (NCWRC 2015*a*). The action plan "…*provides a comprehensive review of the need for conservation and problems that are likely to impact wildlife and natural communities. The* [action plan] *identifies significant wildlife resources and critical habitats across the state and outlines priority conservation actions for these resources*."

1.8 PUBLIC INVOLVEMENT

WS initially developed issues related to bird damage management and the alternatives to address those issues in consultation with the USFWS and the NCWRC. WS defined the issues and identified preliminary alternative approaches to meeting the need for action through the scoping process. As part of this process, and as required by the CEQ and APHIS' NEPA implementing regulations, WS will notice this document to the public for review and comment. WS will notice this EA to the public through legal notices published in local print media, through direct mailings to interested parties, through an electronic notification to stakeholders registered with the APHIS Stakeholder Registry, by posting a notice on the APHIS website, and making the EA available on the regulations.gov website.

WS will make the EA available for a minimum of 30 days for the public and interested parties to provide new issues, concerns, and/or alternatives. Through the public involvement process, WS will clearly communicate to the public and interested parties the analyses of potential environmental impacts on the quality of the human environment. WS will fully consider new issues or alternatives identified after publication of notices announcing the availability of the EA to determine whether WS should revisit the EA and, if appropriate, revise the EA prior to issuance of a Decision.

1.9 RATIONALE FOR PREPARING AN EA RATHER THAN AN EIS

The intent in developing this EA is to determine if the proposed action would potentially have significant individual and/or cumulative impacts on the quality of the human environment that would warrant the preparation of an EIS. This EA addresses impacts of managing damage and threats to human safety associated with birds in the State to analyze individual and cumulative impacts and to provide a thorough analysis. In terms of considering cumulative effects, one EA analyzing impacts for the entire State will provide a more comprehensive and less redundant analysis than multiple EAs covering smaller areas. If a determination were made through this EA that the proposed action might have a significant impact on the quality of the human environment, then an EIS would be prepared. If a determination were made through this EA that the alternatives developed to meet the need for action could result in a significant effect on the quality of the human environment, then an EIS would be prepared.

1.10 ENVIRONMENTAL STATUS QUO DISCUSSION

As defined by the NEPA implementing regulations, the "*human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment*" (40 CFR 1508.14). Therefore, when a federal action agency analyzes its potential impacts on the "*human environment*", it is reasonable for that agency to compare not only the effects of the federal action, but also the potential effects that occur or would occur from a non-federal entity conducting the action in the absence of the federal action. This concept is applicable to situations involving federal assistance in managing damage associated with resident wildlife species managed by the state, invasive species, or unprotected wildlife species.

Most bird species are protected under state and/or federal law and to address damage associated with those species, a permit must be obtained from the appropriate federal and/or state agency. However, in some situations, with the possible exception of restrictions on methods (*e.g*., firearms restrictions, pesticide regulations), some species can be managed without the need for a permit when they are causing damage (*e.g*., take under depredation/control orders, unprotected bird species). For example, under the blackbird depredation order (see 50 CFR 21.43), blackbirds can be lethally removed by any entity without the need to obtain a depredation permit when those blackbird species identified in the order are found committing damage or when posing a human safety threat. People can also address resident Canada geese and Muscovy ducks under several depredation/control orders (see Section 1.11). People can harvest some bird species, such as waterfowl and wild turkeys, during annual hunting seasons. Therefore, other entities can and do conduct activities to alleviate damage.

When a non-federal entity takes an action involving a bird species, the action is not subject to compliance with the NEPA due to the lack of federal involvement[11] in the action. Under such circumstances, the environmental baseline or status quo must be viewed as an environment that includes those resources as they are managed or impacted by non-federal entities in the absence of the federal action being proposed.

Therefore, in those situations in which a non-federal entity has decided that a management action directed towards birds should occur and even the particular methods that should be used, WS' involvement in the action would not affect the environmental status quo because the entity could take the action in the absence of WS' involvement. Because take could occur during hunting seasons, under depredation/control orders, through the issuance of depredation permits, or for some species take can occur at any time without the need for a depredation permit, an entity could take an action in the absence of WS' involvement. WS' involvement would not change the environmental status quo if the requester had conducted the action in the absence of WS' involvement in the action.

1.11 COMPLIANCE WITH LAWS AND STATUTES

In addition to the NEPA, several laws or statutes authorize, regulate, or otherwise would affect the activities that the WS program conducts. WS would comply with those laws and statutes and would consult with other agencies as appropriate. WS would comply with all applicable federal, state, and local laws and regulations in accordance with WS Directive 2.210. Below are brief discussions of those laws and regulations that would relate to damage management activities that WS could conduct in the State.

Migratory Bird Treaty Act of 1918 (16 USC 703-711; 40 Stat. 755), as amended

The MBTA makes it unlawful to pursue, hunt, take, capture, kill, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or their parts, nests, or eggs (16 USC 703-711). A list of bird species protected under the MBTA can be found in 50 CFR 10.13.
The MBTA also provides the USFWS regulatory authority to protect families of migratory birds. The law prohibits any "*take*" of migratory bird species by any entities, except as permitted by the USFWS. Under permitting guidelines in the Act, the USFWS may issue depredation permits to requesters experiencing damage caused by bird species protected under the Act. Information regarding migratory bird permits can be found in 50 CFR 13 and 50 CFR 21. European starlings, rock pigeons, Eurasian

[11]If a federal permit were required to conduct damage management activities or if activities were allowed under a depredation/control order, the issuing federal agency would be responsible for compliance with the NEPA for issuing the permit or establishing the depredation/control order.

collared-doves, house sparrows, wild turkeys[12], Northern bobwhite[13], and feral waterfowl, including mute swans, are not afforded protection under the MBTA; thus, a depredation permit from the USFWS is not required to take those species. All actions conducted in this EA would comply with the regulations of the MBTA, as amended. The law was further clarified to include only those birds afforded protection from take in the United States by the Migratory Bird Treaty Reform Act of 2004. Under the Reform Act, the USFWS published a list of bird species not protected under the MBTA (70 FR 12710-12716).

In addition to the issuance of depredation permits for the take of migratory birds, the Act allows for the establishment of depredation and control orders that allow migratory birds to be taken without a depredation permit when certain criteria are met.

Depredation/Control Orders for Canada Geese

Under 50 CFR 21.49, resident Canada geese can be lethally taken at airports and military airfields without the need for a depredation permit by airport authorities or their agents when those geese are causing damage or posing a threat of damage to aircraft. A Canada goose nest and egg depredation order has also been established that allows the nests and eggs of those geese causing or posing a threat to people, property, agricultural crops, and other interests to be destroyed without the need for a depredation permit once the participant has registered with the USFWS (see 50 CFR 21.50). A similar depredation order was established to manage damage to agricultural resources associated with Canada geese. Under 50 CFR 21.51, designated people can lethally remove Canada geese without a permit from the USFWS in those states designated, including North Carolina, when geese are causing damage to agricultural resources. Resident Canada geese can be addressed using lethal and non-lethal methods by state agencies, Tribes, and the District of Columbia when those geese pose a direct threat to human health under 50 CFR 21.52. Under the depredation orders for Canada geese, no individual federal depredation permit is required to take geese once the criteria of those orders have been met.

Control Order for Muscovy Ducks (50 CFR 21.54)

Muscovy ducks are native to South America, Central America, and Mexico with a small naturally occurring population in southern Texas. Muscovy ducks have also been domesticated and have been sold and kept for food and as pets in the United States. In many states, Muscovy ducks have been released or escaped captivity and have formed feral populations, especially in urban areas, that are non-migratory. The USFWS has issued a Final Rule on the status of the Muscovy duck in the United States (75 FR 9316-9322). Because naturally occurring populations of Muscovy ducks are known to inhabit parts of south Texas, the USFWS has included the Muscovy duck on the list of bird species afforded protection under the MBTA at 50 CFR 10.13 (75 FR 9316-9322). To address damage and threats of damage associated with Muscovy ducks, the USFWS has also established a control order for Muscovy ducks under 50 CFR 21.54 (75 FR 9316-9322). Under 50 CFR 21.54, Muscovy ducks, and their nests and eggs, may be removed or destroyed without a depredation permit from the USFWS at any time in the United States, except in Hidalgo, Starr, and Zapata Counties in Texas (75 FR 9316-9322).

Depredation Order for Blackbirds, Cowbirds, Grackles, Crows, and Magpies (50 CFR 21.43)

Pursuant to the MBTA under 50 CFR 21.43, a depredation permit is not required to lethally remove blackbirds when those species are found committing damage or when posing a threat to human safety. Those bird species that could be lethally taken under the blackbird depredation order that are addressed in

[12]The NCWRC may require a permit to lethally remove wild turkeys because turkeys are managed by the NCWRC.

[13]The NCWRC may require a permit to lethally remove northern bobwhite because bobwhite are managed by the NCWRC.

this EA include American crows, fish crows, red-winged blackbirds, common grackles, boat-tailed grackles, and brown-headed cowbirds.

Bald and Golden Eagle Protection Act (16 USC 668)

Populations of bald eagles showed periods of steep declines in the lower United States during the early 1900s attributed to the loss of nesting habitat, hunting, poisoning, and pesticide contamination. To curtail declining trends in bald eagles, Congress passed the Bald Eagle Protection Act (16 USC 668) in 1940 prohibiting the take or possession of bald eagles or their parts. The Bald Eagle Protection Act was amended in 1962 to include the golden eagle and is now referred to as the Bald and Golden Eagle Protection Act. Certain populations of bald eagles were listed as "endangered" under the Endangered Species Preservation Act of 1966, which was extended when the modern ESA was passed in 1973. The "endangered" status was extended to all populations of bald eagles in the lower 48 states, except populations of bald eagles in Minnesota, Wisconsin, Michigan, Washington, and Oregon, which were listed as "threatened" in 1978. As recovery goals for bald eagle populations began to be reached in 1995, all populations of eagles in the lower 48 States were reclassified as "threatened". In 1999, the recovery goals for populations of eagles had been reached or exceeded and the eagle was proposed for removal from the ESA. The bald eagle was officially de-listed from the ESA on June 28, 2007 with the exception of the Sonora Desert bald eagle population. Although officially removed from the protection of the ESA across most of its range, the bald eagle is still afforded protection under the Bald and Golden Eagle Protection Act.

Under the Bald and Golden Eagle Protection Act (16 USC 668-668c), the take of bald eagles is prohibited without a permit from the USFWS. Under the Act, the definition of "take" includes actions that "*pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, or disturb*" eagles. For the purposes of the Act under 50 CFR 22.3, the term "*disturb*", as it relates to take, has been defined as "*to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior*." The regulations authorize the USFWS to issue permits for the take of bald eagles and golden eagles on a limited basis (see 81 FR 91551-91553, 50 CFR 22.26, 50 CFR 22.27). As necessary, WS would apply for the appropriate permits as required by the Bald and Golden Eagle Protection Act.

Endangered Species Act

Under the ESA, all federal agencies will seek to conserve T&E species and will utilize their authorities in furtherance of the purposes of the Act (Sec. 2(c)). WS conducts Section 7 consultations with the USFWS to use the expertise of the USFWS to ensure that "*any action authorized, funded or carried out by such an agency...is not likely to jeopardize the continued existence of any endangered or threatened species...Each agency will use the best scientific and commercial data available*" (Sec. 7 (a) (2)).

National Historic Preservation Act of 1966, as amended

The National Historic Preservation Act and its implementing regulations (see 36 CFR 800) require federal agencies to initiate the Section 106 process if an agency determines that the agency's actions are undertakings as defined in Section 800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties. If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under Section 106.

Native American Graves Protection and Repatriation Act of 1990

The Native American Graves Protection and Repatriation Act (Public Law 101-106, 25 USC 3001) requires federal agencies to notify the Secretary of the Department that manages the federal lands upon the discovery of Native American cultural items on federal or tribal lands. Federal agencies are to discontinue work until the agency has made a reasonable effort to protect the items and notify the proper authority.

Coastal Zone Management Act of 1972, as amended (16 USC 1451-1464, Chapter 33; PL 92-583, October 27, 1972; 86 Stat. 1280).

This law established a voluntary national program within the Department of Commerce to encourage coastal states to develop and implement coastal zone management plans. Funds were authorized for cost-sharing grants to states to develop their programs. Subsequent to federal approval of their plans, grants would be awarded for implementation purposes. In order to be eligible for federal approval, each state's plan was required to define boundaries of the coastal zone, identify uses of the area to be regulated by the state, determine the mechanism (criteria, standards or regulations) for controlling such uses, and develop broad guidelines for priorities of uses within the coastal zone. In addition, this law established a system of criteria and standards for requiring that federal actions be conducted in a manner consistent with the federally approved plan. The standard for determining consistency varied depending on whether the federal action involved a permit, license, financial assistance, or a federally authorized activity. As appropriate, a consistency determination would be conducted by WS to assure management actions would be consistent with the State's Coastal Zone Management Program.

Federal Insecticide, Fungicide, and Rodenticide Act

The FIFRA and its implementing regulations (Public Law 110-426, 7 USC 136 et. seq.) require the registration, classification, and regulation of all pesticides used in the United States. The EPA is responsible for implementing and enforcing the FIFRA. The EPA and the NCDACS regulate pesticides that could be available to manage damage associated with birds.

Federal Food, Drug, and Cosmetic Act (21 USC 360)

This law places administration of pharmaceutical drugs, including those used in wildlife capture and handling, under the FDA.

New Animal Drugs for Investigational Use

The FDA can grant permission to use investigational new animal drugs (see 21 CFR 511). The sedative drug alpha-chloralose is registered with the FDA to capture waterfowl, coots, and pigeons. The use of alpha-chloralose by WS was authorized by the FDA, which allows use of the drug as a non-lethal form of capture. Alpha-chloralose as a method for resolving waterfowl damage and threats to human safety are discussed in Appendix C of this EA.

Occupational Safety and Health Act of 1970

The Occupational Safety and Health Act of 1970 and its implementing regulations (29 CFR 1910) on sanitation standards states that, "*Every enclosed workplace shall be so constructed, equipped, and maintained, so far as reasonably practical, as to prevent the entrance or harborage of rodents, insects, and other vermin. A continuing and effective extermination program shall be instituted where their* *presence is detected*." This standard includes birds that may cause safety and health concerns at workplaces.

Environmental Justice in Minority and Low Income Populations - Executive Order 12898

Executive Order 12898 promotes the fair treatment of people of all races, income levels, and cultures with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Environmental justice is the pursuit of equal justice and protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, or socioeconomic status. Executive Order 12898 requires federal agencies to make environmental justice part of their mission, and to identify and address disproportionately high and adverse human health and environmental effects of federal programs, policies, and activities on minority and low-income persons or populations. This EA will evaluate activities addressed in the alternatives for their potential impacts on the human environment and compliance with Executive Order 12898.

Protection of Children from Environmental Health and Safety Risks - Executive Order 13045

Children may suffer disproportionately for many reasons from environmental health and safety risks, including the development of their physical and mental status. Federal agencies must make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children. In addition, federal agencies must ensure agency policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

Responsibilities of Federal Agencies to Protect Migratory Birds - Executive Order 13186

Executive Order 13186 requires each federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to develop and implement a MOU with the USFWS that shall promote the conservation of migratory bird populations. APHIS has developed a MOU with the USFWS as required by this Executive Order and WS would abide by the MOU.

Invasive Species - Executive Order 13112

Executive Order 13112 establishes guidance to federal agencies to prevent the introduction of invasive species, provide for the control of invasive species, and to minimize the economic, ecological, and human health impacts that invasive species cause. The Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law: 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations and provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education of invasive species.

CHAPTER 2: ISSUES AND ALTERNATIVES

Chapter 2 contains a discussion of the issues, including issues that will receive detailed environmental impact analysis in Chapter 4 (Environmental Consequences), issues that have driven the development of SOPs, and issues that WS identified but will not consider in detail, with rationale. Pertinent portions of the affected environment will be included in this chapter during the discussion of the issues. The discussion of the environmental effects in Chapter 4 incorporate additional descriptions of affected environments.

2.1 AFFECTED ENVIRONMENT

Damage or threats of damage caused by those bird species addressed in this EA can occur statewide in North Carolina wherever those species of birds occur. However, WS would only provide assistance when the appropriate landowner or manager requested such assistance and only on properties where WS and the appropriate landowner or manager signed a MOU, work initiation document, or another similar document. Most species of birds addressed in this EA are capable of utilizing a variety of habitats and occur statewide where suitable habitat exists for foraging, loafing, roosting, and nesting. In addition, many of the bird species occur throughout the year in the State. Because several bird species addressed in this EA occur statewide, requests for assistance to manage damage or threats of damage could occur in areas of the State occupied by those bird species. Chapter 4 contains additional information on the affected environment.

WS could continue to provide assistance on federal, state, county, municipal, and private land in North Carolina under two of the alternatives analyzed in detail when the appropriate resource owner or manager requested such assistance from WS. Upon receiving a request for assistance, the proposed action alternative, or those actions described in the other alternatives, could be conducted on private, federal, state, tribal, and municipal lands in North Carolina to reduce damages and threats to agricultural resources, natural resources, property, and threats to human safety associated with birds. The analyses in this EA are intended to apply to actions taken under the selected alternative that could occur in any locale and at any time within the analysis area. This EA analyzes the potential impacts of bird damage management and addresses activities in North Carolina that have been conducted and are currently being conducted under a MOU, work initiation document, or a similar document with WS. This EA also addresses the potential impacts of bird damage management in the State where additional agreements may be signed in the future. The USFWS would only issue a depredation permit for the take of birds when requested; therefore, this EA evaluates information from depredation permits issued previously by the USFWS to alleviate damage.

The affected environment could include areas in and around commercial, industrial, public, and private buildings, facilities and properties and at other sites where birds may roost, loaf, feed, nest, or otherwise occur. Examples of areas where bird damage management activities could be conducted are, but are not necessarily limited to: residential buildings, golf courses, athletic fields, recreational areas, swimming beaches, parks, corporate complexes, subdivisions, businesses, industrial parks, schools, agricultural areas, wetlands, restoration sites, cemeteries, public parks, bridges, industrial sites, urban/suburban woodlots, hydro-electric dam structures, reservoirs and reservoir shore lands, nuclear, hydro and fossil power plant sites, substations, transmission line rights-of-way, landfills, on ship fleets, military bases, or at any other sites where birds may roost, loaf, or nest. Damage management activities could be conducted at agricultural fields, vineyards, orchards, farmyards, dairies, ranches, livestock operations, grain mills, and grain handling areas (*e.g.*, railroad yards) where birds destroy crops, feed on spilled grains, or contaminate food products for human or livestock consumption. Additionally, activities could be conducted at airports and surrounding properties where birds represent a threat to aviation safety.

Bird Conservation Regions

Bird Conservation Regions (BCRs) are areas in North America characterized by distinct ecological habitats that have similar bird communities and resource management issues. The eastern portion of North Carolina lies within the Southeastern Coastal Plain, also known as BCR 27. The Southeastern Coastal Plain overlaps areas of Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, and small parts of Louisiana, Tennessee, and Kentucky. Extensive riverine swamps and marsh complexes along the Atlantic Coast characterize this region. The region also includes the interior forests dominated by longleaf, slash, and loblolly pine forests. However, areas within the central portion of the State lie within the Piedmont region (BCR 29). The Piedmont region overlaps Georgia, South Carolina, North Carolina, Virginia, and a small part of east-central Alabama extending northward into Maryland, Pennsylvania, and New Jersey. The Piedmont region is characterized as a transitional area between the Appalachian Mountains and the Southeastern Coastal Plain consisting of a patchwork of various hardwood, grassland, and urban settings. The western edge of North Carolina consists of the Appalachian Mountains region (BCR 28), which consists of rugged mountainous terrain dominated by pine, hemlock, spruce, and fir trees at higher elevations and oak-hickory and other deciduous forest types at lower elevations (USFWS 2000).

2.2 ISSUES ASSOCIATED WITH BIRD DAMAGE MANAGEMENT ACTIVITIES

Issues are concerns regarding potential adverse effects that might occur from a proposed action. Such issues must be considered in the NEPA decision-making process. WS developed the issues related to managing damage associated with birds in North Carolina in consultation with the USFWS and the NCWRC. This EA will also be made available to the public for review and comment to identify additional issues.

The issues, as those issues relate to the possible implementation of the alternatives, including the proposed action alternative, are discussed in Chapter 4. The issues analyzed in detail are the following:

Issue 1 - Effects of Damage Management Activities on Target Bird Populations

A common issue when addressing damage caused by wildlife is the potential impacts of management actions on the populations of target species. Methods available to resolve damage or threats to human safety are categorized into non-lethal and lethal methods. Non-lethal methods available can disperse or otherwise make an area unattractive to target species causing damage, which reduces the presence of those species at the site and potentially the immediate area around the site where non-lethal methods were employed. Lethal methods would also be available to remove a bird or those birds responsible for causing damage or posing threats to human safety. Therefore, if lethal methods were used, the removal of a bird or birds could result in local population reductions in the area where damage or threats were occurring. The number of individuals from a target species that could be removed from a population using lethal methods under the alternatives would be dependent on the number of requests for assistance received, the number of individual birds involved with the associated damage or threat, and the efficacy of methods employed.

The analysis to determine the magnitude of impacts on the populations of those species addressed in this EA from the use of lethal methods would be based on a measure of the number of individuals lethally removed in relation to that species abundance. Magnitude may be determined either quantitatively or qualitatively. Quantitative determinations would be based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations would be based on population trends and harvest trend data, when available. Take would be monitored by comparing the number of birds lethally removed with overall populations or trends. Lethal methods would only be used by WS at the request of a cooperator seeking assistance and only after the take of those bird species had been permitted by the USFWS pursuant to the MBTA, when required.

The populations of several migratory bird species are sufficient to allow for annual harvest seasons that typically occur during the fall migration periods of those species. Migratory bird hunting seasons are established under frameworks developed by the USFWS and implemented in the State by the NCWRC. Those species addressed in this EA that people can harvest during regulated seasons in the State include Canada geese, snow geese, brant, mallards, bufflehead, wood ducks, American wigeons, American black ducks, blue-winged teal, Northern shovelers, Northern pintail, green-winged teal, canvasbacks, greater scaup, lesser scaup, ruddy ducks, gadwalls, redheads, ring-necked ducks, clapper rail, American coots, American woodcock, tundra swan, Wilson's snipe, hooded mergansers, common mergansers, red-breasted mergansers, wild turkeys, mourning doves, Eurasian collared-doves, American crows, fish crows, ruffed grouse, ring-necked pheasant, and Northern bobwhite. A concern is that damage management activities conducted by WS would affect the ability of people to harvest those bird species during the regulated hunting seasons either by reducing local populations through the lethal removal of birds or by reducing the number of birds present in an area through dispersal techniques.

People can harvest Eurasian collared-doves during the regulated hunting season for mourning doves given the similarity in appearance between the two species. However, Eurasian collared-doves are not afforded protection from take under the MBTA and are considered a non-native species in North Carolina. For crows, take can also occur under the blackbird depredation order established by the USFWS; therefore, the take of crows can occur during annual hunting seasons with a state hunting license or outside the hunting season to alleviate damage or threats of damage under the depredation order. For many migratory bird species considered harvestable during a hunting season, the number of birds harvested during the season is estimated and reported by the USFWS and/or the NCWRC.

Therefore, any activities conducted by WS under the alternatives addressed would be occurring along with other natural processes and human-induced events, such as natural mortality, human-induced mortality from private damage management activities, mortality from regulated harvest, and human-induced alterations of wildlife habitat.

Methods available under each of the alternatives to alleviate damage and reduce threats to human safety would be employed targeting an individual of a bird species or a group of individuals after applying the WS' Decision Model (Slate et al. 1992) to identify possible techniques. The effects on the populations of target bird populations in the State from implementation of the alternatives addressed in detail, including the proposed action, are analyzed in Chapter 4. Information on bird populations and trends are often derived from several sources including the Breeding Bird Survey (BBS), the Christmas Bird Count (CBC), the Partners in Flight Landbird Population database, published literature, and harvest data. Further information on those sources of information is provided below.

Breeding Bird Survey

Bird populations can be monitored by using trend data derived from data collected during the BBS. Under established guidelines, observers count birds at established survey points along roadways for a set duration along a pre-determined route. Routes are 24.5 miles long and are surveyed once per year with the observer stopping every 0.5 miles along the route to conduct the survey. The numbers of birds observed and heard within 0.25 miles of each of the survey points are recorded during a 3-minute sampling period at each point. Surveys were started in 1966 and are conducted in June, which is generally considered as the period of time when those birds present at a location are likely breeding in the immediate area. The BBS is conducted annually in the United States, across a large geographical area, under standardized survey guidelines. The BBS is a large-scale inventory of North American birds coordinated by the United States Geological Survey, Patuxent Wildlife Research Center (Sauer et al. 2017). The BBS is a combined set of over 3,700 roadside survey routes primarily covering the continental United States and southern Canada. The primary objective of the BBS has been to generate an estimate of population change for all breeding birds. Populations of birds tend to fluctuate, especially locally, because of variable local habitat and climatic conditions. Trends can be determined using different population equations and statistically tested to determine if a trend is statistically significant.

Current estimates of population trends from BBS data are derived from hierarchical model analysis (Link and Sauer 2002, Sauer and Link 2011) and are dependent upon a variety of assumptions (Link and Sauer 1998).

Christmas Bird Count

The CBC is conducted annually in December and early January by numerous volunteers under the guidance of the National Audubon Society. The CBC reflects the number of birds frequenting a location during the winter months. Survey data is based on birds observed within a 15-mile diameter circle around a central point (177 mi^2). The CBC data does not provide a population estimate, but the data can be used as an indicator of trends in a population over time. Researchers have found that population trends reflected in CBC data tend to correlate well with those from censuses taken by more stringent means (National Audubon Society 2010).

Partners in Flight Landbird Population Estimate

The BBS data are intended for use in monitoring bird population trends, but it is also possible to use BBS data to develop a general estimate of the size of bird populations (Rich et al. 2004, Blancher et al. 2013). Using relative abundances derived from the BBS conducted between 1998 and 2007, the Partners in Flight Science Committee (2013) extrapolated population estimates for many bird species in North America as part of the Partners in Flight Landbird Population Estimate database. The Partners in Flight system involves extrapolating the number of birds in the 50 quarter-mile circles (total area/route = 10 mi^2) surveyed during the BBS to an area of interest. The model used by Rich et al. (2004) and updated by the Partners in Flight Science Committee (2013) makes assumptions on the detectability of birds, which can vary for each species. Some species of birds that are more conspicuous (visual and auditory) are more likely to be detected during bird surveys when compared to bird species that are more secretive and do not vocalize often. Information on the detectability of a species is combined to create a detectability factor, which may be combined with relative abundance data from the BBS to yield a population estimate (Rich et al. 2004, Blancher et al. 2013).

Issue 2 - Effects on Non-target Wildlife Species Populations, Including T&E Species

The potential for effects on non-target species and T&E species arises from the use of non-lethal and lethal methods identified in the alternatives. The use of non-lethal and lethal methods has the potential to inadvertently disperse, capture, or kill non-target wildlife. To reduce the risks of adverse effects to non-target wildlife, WS would select damage management methods that were as target-selective as possible or apply such methods in ways to reduce the likelihood of capturing non-target species. Before initiating management activities, WS would select locations that were extensively used by the target species. WS would also use SOPs designed to reduce the effects on populations of non-target species. SOPs are further discussed in Chapter 3. Methods available for use under the alternatives are described in Appendix C.

Concerns have also been raised about the potential for adverse effects to occur to non-target wildlife from the use of chemical methods. Chemical methods that would be available to manage damage or threats of damage associated with birds include the avicide DRC-1339, Avitrol, alpha chloralose, mesurol, nicarbazin, and taste repellents. Chemical methods that could be available for use to manage damage and threats associated with birds in North Carolina are further discussed in Appendix C.

The ESA states that all federal agencies "*...shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the Act*" [Sec. 7(a)(1)]. WS conducts Section 7 consultations with the USFWS to ensure compliance with the ESA and to ensure that "*any* *action authorized, funded or carried out by such an agency...is not likely to jeopardize the continued existence of any endangered or threatened species…Each agency shall use the best scientific and commercial data available*" [Sec. 7(a)(2)].

Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or minimization measures. As part of the scoping process to facilitate interagency cooperation, WS consulted with the USFWS pursuant to Section 7 of the ESA during the development of this EA, which is further discussed in Chapter 4.

Issue 3 - Effects of Damage Management Methods on Human Health and Safety

An additional issue often raised is the potential risks associated with employing methods to manage damage caused by target species. Both chemical and non-chemical methods have the potential to have adverse effects on human health and safety. WS' employees would use and recommend only those methods that were legally available, selective for target species, and were effective at resolving the damage associated with the target species. Still, some concerns exist regarding the safety of methods despite their legality, selectivity, and effectiveness. As a result, this EA will analyze the potential for proposed methods to pose a risk to members of the public and employees of WS. Selection of methods would include consideration for public and employee safety.

Safety of Chemical Methods Employed

The issue of using chemical methods as part of managing damage associated with wildlife relates to the potential for human exposure either through direct contact with the chemical or exposure to the chemical from wildlife that have been exposed. Under the alternatives identified, the use of chemical methods would include avicides, alpha chloralose, nicarbazin, and repellents. Avicides are those chemical methods used to remove birds lethally. DRC-1339 is the only avicide being considered for use to manage damage in this EA. DRC-1339 is currently registered with the EPA for use by WS to manage damage associated with pigeons, starlings, red-winged blackbirds, brown-headed cowbirds, common grackles, crows, and gulls. However, formulations registered with the EPA must also be registered with the NCDACS for use in the State. The WS program would only employ those products that are registered with the EPA and NCDACS.

Several avian repellents are commercially available to disperse birds from an area or discourage birds from feeding on desired resources. Avitrol is a flock dispersal method available for use to manage damage associated with some bird species. For those species addressed in this EA, Avitrol is registered with the EPA to manage damage associated with house sparrows, red-winged blackbirds, common grackles, boat-tailed grackles, brown-headed cowbirds, European starlings, rock pigeons, fish crows, and American crows. Other repellents are also available with the most common ingredients being polybutene, anthraquinone, and methyl anthranilate. An additional repellent being considered for use in this assessment is mesurol, which is intended for use to discourage crows from predating on the eggs of T&E species.

Nicarbazin is the only reproductive inhibitor currently registered with the EPA. Products containing nicarbazin can be used to inhibit the reproduction of local populations of resident Canada Geese, domestic waterfowl, and pigeons by reducing or eliminating the hatchability of eggs laid. Reproductive inhibitors containing the active ingredient nicarbazin could also be available under the alternatives. The use of chemical methods would be regulated by the EPA through the FIFRA, by the NCDACS, and by WS' directives. Chemical methods are further discussed in Appendix C of this EA.

Alpha chloralose is a sedative that is also being considered as a method that could be employed under the alternatives to manage damage associated with waterfowl. Alpha chloralose could be used to sedate waterfowl temporarily and lessen stress on the animal from handling and transportation from the capture site. Drugs delivered to immobilize waterfowl would occur on site with close monitoring to ensure proper care of the animal. Alpha chloralose is reversible with a full recovery of sedated animals occurring. WS can use alpha chloralose to sedate target waterfowl through an Investigational New Animal Drug (INAD) registration with the FDA.

Safety of Non-Chemical Methods Employed

Most methods available to alleviate damage and threats associated with birds are considered non-chemical methods. Non-chemical methods employed to reduce damage and threats to safety caused by birds, if misused, could potentially be hazardous to human safety. Non-chemical methods may include cultural methods, limited habitat modification, animal behavior modification, and other mechanical methods. Changes in cultural methods could include altering feeding schedules, changes in crop rotations, or conducting structural repairs. Limited habitat modification would be practices that alter specific characteristics of a localized area, such as pruning trees to discourage birds from roosting or planting vegetation that was less palatable to birds. Animal behavior modification methods would include those methods designed to disperse birds from an area through harassment or exclusion. Behavior modification methods could include pyrotechnics, propane cannons, bird-proof barriers, electronic distress calls, effigies, Mylar tape, lasers, eye-spot balloons, or nest destruction. Other mechanical methods could include live-traps, mist nests, cannon nets, net guns, shooting, or recommending a local population of harvestable birds be reduced through hunting.

Effects of Not Employing Methods to Reduce Threats to Human Safety

An issue that WS identified was the concern for human safety from not employing methods or not employing the most effective methods to reduce the threats that birds can pose. The risks to human safety from diseases associated with certain bird populations were addressed previously in Chapter 1 under the need for action section. The low risk of disease transmission from birds does not lessen the concerns of cooperators requesting assistance to reduce threats from zoonotic diseases. Increased public awareness of zoonotic events has only heightened the concern of direct or indirect exposure to zoonoses. Not adequately addressing the threats associated with potential zoonoses could lead to an increase in incidences of injury, illness, or loss of human life.

Additional concern is raised with inadequately addressing threats to human safety associated with aircraft striking birds at airports in North Carolina. Birds have the potential to cause severe damage to aircraft and can threaten the safety of flight crews and passengers. If the use of certain methods to address the threat of aircraft striking birds was limited or were excluded from use, the unavailability of those methods could lead to higher risks to passenger safety. This issue will be fully evaluated in Chapter 4 in relationship to the alternatives.

Issue 4 - Effects on the Aesthetic Values of Birds

One issue is the concern that the proposed action or the other alternatives would result in the loss of aesthetic benefits of target birds to the public, resource owners, or neighboring residents in the area where damage management activities occur. Wildlife generally is regarded as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987). The mere knowledge that wildlife exists is a positive benefit to many people. Aesthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics is truly subjective in nature dependent on what an observer regards as beautiful.

The human attraction to animals has been well documented throughout history and started when humans began domesticating animals. The American public shares a similar bond with animals and/or wildlife in general. In modern societies, many households have indoor or outdoor pets. However, some people may consider individual wild animals as "*pets*" or exhibit affection toward those animals, especially people who enjoy viewing and/or feeding wildlife. Therefore, the public reaction is variable and mixed to wildlife damage management because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to manage conflicts/problems between humans and wildlife.

Wildlife populations provide a wide range of social and economic benefits (Decker and Goff 1987). Those benefits include direct benefits related to consumptive and non-consumptive uses, indirect benefits derived from vicarious wildlife related experiences, and the personal enjoyment of knowing wildlife exists and contributes to the stability of natural ecosystems (Bishop 1987). Direct benefits are derived from a personal relationship with animals, which may take the form of direct consumptive use (*e.g.*, using parts of or the entire animal) or non-consumptive use (*e.g.*, viewing the animal in nature) (Decker and Goff 1987).

Indirect benefits or indirect exercised values arise without the user being in direct contact with the animal and come from experiences such as looking at photographs and films of wildlife, reading about wildlife, or benefiting from activities or contributions of animals such as their use in research (Decker and Goff 1987). Indirect benefits come in two forms: bequest and pure existence (Decker and Goff 1987). Bequest is providing for future generations and pure existence is merely knowledge that the animals exist (Decker and Goff 1987).

Public attitudes toward wildlife vary considerably. Some people believe that all wildlife should be captured and translocated to another area to alleviate damage or threats to protected resources. Some people directly affected by the problems caused by wildlife strongly support removal. Individuals not directly affected by the harm or damage may be supportive, neutral, or totally opposed to any removal of wildlife from specific locations. Some people totally opposed to wildlife damage management want agencies to teach tolerance for damage and threats caused by wildlife, and that wildlife should never be killed. Some of the people who oppose removal of wildlife do so because of human-affectionate bonds with individual wildlife. Those human-affectionate bonds are similar to attitudes of a pet owner and result in aesthetic enjoyment.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

The issue of humaneness and animal welfare, as it relates to the killing or capturing of wildlife is an important but very complex concept that can be interpreted in a variety of ways. Schmidt (1989) indicated that vertebrate damage management for societal benefits could be compatible with animal welfare concerns, if "…*the reduction of pain, suffering, and unnecessary death is incorporated in the decision making process*."

Suffering has previously been described by the American Veterinary Medical Association (AVMA) as a "…*highly unpleasant emotional response usually associated with pain and distress*" (AVMA 1987). However, suffering "…*can occur without pain*…," and "…*pain can occur without suffering*…" because suffering carries with it the implication of occurring over time, a case could be made for "…*little or no suffering where death comes immediately*…" (California Department of Fish and Game 1991). Pain and physical restraint can cause stress in animals and the inability of animals to effectively deal with those stressors can lead to distress. Suffering occurs when action is not taken to alleviate conditions that cause pain or distress in animals.

Defining pain as a component in humaneness appears to be a greater challenge than that of suffering. Pain obviously occurs in animals. Altered physiology and behavior can be indicators of pain. However, pain experienced by individual animals probably ranges from little or no pain to considerable pain (California Department of Fish and Game 1991).

The AVMA has previously stated "*...euthanasia is the act of inducing humane death in an animal*" and "*...the technique should minimize any stress and anxiety experienced by the animal prior to unconsciousness*" (Beaver et al. 2001). Some people would prefer AVMA accepted methods of euthanasia to be used when killing all animals, including wild animals. The AVMA has previously stated that "[f]*or wild and feral animals, many of the recommended means of euthanasia for captive animals are not feasible. In field circumstances, wildlife biologists generally do not use the term euthanasia, but terms such as killing, collecting, or harvesting, recognizing that a distress- free death may not be possible*" (Beaver et al. 2001).

Pain and suffering, as it relates to methods available for use to manage birds has both a professional and lay point of arbitration. Wildlife managers and the public would be better served to recognize the complexity of defining suffering, since "*…neither medical nor veterinary curricula explicitly address suffering or its relief*" (California Department of Fish and Game 1991). Research suggests that some methods may cause "*stress*" in animals (*e.g.*, see Kreeger et al. 1990). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness (Bateson 1991).

The decision-making process can involve trade-offs between the above aspects of pain and humaneness. Therefore, humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently. The challenge in coping with this issue is how to achieve the least amount of animal suffering.

Additional concerns have been expressed over the potential separation of goose families through management actions. Generally, adult geese form pair bonds that are maintained until one of the pair dies. Goose family units generally migrate together during the fall migration period and spend much of the fall and winter together (Raveling 1968, Raveling 1969). The separation of family units could occur during damage management activities targeting geese. This could occur through translocation of geese, dispersal, or through removal and euthanasia.

The issue of humaneness and animal welfare concerns as those concerns relate to the methods available for use will be further discussed under the alternatives in Chapter 4. SOPs to alleviate pain and suffering are discussed in Chapter 3.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

WS, the NCWRC, and the USFWS also identified additional issues during the scoping process of this EA. WS considered the following issues; however, those issues will not receive detailed analyses for the reasons provided.

WS' Impact on Biodiversity

The WS program does not attempt to eradicate any species of native wildlife in the State. WS operates in accordance with international, federal, and state laws and regulations enacted to ensure species viability. Methods available are employed to target individual birds or groups of birds identified as causing damage or posing a threat of damage. Any reduction of a local population or group is frequently temporary because immigration from adjacent areas or natural reproduction replaces those animals that an entity removes. WS operates on a small percentage of the land area of North Carolina and only targets those birds identified as causing damage or posing a threat. Therefore, bird damage management activities conducted pursuant to any of the alternatives will not adversely affect biodiversity in the State.

Cost Effectiveness of Management Methods

The CEQ does not require a formal, monetized cost benefit analysis to comply with the NEPA. Consideration of this issue is not essential to making a reasoned choice among the alternatives being considered. However, the methods determined to be most effective to reduce damage and threats to human safety caused by birds and that prove to be the most cost effective will receive the greatest application. As part of an integrated approach, evaluation of methods would continually occur to allow for those methods that were most effective at resolving damage or threats to be employed under similar circumstances where birds are causing damage or pose a threat. Additionally, management operations may be constrained by cooperator funding and/or objectives and needs.

Impacts of Avian Influenza on Bird Populations

Avian influenza is caused by a virus in the Orthomyxovirus group. Viruses in this group vary in the intensity of illness (*i.e*., virulence) they may cause. Wild birds, in particular waterfowl and shorebirds, are considered the natural reservoirs for AI (Davidson and Nettles 1997, Alexander 2000, Stallknecht 2003, Pedersen et al. 2012). Most strains of AI rarely cause severe illness or death in birds, although the H5 and H7 strains tend to be highly virulent and very contagious. However, even the strains that do not cause severe illness in birds are a concern for human and animal health officials because the viruses have the potential to become virulent and transmissible to other species through mutation and re-assortment (Clark and Hall 2006).

There are two types of AI viruses, low pathogenic and high pathogenic (USGS 2013). The low and high refer to the potential of the viruses to kill domestic poultry (USGS 2013). In wild birds, low pathogenic avian influenza rarely causes signs of illness and it is not an important mortality factor for wild birds (Davidson and Nettles 1997, Clark and Hall 2006). In contrast, high pathogenic avian influenza has sickened and killed large numbers of wild birds in China (USGS 2013). However, there have been reports of apparently healthy wild birds being infected with high pathogenic avian influenza (USGS 2013). Previously, high pathogenic strains have only been found to exist in wild waterfowl species in China (Brown et al. 2006, Keawcharoen et al. 2008, USGS 2013).

However, in December 2014, the highly pathogenic avian influenza virus was isolated from a northern pintail (*Anas acuta*) in Washington State making it the first detection of the highly pathogenic avian influenza virus in wild birds in North America (USGS 2015*a*). The detection of the highly pathogenic avian influenza virus in North America has coincided with detection of the virus in poultry across the western and central United States (USDA 2015*a*). WS has been one of several agencies and organizations conducting surveillance and monitoring of avian influenza in migratory birds. Between December 8, 2014 and July 15, 2015, the USGS (2015*b*) reported 84 cases of highly pathogenic avian influenza in wild birds across the United States. Most cases have involved waterfowl and raptors (USGS 2015*b*). Many of the 84 cases involved detection of the virus in waterfowl that people harvested during the annual hunting season that agencies have sampled as part of monitoring efforts (USGS 2015*b*). Although mortality events involving the highly pathogenic avian influenza virus have occurred in waterfowl, there have been no reports of major waterfowl die-offs from the virus. In addition, no reports of major die-offs of other bird species have occurred. Therefore, there is no evidence to suggest that the avian influenza virus is or will have an effect on bird populations. As stated previously, most strains of AI do not cause severe illnesses or death in bird populations.

Effects from the Use of Lead Ammunition in Firearms

Questions have arisen about the deposition of lead into the environment from ammunition used in firearms to remove birds lethally. As described in Appendix C, the lethal removal of birds with firearms by WS to alleviate damage or threats could occur using a shotgun or rifle, including an air rifle. In an ecological risk assessment of lead shot exposure in non-waterfowl birds, ingestion of lead shot was identified as the concern rather than just contact with lead shot or lead leaching from shot in the environment (Kendall et al. 1996). To address lead exposure from the use of shotguns, the USFWS Migratory Bird Permit Program has implemented the requirement to use non-toxic shot as defined under 50 CFR 20.21(j) as part of the standard conditions of depredation permits issued pursuant to the MBTA for the lethal take of birds under 50 CFR 21.41. In 2011, the depredation order for blackbirds (see 50 CFR 21.43(b)) was amended to include the requirement for use of non-toxic shot, as defined under 50 CFR 20.21(j), in most cases. However, this prohibition does not apply if an air rifle, an air pistol, or a .22 caliber rimfire firearm was used for removing depredating birds under the depredation order. To alleviate concerns associated with lead exposure in wildlife, WS would only use non-toxic shot as defined in 50 CFR 20.21(j) when using shotguns.

The take of birds by WS in the State would occur primarily from the use of shotguns. However, the use of rifles and air rifles could be employed to remove some species. To reduce risks to human safety and property damage from bullets passing through birds, the use of rifles and air rifles would be applied in such a way (*e.g.*, caliber, bullet weight, distance) to ensure the bullet does not pass through birds, and if the bullet does pass through or misses the target, it impacts in a safe location. Birds that were removed using rifles and air rifles would occur within areas where retrieval of all bird carcasses for proper disposal would be highly likely (*e.g.*, at roost sites). With risks of lead exposure occurring primarily from ingestion of bullet fragments and lead shot, the retrieval and proper disposal of bird carcasses would greatly reduce the risk of scavengers ingesting or being exposed to lead that may be contained within the carcass.

However, deposition of lead into soil could occur if, during the use of a rifle or air rifle, the projectile passes through a bird, if misses occur, or if the bird carcass is not retrieved. Laidlaw et al. (2005) reported that, because of the low mobility of lead in soil, all of the lead that accumulates on the surface layer of the soil is generally retained within the top 20 cm (about 8 inches). In addition, concerns occur that lead from bullets deposited in soil from shooting activities could lead to contamination of ground water or surface water. Stansley et al. (1992) studied lead levels in water that was subjected directly to high concentrations of lead shot accumulation because of intensive target shooting at several shooting ranges. Lead did not appear to "*transport*" readily in surface water when soils were neutral or slightly alkaline in pH (*i.e.*, not acidic), but lead did transport more readily under slightly acidic conditions. Although Stansley et al. (1992) detected elevated lead levels in water in a stream and a marsh that were in the shot "*fall zones*" at a shooting range, the study did not find higher lead levels in a lake into which the stream drained, except for one sample collected near a parking lot. Stansley et al. (1992) believed the lead contamination near the parking lot was due to runoff from the lot, and not from the shooting range areas. The study also indicated that even when lead shot was highly accumulated in areas with permanent water bodies present, the lead did not necessarily cause elevated lead levels in water further downstream. Muscle samples from two species of fish collected in water bodies with high lead shot accumulations had lead levels that were well below the accepted threshold standard of safety for human consumption (Stansley et al. 1992).

Craig et al. (1999) reported that lead levels in water draining away from a shooting range with high accumulations of lead bullets in the soil around the impact areas were far below the "*action level*" of 15 parts per billion as defined by the EPA (*i.e.*, requiring action to treat the water to remove lead). The study found that the dissolution (*i.e.*, capability of dissolving in water) of lead declines when lead oxides form on the surface areas of the spent bullets and fragments (Craig et al. 1999). Therefore, the transport of lead from bullets or shot distributed across the landscape is reduced once the bullets and shot form crusty lead oxide deposits on their surfaces, which naturally serves to reduce the potential for ground or surface water contamination (Craig et al. 1999). Those studies suggest that, given the very low amount of lead being deposited and the concentrations that would occur from WS' activities to reduce bird damage using rifles, as well as most other forms of dry land hunting in general, lead contamination from such sources would be minimal to nonexistent.

Because the take of birds could occur by other entities during regulated hunting seasons, through the issuance of depredation permits, under depredation/control orders, or without the need to obtain a depredation permit, WS' assistance with removing birds would not be additive to the environmental status quo. WS' assistance would not be additive to the environmental status quo because those birds removed by WS using firearms could be lethally removed by the entities experiencing damage using the same method in the absence of WS' involvement. The amount of lead deposited into the environment may be lowered by WS' involvement in activities due to efforts by WS to ensure projectiles do not pass through, but are contained within the bird carcass, which would limit the amount of lead potentially deposited into soil from projectiles passing through the carcass or missing the target. The proficiency training received by WS' employees in firearm use and accuracy increases the likelihood that birds are lethally removed humanely in situations that ensure accuracy and that misses occur infrequently, which would further reduce the potential for lead to be deposited in the soil. In addition, WS' involvement would ensure efforts were made to retrieve bird carcasses lethally removed using firearms to prevent the ingestion of lead in carcasses by scavengers. WS' involvement would also ensure carcasses were disposed of properly to limit the availability of lead. Based on current information, the risks associated with lead bullets that would be deposited into the environment from WS' activities due to misses, the bullet passing through the carcass, or from bird carcasses that may be irretrievable would be below any level that would pose any risk from exposure or significant contamination. As stated previously, when using shotguns, only non-toxic shot would be used by WS pursuant to 50 CFR 20.21(j). Additionally, WS may utilize non-toxic ammunition in rifles and air rifles as the technology improves and ammunition become more effective and available.

Impacts of Dispersing a Bird Roost on People in Urban/Suburban Areas

Another issue often raised is that the dispersal of birds from a roost location to alleviate damage or conflicts at one site could result in new damage or conflicts at a new roost site. While the original complainant may see resolution to the bird problem when the roost is dispersed, the recipient of the bird roost may see the bird problem as imposed on them. Thus, overall, there is no resolution to the original bird problem (Mott and Timbrook 1988). Bird roosts usually are dispersed using a combination of harassment methods including pyrotechnics, propane cannons, effigies, and electronic distress calls (Booth 1994, Avery et al. 2008*a*, Chipman et al. 2008). A similar conflict could develop when habitat alteration was used to disperse a bird roost. This concern would be heightened in large metropolitan areas where the likelihood of birds dispersed from a roost finding a new roost location and not coming into conflict would be very low. WS has developed alternatives to minimize the potential of dispersing bird roosts in urban/suburban areas by evaluating a management option to depopulate a bird roost.

In urban areas, WS would often work with the community or municipal leaders to address bird damage involving large bird roosts that would likely be affecting several people. Therefore, WS often consults not only with the property owner where roosts were located but also with community leaders to allow for community-based decision-making on the best management approach. In addition, funding would often be provided by the municipality where the roost was located, which would allow activities to occur within city limits where bird roosts occurred. This would allow roosts that relocated to other areas to be addressed effectively and often times, before roosts become well established. The community-based decision-making approach to bird damage management in urban areas is further discussed under the proposed action alternative in Chapter 3. Therefore, this issue was not analyzed further.

Effects of Activities on Soils, Water, and Air Quality

The implementation of those alternative approaches discussed in Section 3.1 by WS would meet the requirements of applicable federal laws, regulations, and Executive Orders for the protection of the environment, including the Clean Air Act. The actions discussed in this EA do not involve major ground disturbance, construction, or habitat alteration. Chapter 3 discusses the SOPs to reduce risks to the environment that WS would incorporate into activities when implementing applicable alternative approaches to managing damage. Activities that WS could implement pursuant to those applicable alternative approaches discussed in Section 3.1 would not alter aquatic systems or cause changes in the flow, quantity, or storage of water resources. Personnel of WS would use, store, and dispose of all chemical methods in accordance with applicable laws and regulations pursuant to WS Directive 2.210. The use, storage, and disposal of chemical methods by WS' personnel would also follow WS' directives, including WS Directive 2.401, WS Directive 2.405, WS Directive 2.430, WS Directive 2.455, and WS Directive 2.465.

Personnel of WS would follow EPA-approved label directions for all pesticide use (see WS Directive 2.401). The intent of the registration process for chemical pesticides is to assure minimal adverse effects occur to the environment when people use the chemicals in accordance with label directions. The WS program would properly dispose of any excess solid or hazardous waste in accordance with applicable federal, tribal, state, and local regulations.

Consequently, the WS program in North Carolina does not expect the alternative approaches discussed in Section 3.1 to significantly impact soils, geology, minerals, water quality and quantity, floodplains, other aquatic resources, air quality, prime and unique farmlands, timber, and range. Therefore, the EA will not analyze those elements further.

Influence of Global Climate Change

The State of the Climate in 2012 report indicates that every year has been warmer than the long-term average since 1976 (Blunden and Arndt 2013). Impacts of this change will vary throughout the United States, but some areas could experience air and water temperature increases, alterations in precipitation, and increased severe weather events. Temperature and precipitation often influence the distribution and abundance of a plant or animal species. According to the EPA (2016), as temperatures continue to increase, the ranges of many species will likely expand into northern latitudes and higher altitudes. Species adapted to cold climates may struggle to adjust to changing climate conditions (*e.g.*, less snowfall, range expansions of other species).

The impact of climate change on wildlife and their habitats is of increasing concern to land managers, biologists, and members of the public. For example, climate change may alter the frequency and severity of habitat-altering events, such as wildfires, weather extremes, such as drought, presence of invasive species, and wildlife diseases. WS recognizes that climate change is an ongoing concern and may result in changes in species range and abundance. Over time, a combination of factors is likely to lead to changes in the scope and nature of human-wildlife conflicts in the State. Because these types of changes are an ongoing process, this EA has developed a dynamic system, including SOPs, and built in measures that allow agencies to monitor for and adjust to impacts of ongoing changes in the affected environment (see Section 3.3 and Section 3.4).

If WS selected an alternative approach to meeting the need for action that allows the program to provide assistance (see Section 3.1), WS would monitor activities, in context of the issues analyzed in detail, to determine if the need for action and the associated impacts remain with the parameters established and analyzed in this EA. Pursuant to SOPs discussed in Section 3.3 and Section 3.4, WS would continue to coordinate activities to reduce and/or prevent bird damage in the State with the NCWRC and/or the USFWS. The mission of the NCWRC is "*…to conserve and sustain the state's fish and wildlife resources through research, scientific management, wise use, and public input*". Therefore, coordinating activities would ensure the NCWRC and/or the USFWS have the opportunity to incorporate any activities the WS program conducts into population objectives established for wildlife populations in the State. If WS determines there to be a new need for action, changed conditions, new issues, or new alternatives having different environmental impacts, WS would supplement this analysis or conduct a separate evaluation pursuant to the NEPA. Through monitoring, the WS program in North Carolina can evaluate and adjust activities as changes occur over time.

Monitoring by WS would also include reviewing the list of species the USFWS considers as threatened or endangered within the State pursuant to the ESA. As appropriate, WS would consult with the USFWS pursuant to Section 7 of the ESA to ensure the activities conducted by WS would not jeopardize the continued existence of threatened or endangered species or result in adverse modification to areas designated as critical habitat for a species within the State. Through the review of species listed as threatened or endangered and the consultation process with the USFWS, WS can evaluate and adjust activities conducted pursuant to any alternative approach selected to meet the need for action. Accordingly, WS could supplement this analysis or conduct a separate evaluation pursuant to the NEPA based on the review and consultation process. In this way, any actions conducted by WS would be responsive to ongoing climate changes and the associated cumulative impacts of actions conducted in North Carolina in accordance with the NEPA.

Greenhouse Gas Emissions by the WS Program

Under the alternative approaches intended to meet the need for action discussed in Section 3.1, the WS program in North Carolina could potentially produce criteria pollutants (*i.e*., pollutants for which maximum allowable emission levels and concentrations are enforced by state agencies). Those activities could include working in the office, travel from office to field locations, travel at field locations (vehicles or ATV), and from other work-related travel (*e.g*., attending meetings). During evaluations of the national program to manage feral swine (*Sus scrofa*), the WS program reviewed greenhouse gas emissions for the entire national WS program (see pages 266 and 267 in USDA 2015*b*). The analysis estimated effects of vehicle, aircraft, office, and ATV use by WS for FY 2013 and included the potential new vehicle purchases that could be associated with a national program to manage damaged caused by feral swine. The review concluded that the range of Carbon Dioxide Equivalents (includes CO_2, NO_x CO, and SO_x) for the entire national WS program would be below the reference point of 25,000 metric tons per year recommended by CEQ for actions requiring detailed review of impacts on greenhouse gas emissions. The activities that WS could conduct under the alternative approaches discussed in Section 3.1 would have negligible cumulative effects on atmospheric conditions, including the global climate.

CHAPTER 3: ALTERNATIVES

Section 3.1 and Section 3.2 discuss those alternative approaches that WS identified during the initial scoping process for this EA. WS developed the alternative approaches based on the need for action. The need for action identified by WS is associated with requests for assistance that WS receives to manage damage and threats of damage caused by several bird species in North Carolina. WS also developed the alternative approaches to address those issues identified in Section 2.2.

Section 3.1 discusses those alternative approaches WS will consider in detail within Chapter 4 of this EA. Chapter 4 analyzes the environmental consequences of each alternative as an alternative relates to the identified issues. Section 3.2 discusses additional alternative approaches that WS identified but this EA will not analyze those alternative approaches in detail within Chapter 4 for the reasons provided in the description of each alternative. Section 3.3 and Section 3.4 discuss SOPs that WS would incorporate into the relevant alternative approaches identified in Section 3.1.

3.1 DESCRIPTION OF THE ALTERNATIVES

The following alternatives were developed to meet the need for action and to address the identified issues associated with managing damage caused by birds in the State.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

The proposed action/no action alternative would continue the current implementation of an adaptive integrated approach utilizing non-lethal and lethal techniques, as deemed appropriate using the WS Decision Model (Slate et al. 1992; see WS Directive 2.201), to reduce damage and threats caused by birds in North Carolina. A major goal of the program would be to resolve and prevent bird damage and to reduce threats to human safety[14]. To meet this goal, WS, in consultation with the USFWS, the NCWRC, and the NCDACS, would continue to respond to requests for assistance with, at a minimum, technical assistance, or when funding was available, operational damage management.

Therefore, under this alternative, WS could respond to requests for assistance by: 1) taking no action, if warranted, 2) providing only technical assistance to property owners or managers on actions they could take to reduce damages caused by birds, or 3) providing technical assistance and direct operational assistance to a property owner or manager experiencing damage. Funding for activities conducted by WS could occur through federal appropriations; however, in most cases, those entities requesting assistance would provide the funding for activities conducted by WS.

A key component of assistance provided by WS would be providing information to the requester about wildlife and wildlife damage. Education is an important element of activities because wildlife damage management is about finding balance and coexistence between the needs of people and needs of wildlife. This is extremely challenging as nature has no balance, but rather is in continual flux. When responding to a request for assistance, WS would provide those entities with information regarding the use of appropriate methods. Property owners or managers requesting assistance would be provided with information regarding the use of effective and practical techniques and methods. In addition to the routine dissemination of recommendations and information to individuals or organizations experiencing damage, WS provides lectures, courses, and demonstrations to producers, homeowners, state and county agents, colleges and universities, and other interested groups. WS frequently cooperates with other entities in education and public information efforts. Additionally, technical papers are presented at professional meetings and conferences so that other wildlife professionals and the public are periodically updated on recent developments in damage management technology, programs, laws and regulations, and agency policies. Providing information about bird damage and methods would be a primary component of technical assistance and direct operational assistance available from WS under this alternative.

The WS program in North Carolina regularly provides technical assistance to individuals, organizations, and other federal, state, and local government agencies for managing bird damage. Technical assistance

[14]All management actions conducted or recommended by WS would comply with appropriate federal, state, and local laws in accordance with WS Directive 2.210.

includes collecting information about the species involved, the extent of the damage, and previous methods that the cooperator has employed to alleviate the problem. WS would then provide information on appropriate methods that the cooperator may consider to alleviate the damage themselves. Types of technical assistance projects may include a visit to the affected property, written communication, telephone conversations, or presentations to groups such as homeowner associations or civic leagues. Technical assistance provided by WS would occur as described in Alternative 2 of this EA.

Direct operational damage management assistance would include damage management activities that WS' personnel would conduct directly or supervise. WS' employees may initiate operational damage management assistance when technical assistance alone could not effectively alleviate the damage or the threat of damage and when WS and the entity requesting assistance have signed a MOU, work initiation document, or another comparable document. The initial investigation would define the nature, history, and extent of the problem; species responsible for the damage; and methods available to alleviate the problem.

Under this alternative, the WS program would follow the "*co-managerial approach*" to solve wildlife damage or conflicts as described by Decker and Chase (1997). Within this management model, WS could provide technical assistance regarding the biology and ecology of birds and effective, practical, and reasonable methods available to a local decision-maker(s) to reduce damage or threats. WS and other state and federal wildlife management agencies may facilitate discussions at local community meetings when resources are available. Those entities requesting assistance could choose to use the services of private businesses, use volunteer services of private organizations, implement WS' recommendations on their own (*i.e.*, technical assistance), request direct assistance from WS (*i.e.*, direct operational assistance), or take no action. Generally, a decision-maker seeking assistance would be part of a community, municipality, business, governmental agency, and/or a private property owner.

Under a community based decision-making process, WS would provide information, demonstration, and discussion on all available methods to the appropriate representatives of the community for which services were requested to ensure a community-based decision was made. By involving decision-makers in the process, WS could present damage management recommendations to the appropriate decision-maker(s) to allow decisions on damage management to involve those individuals that the decision-maker(s) represents. As addressed in this EA, WS would provide technical assistance to the appropriate decision-maker(s) to allow the decision-maker(s) to present information on damage management activities to those persons represented by the decision-maker(s), including demonstrations and presentation by WS at public meetings to allow for involvement of the community. Requests for assistance to manage birds often originate from the decision-maker(s) based on community feedback or from concerns about damage or threats to human safety. As representatives, the decision-maker(s) are able to provide the information to local interests either through technical assistance provided by WS or through demonstrations and presentations by WS on activities to manage damage. This process allows WS to recommend and implement activities based on local input.

The decision-maker for the local community would be elected officials or representatives of the communities. The elected officials or representatives are popularly elected residents of the local community or appointees who oversee the interests and business of the local community. This person or persons would represent the local community's interest and make decisions for the local community or bring information back to a higher authority or the community for discussion and decision-making. Identifying the decision-maker for local business communities can be more complex because business owners may not indicate whether the business must manage wildlife damage themselves, or seek approval to manage wildlife from the property owner or manager, or from a governing Board. WS could provide technical assistance and make recommendations for damage reduction to the local community or local business community decision-maker(s). Direct operational assistance could be provided by WS only if requested by the local community decision-maker, funding was provided, and if the requested assistance was compatible with WS' recommendations.

In the case of private property owners, the decision-maker would be the individual that owns or manages the affected property. The private property owner would have the discretion to involve others as to what occurs or does not occur on property they own or manage. Therefore, in the case of an individual property owner or manager, the involvement of others and to what degree others were involved in the decision-making process would be a decision made by that individual. Direct control could be provided by WS if requested, funding was provided, and the requested management was according to WS' recommendations.

The decision-maker for local, state, or federal property would be the official responsible for or authorized to manage the public land to meet interests, goals, and legal mandates for the property. WS could provide technical assistance to this person and recommendations to reduce damage. Direct control could be provided by WS if requested, funding provided, and the requested actions were within the recommendations made by WS.

WS would work with those persons experiencing bird damage to address those birds responsible for causing damage as expeditiously as possible. To be most effective, damage management activities should begin as soon as birds begin to cause damage. Bird damage that has been ongoing can be difficult to alleviate using available methods since birds are conditioned to feed, roost, loaf, and are familiar with a particular location. Subsequently, making that area unattractive using available methods can be difficult to achieve once damage has been ongoing. WS would work closely with those entities requesting assistance to identify situations where damage could occur and begin to implement damage management activities under this alternative as early as possible to increase the likelihood of those methods achieving the level of damage reduction requested by the cooperating entity.

In general, the most effective approach to resolving damage would be to integrate the use of several methods simultaneously or sequentially. This adaptive approach to managing damage associated with birds would integrate the use of the most practical and effective methods as determined by a site-specific evaluation for each request after applying the WS Decision Model. The philosophy behind an adaptive approach would be to integrate the best combination of methods in a cost-effective[15] manner while minimizing the potentially harmful effects on humans, target and non-target species, and the environment. Integrated damage management may incorporate cultural practices (*e.g.*, animal husbandry), habitat modification (*e.g.*, exclusion, vegetation management), animal behavior modification (*e.g.*, scaring, repellents), removal of individual offending animals (*e.g.*, trapping, shooting, and avicides), and local population reduction, or any combination of these, depending on the circumstances of the specific damage problem.

Once contacted for direct operational assistance, WS would conduct site visits to assess the damage or threat of damage, would identify the species responsible, and would apply the Decision Model described by Slate et al. (1992) and WS Directive 2.201 to determine the appropriate methods to alleviate or prevent damage. WS' personnel would assess the damage or threat of damage and then evaluate the appropriateness and availability (legal and administrative) of strategies and methods based on several considerations, including legal, biological, humaneness, economic, and social considerations. Following this evaluation, WS' employees would incorporate methods deemed practical for the situation into a damage management strategy. After WS' employees implemented this strategy, employees would continue to monitor and evaluate the strategy to assess effectiveness. If the strategy were effective, the

[15]The cost of management may sometimes be secondary because of overriding environmental, legal, human health and safety, animal welfare, or other concerns.

need for further management would end. In terms of the WS Decision Model, most efforts to resolve wildlife damage consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions, including WS.

The general thought process and procedures of the WS Decision Model would include the following steps.

1. **Receive Request for Assistance:** WS would only provide assistance after receiving a request for such assistance. WS would not respond to public bid notices.
2. **Assess Problem:** First, WS would make a determination as to whether the assistance request was within the authority of WS. If an assistance request were within the authority of WS, WS' employees would gather and analyze damage information to determine applicable factors, such as what species was responsible for the damage, the type of damage, the extent of damage, and the magnitude of damage. Other factors that WS' employees could gather and analyze would include the current economic loss or current threat (*e.g.*, threat to human safety), the potential for future losses or damage, the local history of damage, and what management methods, if any, were used to reduce past damage and the results of those actions.
3. **Evaluate Management Methods:** Once a problem assessment was completed, a WS' employee would conduct an evaluation of available management methods. The employee would evaluate available methods in the context of their legal and administrative availability and their acceptability based on legal, safety, biological, humaneness, environmental, social, and cultural factors.
4. **Formulate Management Strategy:** A WS' employee would formulate a management strategy using those methods that the employee determines to be practical for use. The WS employee would also consider factors essential to formulating each management strategy, such as available expertise, legal constraints on available methods, costs, and effectiveness.
5. **Provide Assistance:** After formulating a management strategy, a WS employee could provide technical assistance and/or direct operational assistance to the requester (see WS Directive 2.101).
6. **Monitor and Evaluate Results of Management Actions:** When providing direct operational assistance, it is necessary to monitor the results of the management strategy. Monitoring would be important for determining whether further assistance was required or whether the management strategy resolved the request for assistance. Through monitoring, a WS' employee would continually evaluate the management strategy to determine whether additional techniques or modification of the strategy was necessary.
7. **End of Project:** When providing technical assistance, a project would normally end after a WS' employee provided recommendations or advice to the requester. A direct operational assistance project would normally end when WS' personnel stop or reduce the damage or threat to an acceptable level to the requester or to the extent possible. Some damage situations may require continuing or intermittent assistance from WS' personnel and may have no well-defined termination point.

Methods available to alleviate or prevent damage under this alternative could be considered lethal methods or non-lethal methods. Preference would be given to non-lethal methods when practical and effective under this alternative (see WS Directive 2.101). Non-lethal methods that would be available for use by WS would include, but would not be limited to habitat/behavior modification, inactive nest destruction, lure crops, visual deterrents, live traps, translocation, exclusionary devices, frightening devices, alpha chloralose, reproductive inhibitors, and chemical repellents (see Appendix C for a complete list and description of potential methods). Lethal methods that would be available to WS would include live-capture followed by euthanasia, the avicide DRC-1339, the recommendation of take during hunting seasons, egg destruction, and firearms. Euthanasia of live-captured birds would occur in accordance with WS Directive 2.505. WS would employ cervical dislocation, carbon dioxide, or firearms to euthanize target birds once those birds were live-captured using other methods. Carbon dioxide, cervical dislocation, and the use of firearms are considered acceptable forms of euthanasia for free-ranging birds with conditions[16] (AVMA 2013).

As discussed in Chapter 1, the lethal removal of many bird species to alleviate damage would be prohibited unless authorized by the USFWS pursuant to the MBTA. The take of birds can only legally occur through the issuance of a depredation permit by the USFWS and only at levels specified in the permit, unless those bird species are afforded no protection under the MBTA or a depredation/control order has been established by the USFWS, in which case, no permit for take would be required. In addition, authorization from the NCWRC would be required to lethally control protected birds causing damage in the State. For some bird species (*e.g.*, waterfowl, turkeys, crows, doves), lethal take can occur during a hunting season that the NCWRC implements and regulates. In most cases, the use of non-lethal dispersal methods and the destruction of inactive nests (*i.e.*, nests that to not contain eggs and/or nestlings) would not require a permit from the USFWS or the NCWRC.

The use of many lethal and non-lethal methods would be short-term attempts at reducing damage occurring at the time those methods were employed. Long-term solutions to managing bird damage would include limited habitat manipulations and changes in cultural practices that are addressed in Chapter 4. Appendix C contains a discussion of the methods that would be available for use in an integrated approach under this alternative. The WS program also researches and actively develops methods to address bird damage through the National Wildlife Research Center (NWRC). The NWRC functions as the research unit of WS by providing scientific information and by developing methods to address damage caused by animals. Research biologists with the NWRC work closely with wildlife managers, researchers, and others to develop and evaluate methods and techniques. For example, research biologists from the NWRC were involved with developing and evaluating the repellent mesurol for crows. Research biologists with the NWRC have authored hundreds of scientific publications and reports based on research conducted involving wildlife and methods.

The effectiveness of any damage management program could be defined in terms of losses or risks potentially reduced or prevented, how accurately practitioners diagnose the problem, the species responsible for the damage, and how actions are implemented to correct or mitigate risks or damages. To determine that effectiveness, WS must be able to complete management actions expeditiously to minimize harm to non-target animals and the environment, while at the same time using methods as humanely as possible. An adaptive integrated approach calls for the use of several management methods simultaneously or sequentially (Courchamp et al. 2003). The purpose behind integrated management is to implement methods in the most effective manner while minimizing the potentially harmful effects on people, target and non-target species, and the environment[17]. Efficacy is based on the types of methods employed, the application of the method, restrictions on the use of the method(s), the skill of the personnel using the method and, for WS' personnel, the guidance provided by WS' directives and policies.

The goal would be to reduce damage, risks, and conflicts with birds as requested and not to necessarily reduce/eliminate populations. Localized population reduction could be short-term because new individuals may immigrate to an area, be released at the site, or new individuals could be born to animals remaining at the site (Courchamp et al. 2003). The ability of an animal population to sustain a certain

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[16]The AVMA (2013) defines acceptable with conditions as "*A method considered to reliably meet the requirements of euthanasia when specified conditions are met*".

[17]The cost of management may sometimes be secondary because of overriding environmental, legal, human health and safety, animal welfare, or other concerns.

level of removal and to return to pre-management population levels eventually does not mean individual management actions were unsuccessful, but that periodic management may be necessary. The return of wildlife to pre-management levels also demonstrates that limited, localized damage management methods have minimal impacts on species' populations.

Based on an evaluation of the damage, the most effective methods would be employed individually or in combination based on the prior evaluations of methods or combinations of methods in other damage management situations using the WS Decision Model. Once employed, methods would be further evaluated for effectiveness based on a continuous evaluation of activities by WS; therefore, the effectiveness of methods would be considered as part of the decision making-process under WS' use of the Decision Model for each damage management request based on continual evaluation of methods and results.

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

Under this alternative, WS would provide those cooperators requesting assistance with technical assistance only. Technical assistance would provide those cooperators experiencing damage or threats of damage with information, demonstrations, and recommendations on available and appropriate methods available. The implementation of methods and techniques to alleviate or prevent damage would be the responsibility of the requester with no direct involvement by WS. In some cases, WS may provide supplies or materials that were of limited availability for use by private entities (*e.g.*, loaning of propane cannons). Similar to the proposed action alternative, a key component of assistance provided by WS would be providing information to the requester about wildlife and wildlife damage. Educational efforts conducted under the proposed action alternative would be similar to those conducted under this alternative.

Technical assistance would include collecting information about the species involved, the nature and extent of the damage, and previous methods that the cooperator had used to alleviate the problem. WS would then provide information on appropriate methods that the cooperator may consider to alleviate the damage themselves. Types of technical assistance projects may include a visit to the affected property, written communication, telephone conversations, or presentations to groups such as homeowner associations or civic leagues.

Generally, several management strategies would be described to the requester for short and long-term solutions to managing damage based on the level of risk, need, and the practicality of their application. Only those methods legally available for use by the appropriate individual would be recommended or loaned by WS. Similar to Alternative 1, those methods described in Appendix C would be available to those people experiencing damage or threats associated with birds in the State, except for alpha chloralose, DRC-1339, and mesurol, which are currently only available for use by WS.

Those entities seeking assistance with reducing damage could seek direct operational assistance from other governmental agencies, private entities, or conduct activities on their own. In situations where non-lethal methods were ineffective or impractical, WS could advise the property owner or manager of appropriate lethal methods to supplement non-lethal methods. In order for the property owner or manager to use lethal methods, they would be required to apply for their own depredation permit to take birds from the USFWS and/or the NCWRC, when a permit was required. WS could evaluate damage occurring or the threat of damage and complete a Migratory Bird Damage Report, which would include information on the extent of the damages or risks, the number of birds present, and a recommendation for the number of birds that should be taken to best alleviate damage or the threat of damage. Following review by the USFWS of a complete application for a depredation permit from a property owner or manager and the

Migratory Bird Damage Report, the USFWS could issue a depredation permit to authorize the lethal take of a specified number of birds.

This alternative would place the immediate burden of using methods to alleviate damage on the resource owner, other governmental agencies, and/or private businesses. Those entities could take action using those methods legally available to alleviate or prevent bird damage as permitted by federal, state, and local laws and regulations or those persons could take no action.

Alternative 3 – No Bird Damage Management Conducted by WS

This alternative would preclude any activities by WS to reduce threats to human health and safety, and alleviate damage to agricultural resources, property, and natural resources. WS would not be involved with any aspect of bird damage management in the State. All requests for assistance received by WS to alleviate damage caused by birds would be referred to the USFWS, to the NCWRC, and/or to private entities. This alternative would not deny other federal, state, and/or local agencies, including private entities, from conducting damage management activities directed at alleviating damage and threats associated with birds in the State. Therefore, under this alternative, entities seeking assistance with addressing damage caused by birds could contact WS but WS would immediately refer the requester to other entities. The requester could then contact other entities for information and assistance, could take actions to alleviate damage without contacting any entity, or could take no further action.

Many of the methods listed in Appendix C would be available for use by other agencies and private entities to manage damage and threats associated with birds. All methods described in Appendix C would be available for use by those persons experiencing damage or threats, except for the use of DRC-1339 for blackbirds, pigeons, and gulls, the use of alpha chloralose for waterfowl, and mesurol for crows.

3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

In addition to those alternatives identified in Section 3.1, several alternatives were also identified during the scoping process for the EA. The following issues were identified and considered but will not be analyzed in detail for the reasons provided.

Non-lethal Methods Implemented by WS before Lethal Methods

This alternative would require that WS apply non-lethal methods or techniques described in Appendix C to all requests for assistance to reduce damage and threats to safety from birds in the State. If the use of non-lethal methods failed to resolve the damage situation or reduce threats to human safety in each damage situation, lethal methods would be employed to resolve the request. Non-lethal methods would be applied to every request for assistance regardless of severity or intensity of the damage or threat until deemed inadequate to resolve the request. This alternative would not prevent the use of lethal methods by those people experiencing bird damage.

Those people experiencing damage often employ non-lethal methods to reduce damage or threats prior to contacting WS. Verification of the methods used would be the responsibility of WS. No standard exists to determine the diligence of the requester in applying those methods, nor are there any standards to determine how many non-lethal applications are necessary before the initiation of lethal methods. Thus, only the presence or absence of non-lethal methods can be evaluated. The proposed action (Alternative 1) would be similar to a non-lethal before lethal alternative because the use of non-lethal methods would be considered before lethal methods by WS (see WS Directive 2.101). Adding a non-lethal before lethal alternative and the associated analysis would not provide additional information to the analyses in this EA.

Use of Non-lethal Methods Only by WS

Under this alternative, WS would be required to implement non-lethal methods only to resolve damage caused by birds in North Carolina. Only those methods discussed in Appendix C that are considered non-lethal would be employed by WS. No lethal take of birds would occur by WS. The use of lethal methods could continue to be used under this alternative by those persons experiencing damage by birds when permitted by the USFWS and/or the NCWRC, when required. The non-lethal methods that could be employed or recommended by WS under this alternative would be identical to those methods identified in any of the alternatives. Non-lethal methods would be employed by WS in an integrated approach under this alternative.

Exclusionary devices can be effective in preventing access to resources in certain circumstances. The primary exclusionary methods are netting and overhead lines. Exclusion is most effective when applied to small areas to protect high value resources. However, exclusionary methods are neither feasible nor effective for protecting human safety, agricultural resources, or native wildlife species from birds across large areas. The non-lethal methods used or recommended by WS under this alternative would be identical to those methods identified in any of the alternatives. WS would not apply for a depredation permit from the USFWS and/or the NCWRC under this alternative because no take of birds would occur.

In situations where non-lethal methods were impractical or ineffective to alleviate damages, WS could refer requests for information regarding lethal methods to the NCWRC, the USFWS, local municipalities, local animal control agencies, or private businesses or organizations. Under this alternative, however, property owners/managers might be limited to using non-lethal methods only, as they may have difficulty obtaining permits for lethal methods. The USFWS needs professional recommendations on individual damage situations before issuing a depredation permit for lethal methods, and the USFWS does not have the mandate or resources to conduct activities related to wildlife damage management. State agencies with responsibilities for migratory birds would likely have to provide this information if depredation permits were to be issued. If the information were provided to the USFWS, following the agency's review of a complete application package for a depredation permit from a property owner or manager to lethally take birds, the permit issuance procedures would follow that described in the proposed action/no action alternative.

Property owners or managers could conduct management using any non-lethal or lethal method that was legal, once a permit had been issued for lethal take, when required. Property owners or managers might choose to implement WS' non-lethal recommendations, implement lethal methods, or request assistance from a private or public entity other than WS. Property owners/managers frustrated by the lack of WS' assistance with the full range of methods may try methods not recommended by WS or use illegal methods (*e.g.*, poisons). In some cases, property owners or managers may misuse some methods or use some methods in excess of what is necessary, which could then become hazardous and pose threats to the safety of humans and non-target species. The USFWS may authorize more lethal take than was necessary to alleviate bird damages and conflicts because agencies, businesses, and organizations may have less technical knowledge and experience managing wildlife damage than WS.

The proposed action, using an integrated damage management approach, incorporates the use of non-lethal methods when addressing requests for assistance. In those instances where non-lethal methods could effectively resolve damage caused by birds, those methods would be used or recommended under the proposed action. Because non-lethal methods would be available for use under the alternatives analyzed in detail, this alternative would not add to the analyses.

This alternative was not analyzed in detail because the take of birds and the destruction of active nests that contain eggs and/or nestlings could continue at the levels analyzed in the proposed action/no action alternative. The USFWS and/or the NCWRC could permit the take, when required, despite WS' lack of involvement in the action. In addition, limiting the availability of methods under this alternative to only non-lethal methods could be inappropriate when attempting to address threats to human safety expeditiously, primarily at airports.

Use of Lethal Methods Only by WS

This alternative would require the use of lethal methods only to reduce threats and damage associated with birds. Under WS Directive 2.101, WS must consider the use of non-lethal methods before lethal methods. Non-lethal methods have been effective in alleviating some bird damage. For example, the use of non-lethal methods has been effective in dispersing urban crow roosts and vulture roosts (Avery et al. 2002, Seamans 2004, Avery et al. 2008*a*, Chipman et al. 2008). In those situations where damage could be alleviated using non-lethal methods, those methods would be employed or recommended as determined by the WS Decision Model. Therefore, this alternative was not considered in detail.

WS would implement Alternative 1 but would establish a Loss Threshold before Allowing Lethal Methods

A concern that WS sometimes receives during public comments is damage caused by animals should be a cost of doing business and/or that there should be a threshold of damage before allowing the use of lethal methods to manage damage. In some cases, cooperators likely tolerate some damage and economic loss until the damage reaches a threshold where the damage becomes an economic burden. The appropriate level of allowed tolerance or threshold before employing lethal methods would differ among cooperators and damage situations. In some cases, any loss in value of a resource caused by birds could be financially burdensome to some people. In addition, establishing a threshold would be difficult or inappropriate to apply to human health and safety situations. For example, aircraft striking birds could lead to property damage and could threaten passenger safety if a catastrophic failure of the aircraft occurred because of the strike. Therefore, addressing the threats of aircraft strikes prior to an actual strike occurring would be appropriate. For those reasons, WS did not carry this alternative forward for further analysis in Chapter 4.

WS would require Cooperators Completely Fund Activities (no taxpayer money)

This alternative would be similar to Alternative 1 except WS would require the entity requesting assistance to pay for any activities conducted by WS. Therefore, no activities conducted by WS would occur through federal appropriations or state funding (*i.e*., no taxpayer money). Funding for WS' activities could occur from federal appropriations, through state funding, and/or through money received from the entity requesting assistance. In those cases where WS receives federal and/or state funding to conduct activities, federal, state, and/or local officials have made the decision to provide funding for damage management activities and have allocated funds for such activities. Additionally, damage management activities are an appropriate sphere of activity for government programs because managing wildlife is a government responsibility. Treves and Naughton-Treves (2005) and the International Association of Fish and Wildlife Agencies (2005) discuss the need for wildlife damage management and that an accountable government agency is best suited to take the lead in such activities because it increases the tolerance for wildlife by those people being impacted by their damage and has the least impacts on wildlife overall. Therefore, WS did not carry this alternative forward for further analysis in Chapter 4.

Trap and Translocate Birds Only by WS

Under this alternative, all requests for assistance would be addressed using live-capture methods or the recommendation of live-capture methods. Birds would be live-captured using alpha chloralose, live-traps, cannon nets, rocket nets, bow nets, net guns, mist nets, or hand-capture. All birds live-captured through direct operational assistance by WS would be translocated. Prior to live-capture, release sites would be identified and approved by the USFWS, the NCWRC, and/or the property owner where the translocated birds would be released.

Live-capture and translocation could be conducted as part of the alternatives analyzed in detail. However, the translocation of birds could only occur under the authority of the USFWS and/or NCWRC. Therefore, the translocation of birds by WS would only occur as directed by those agencies. When requested by the USFWS and/or the NCWRC, WS could translocate birds under any of the alternatives analyzed in detail, except under the no involvement by WS alternative (Alternative 3). However, birds could be translocated by other entities to alleviate damage under Alternative 3. Because WS does not have the authority to translocate birds in the State unless permitted by the USFWS and/or the NCWRC, this alternative was not considered in detail.

The translocation of birds causing damage or posing a threat of damage to other areas following live-capture generally would not be effective or cost-effective. Translocation is generally ineffective because problem bird species are highly mobile and can easily return to damage sites from long distances, habitats in other areas are generally already occupied, and translocation would most likely result in bird damage problems at the new location. In addition, hundreds or thousands of birds would need to be captured and translocated to solve some damage problems (*e.g.*, urban crow roosts); therefore, translocation would be unrealistic in those circumstances. Translocation of wildlife is also discouraged by WS policy (see WS Directive 2.501) because of the stress to the translocated animal, poor survival rates, the potential for disease transmission, and the difficulties that translocated wildlife have with adapting to new locations or habitats (Nielsen 1988, Craven et al. 1998).

Reducing Damage by Managing Bird Populations through the Use of Reproductive Inhibitors

Under this alternative, the only method available to resolve requests for assistance would be the recommendation and the use of reproductive inhibitors to reduce or prevent reproduction in birds responsible for causing damage. Reproductive inhibitors are often considered for use where wildlife populations are overabundant and where traditional hunting or lethal control programs are not publicly acceptable (Muller et al. 1997). Use and effectiveness of reproductive control as a population management tool is limited by population dynamic characteristics (*e.g.*, longevity, age at onset of reproduction, population size, and biological/cultural carrying capacity), habitat and environmental factors (*e.g.*, isolation of target population, cover types, and access to target individuals), socioeconomic factors, and other factors.

Reproductive control for wildlife could be accomplished through sterilization (permanent) or contraception (reversible). Sterilization could be accomplished through surgical sterilization (vasectomy, castration, and tubal ligation), chemosterilization, or gene therapy. Contraception could be accomplished through hormone implantation (synthetic steroids such as progestins), immunocontraception (contraceptive vaccines), or oral contraception (progestin administered daily).

Population modeling indicates that reproductive control is more effective than lethal control only for some rodent and small bird species with high reproductive rates and low survival rates (Dolbeer 1998). Additionally, the need to treat a sufficiently large number of target animals, multiple treatments, and population dynamics of free-ranging populations place considerable logistic and economic constraints on the adoption of reproductive control technologies as a wildlife management tool for some species. Currently, no reproductive inhibitors are available for use to manage most bird populations. Given the costs associated with live-capturing and performing sterilization procedures on birds and the lack of availability of chemical reproductive inhibitors for the management of most bird populations, this alternative was not evaluated in detail.

If a reproductive inhibitor becomes available to manage a large number of bird populations and proven effective in reducing localized bird populations, the use of the inhibitor could be evaluated as a method available under the alternatives. This EA would be reviewed and supplemented to the degree necessary to evaluate the use of the reproductive inhibitor. Currently, the only reproductive inhibitor registered with the EPA is nicarbazin, which is registered for use to manage local populations of Canada geese, domestic mallards, Muscovy ducks, other feral waterfowl, and pigeons. However, the only reproductive inhibitor currently available in North Carolina is a formulation of nicarbazin under the trade name of OvoControl® P, which people can use to manage urban pigeon populations. Reproductive inhibitors for the other bird species addressed in this EA do not currently exist.

Compensation for Bird Damage

The compensation alternative would require WS to establish a system to reimburse persons impacted by bird damage. Under such an alternative, WS would continue to provide technical assistance to those persons seeking assistance with managing damage. In addition, WS would conduct site visits to verify damage. Compensation would 1) require large expenditures of money and labor to investigate and validate all damage claims and to determine and administer appropriate compensation; 2) most likely would be below full market value; 3) give little incentive to resource owners to limit damage through improved cultural or other practices and management strategies; and 4) not be practical for reducing threats to human health and safety. For the above listed reasons, this alternative was not considered in detail.

WS would refer requests for assistance to Private Nuisance Wildlife Control Agents

People experiencing damage or threats of damage associated with birds could contact private wildlife control agents and/or other private entities to reduce damage when they deem appropriate. In addition, WS could refer persons requesting assistance to private wildlife control agents and/or other private entities if WS implemented Alternative 1 or Alternative 2. WS Directive 3.101 provides guidance on establishing cooperative projects and interfacing with private businesses. WS only responds after receiving a request for assistance. If WS implemented Alternative 1 or Alternative 2, WS would inform requesters that other service providers, including private entities, might be available to provide assistance. Therefore, WS did not carry this alternative forward for further analysis.

3.3 STANDARD OPERATING PROCEDURES FOR BIRD DAMAGE MANAGEMENT

WS' directives and SOPs improve the safety, selectivity, and efficacy of those methods available to alleviate or prevent damage. WS' directives and SOPs would be incorporated into activities conducted by WS when addressing bird damage and threats in the State.

Some key SOPs pertinent to the alternatives include the following:

- The WS Decision Model, which is designed to identify effective damage management strategies and their impacts, would be consistently used and applied when addressing bird damage.

- EPA-approved label directions would be followed for all pesticide use. The registration process for chemical pesticides is intended to assure minimal adverse effects occur to the environment when chemicals are used in accordance with label directions.

- Material Safety Data Sheets for pesticides would be provided to all WS' personnel involved with specific damage management activities.

- Non-target animals captured in traps would be released unless it was determined that the animal would not survive and/or that the animal could not be released safely.

- The presence of non-target species would be monitored before using DRC-1339 to reduce the risk of mortality of non-target species' populations.

- WS has consulted with the USFWS and the NCWRC to determine the potential risks to T&E species in accordance with the ESA and State laws.

- All personnel who use chemicals would be trained and certified to use such substances or would be supervised by trained or certified personnel.

- All personnel who use firearms would be trained according to WS' directives.

- The use of non-lethal methods would be considered prior to the use of lethal methods when providing assistance.

- Management actions would be directed toward specific birds posing a threat of damage or causing damage.

- Only non-toxic shot would be used when employing shotguns to lethally take birds in the State.

- The lethal removal of birds would only occur when authorized by the USFWS and/or the NCWRC, when applicable, and only at levels authorized.

3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES

Several additional SOPs would be applicable to the alternatives and the issues identified in Chapter 2 including the following:

Issue 1 - Effects of Damage Management Activities on Target Bird Populations

- Lethal take of birds by WS would be reported and monitored by WS, by the USFWS, and by the NCWRC to evaluate population trends and the magnitude of cumulative take of birds in the State.

- WS would only target those individuals or groups of target species identified as causing damage or posing a threat to human safety.

- The WS' Decision Model, designed to identify the most appropriate damage management strategies and their impacts, would be used to determine damage management strategies.

- WS would monitor damage management activities to ensure activities do not adversely affect bird populations in the State.

- Preference would be given to non-lethal methods, when practical and effective pursuant to WS Directive 2.101.

- Damage management activities would only occur after WS received a request for assistance.

Issue 2 - Effects on Non-target Wildlife Species Populations, Including T&E Species

- When conducting removal operations via shooting, identification of the target would occur prior to application.

- As appropriate, suppressed firearms would be used to minimize noise impacts.

- WS' personnel would use bait, trap placement, and capture devices that were strategically placed at locations likely to capture a target bird species and minimize the potential of non-target animal captures.

- Any non-target animals captured in cage traps, nets, or any other restraining device would be released whenever it was possible and safe to do so.

- WS' personnel would be present during the use of live-capture methods or live-traps would be checked frequently to ensure non-target animals were released immediately or would be prevented from being captured.

- WS would retrieve all dead birds to the extent possible following treatment with DRC-1339.

- Carcasses of birds retrieved after damage management activities had been conducted would be disposed of in accordance with WS Directive 2.515.

- WS has consulted with the USFWS and the NCWRC to evaluate activities to resolve bird damage and threats to ensure the protection of T&E species.

- WS would monitor activities conducted under the selected alternative, if activities are determined to have no significant impact on the environment and an EIS is not required, to ensure those activities do not negatively impact non-target species.

Issue 3 - Effects of Damage Management Methods on Human Health and Safety

- Damage management activities would be conducted professionally and in the safest manner possible. Damage management activities would be conducted away from areas of high human activity. If this were not possible, then activities would be conducted during periods when human activity was low (*e.g.*, early morning).

- The use of firearms would occur during times when public activity and access to the control areas was restricted, when possible. Personnel involved in the use of firearms would be fully trained in the proper and safe application of this method.

- All personnel employing chemical methods would be properly trained and certified in the use of those chemicals. All chemicals used by WS would be securely stored and properly monitored to ensure the safety of the public. WS' use of chemicals and training requirements for those chemicals are outlined in WS Directive 2.401 and WS Directive 2.430.

- All chemical methods used by WS or recommended by WS would be registered with the FDA, the EPA, and/or the NCDACS, when applicable.

- Carcasses of birds retrieved after damage management activities would be disposed of in accordance with WS Directive 2.515.

Issue 4 - Effects on the Aesthetic Values of Birds

- Management actions to reduce or prevent damage caused by birds would be directed toward specific individuals identified as responsible for the damage, identified as posing a threat to human safety, or identified as posing a threat of damage.

- All methods or techniques applied to resolve damage or threats to human safety would be agreed upon with the property owner and/or manager by entering into a work initiation document, MOU, or comparable document prior to the implementation of those methods.

- Preference would be given to non-lethal methods, when practical and effective under WS Directive 2.101.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

- Personnel would be trained in the latest and most humane devices/methods for removing problem birds.

- WS' personnel would be present during the use of most live-capture methods (*e.g.*, mist nets, cannon nets, rocket nets) to ensure birds captured were addressed in a timely manner to minimize the stress of being restrained.

- WS' use of euthanasia methods would comply with WS Directive 2.505.

- The NWRC would continue to conduct research to improve the selectivity and humaneness of wildlife damage management devices used by personnel in the field.

- Preference would be given to non-lethal methods when practical and effective under WS Directive 2.101.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions in selecting the appropriate alternative to address the need for action described in Chapter 1 and the issues described in Chapter 2. This chapter analyzes the environmental consequences of each alternative as those alternatives relate to the issues identified.

4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

This section analyzes the environmental consequences of each alternative in comparison to determine the extent of actual or potential impacts on the issues. Therefore, the proposed action/no action alternative serves as the baseline for the analysis and the comparison of expected impacts among the alternatives. The analysis also takes into consideration mandates, directives, and the procedures of WS, the NCWRC, the USFWS, and the NCDACS.

Issue 1 - Effects of Damage Management Activities on Target Bird Populations

A common issue is whether damage management actions would adversely affect the populations of target bird species, especially when lethal methods were employed. WS would maintain ongoing contact with the USFWS and the NCWRC to ensure activities occurred within management objectives for those species. WS would submit annual activity reports to the USFWS. Therefore, the USFWS would have the opportunity to monitor the total take of birds from all sources and could factor in survival rates from predation, disease, and other mortality data. Ongoing contact with the USFWS and the NCWRC would assure local, state, and regional knowledge of bird population trends were considered.

As discussed previously, methods available to address bird damage or threats of damage in the State that would be available for use or recommendation by WS under Alternative 1 (technical and operational assistance) and Alternative 2 (technical assistance only) would be either lethal methods or non-lethal methods. Under Alternative 2, WS could recommend lethal and non-lethal methods as part of an integrated approach to resolving requests for assistance but would provide no direct operational assistance. Alternative 1 addresses requests for assistance received by WS through technical and operational assistance where an integrated approach to methods could be employed and/or recommended. Non-lethal methods would include, but would not be limited to habitat/behavior modification, lure crops, visual deterrents, lasers, live traps, translocation, alpha chloralose, inactive nest destruction, exclusionary devices, frightening devices, nets, and chemical repellents (see Appendix C for a complete list and description of potential methods). Lethal methods considered by WS to address bird damage include live-capture followed by euthanasia, the avicide DRC-1339, shooting, egg destruction, and the recommendation of legal hunting practices, where appropriate. Target birds would be euthanized using cervical dislocation, carbon dioxide, or firearms once birds were live-captured using other methods. Cervical dislocation, carbon dioxide, and firearms are considered conditionally acceptable forms of euthanasia for birds (AVMA 2013). No assistance would be provided by WS under Alternative 3 but many of those methods available to address bird damage would continue to be available for use by other entities under Alternative 3.

Non-lethal methods can disperse or otherwise make an area unattractive to birds causing damage; thereby, reducing the presence of birds at the site and potentially the immediate area around the site where non-lethal methods are employed. Non-lethal methods would be given priority when addressing requests for assistance (see WS Directive 2.101). However, non-lethal methods would not necessarily be employed to alleviate every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model. For example, if a cooperator requesting assistance had already used non-lethal methods, WS would not likely recommend or continue to employ those particular methods since their use had already been proven ineffective in adequately resolving the damage or threat. Non-lethal methods would be used to exclude, harass, and disperse target wildlife from areas where damage or threats were occurring. When effective, non-lethal methods would disperse birds from the area resulting in a reduction in the presence of those birds at the site where those methods were employed.

The use of non-lethal methods in an integrated approach has proven effective in dispersing birds. For example, Avery et al. (2002) and Seamans (2004) found that the use of vulture effigies were an effective non-lethal method to disperse roosting vultures. Non-lethal methods have been effective in dispersing crow roosts (Gorenzel et al. 2000, Chipman et al. 2008), including the use of crow effigies (Avery et al. 2008*a*), lasers (Gorenzel et al. 2002), and electronic distress calls (Gorenzel and Salmon 1993). Chipman et al. (2008) found the use of only non-lethal methods to disperse urban crow roosts often requires a long-term commitment of affected parties, including financial commitments, to achieve and maintain the desired result of reducing damage.

The use of non-lethal methods could cause those species to move to other areas with minimal impact on those species' populations. Non-lethal methods would generally be regarded as having minimal effects on overall populations of target bird species because those birds would be unharmed. Non-lethal methods would not be employed over large geographical areas or applied at such intensity that essential resources (*e.g*., food sources, habitat) would be unavailable for extended durations or over such a wide geographical scope that long-term adverse effects would occur to a species' population.

The continued use of non-lethal methods often leads to the habituation of birds to those methods, which can decrease the effectiveness of those methods (Avery et al. 2008*a*, Chipman et al. 2008). For any management methods employed, the proper timing would be essential in effectively dispersing those birds causing damage. Employing methods soon after damage begins or soon after threats were identified would increase the likelihood that those damage management activities would achieve success in addressing damage. Therefore, coordination and timing of methods is necessary to be effective in achieving expedient resolution of bird damage. The use of non-lethal methods would not have adverse effects on populations of birds in the State under any of the alternatives.

Lethal methods would be employed or recommended to alleviate damage associated with those birds identified by WS as responsible for causing damage or threats to human safety only after receiving a request for the use of those methods. The use of lethal methods could result in local population reductions in the area where damage or threats were occurring because birds would be removed from the population. Lethal methods are often employed to reinforce non-lethal methods and to remove birds that have been identified as causing damage or posing a threat to human safety. The number of birds removed from a species' population using lethal methods would be dependent on the number of requests for assistance received, the number of birds involved with the associated damage or threat, and the efficacy of methods employed.

Most lethal methods are intended to reduce the number of birds present at a location because a reduction in the number of birds at a location leads to a reduction in damage, which is similar to the intent of using non-lethal methods because non-lethal methods disperse birds so they are no longer at a location to cause damage (*e.g*., see Avery et al. 2008*a*, Chipman et al. 2008). The use of lethal methods has been successful in reducing bird damage (Boyd and Hall 1987, Gorenzel et al. 2000). Boyd and Hall (1987) found the use of DRC-1339 to reduce local crow roosts by up to 25% could lead to a reduction in damage associated with those crows. The intent of non-lethal methods is to harass, exclude, or otherwise make an area unattractive to birds, which disperses those birds to other areas; thereby, leading to a reduction in damage at the location where those birds were dispersed. The intent of using lethal methods would be similar to the objective trying to be achieved when using non-lethal methods, which would be to reduce the number of birds in the area where damage was occurring; thereby, leading to a reduction in the damage occurring at that location.

Although the use of firearms can reduce the number of birds using a location (similar to dispersing birds), the use of a firearm would most often be used to supplement and reinforce the noise associated with non-lethal methods (*e.g*., pyrotechnics). The capture of birds using live-traps and subsequently euthanizing those birds would be employed to reduce the number of birds using a particular area where damage was occurring. Similarly, the recommendation that birds be harvested during the regulated hunting season for those species in the State would be intended to manage those populations in an area where damage was occurring.

Often of concern with the use of lethal methods is that birds that are lethally taken would only be replaced by other birds either during the application of those methods (from other birds that move into the area) or by birds the following year (increase in reproduction that could result from less competition for limited resources).

This would assume birds only return to an area where damage was occurring if WS used lethal methods; however, the use of non-lethal methods can also be temporary, which could result in birds returning to an area where damage was occurring once those methods were no longer used. The common factor when employing any method would be that birds would return if suitable conditions continue to exist at the location where damage was occurring and bird densities were sufficient to occupy all available habitats. Therefore, any reduction or prevention of damage from the use of methods addressed in Appendix C would be temporary if habitat conditions continued to exist that attracted birds to an area where damage was occurring.

Furthermore, any method that disperses or removes birds from areas would only be temporary if preferred characteristics continued to exist the following year when birds returned. Dispersing birds using non-lethal methods addressed in Appendix C often requires repeated application to discourage birds from returning to locations, which can increase costs, moves birds to other areas where they could cause damage, and could be temporary if conditions where damage was occurring remained unchanged. Dispersing and the relocating of birds could move a problem from one area to another, which would require addressing damage caused by those birds at another location. WS' recommendation of or use of techniques to modify existing habitat or making areas unattractive to birds is discussed in Appendix C. WS' objective would be to respond to requests for assistance with the most effective methods and to provide for the long-term solution to the problem using WS' Decision Model.

Managing damage can be divided into short-term redistribution approaches and long-term population/habitat management approaches (Cooper and Keefe 1997). Short-term approaches focus on redistribution and dispersal to limit use of an area where damage or threats were occurring. Short-term redistribution approaches may include prohibiting feeding, hazing with vehicles, dogs, effigies, and adverse noise, erecting access barriers such as wire grids or fences, and taste aversion chemicals. Population reduction by limiting survival or reproduction, removing birds, and habitat modifications would be considered long-term solutions to managing damage caused by birds.

Redistribution methods are often employed to provide immediate resolution to damage occurring until long-term approaches can be implemented or have had time to reach the desired result. Dispersing birds is often a short-term solution that moves birds to other areas where damages or threats could occur (Smith et al. 1999, Gorenzel et al. 2000, Gorenzel et al. 2002, Avery et al. 2008*a*, Chipman et al. 2008). For example, Chipman et al. (2008) found that crows returned to roosts previously dispersed using non-lethal methods within two to eight weeks. In addition, Chipman et al. (2008) found that the use of non-lethal methods had to be re-applied every year during a six-year project that evaluated the use of only non-lethal methods. Some short-term methods may become less effective in resolving damage as a bird population increases, as birds become more acclimated to human activity, and as birds become habituated to harassment techniques (Smith et al. 1999, Chipman et al. 2008). Non-lethal methods often require a constant presence at locations when birds are present and must be repeated every day until the desired results are achieved, which can increase the costs associated with those activities. For example, during a six-year project using only non-lethal methods to disperse crows in New York, the number of events required to disperse crows remained similar amongst years and at some locations, the number of events required to harass crows increased from the start of the project (Chipman et al. 2008). Despite the need to re-apply non-lethal methods yearly, the return of birds to roost locations previously dispersed, and the number of crows using roost locations increasing annually at some roost locations, Chipman et al. (2008) determined the use of non-lethal methods could be effective at dispersing urban crow roosts in New York.

Avery et al. (2008*a*) found similar results during the use of crow effigies and other non-lethal methods to disperse urban crow roosts in Pennsylvania. Crows returned to roost locations in Pennsylvania annually despite the use of non-lethal methods and effigies (Avery et al. 2008*a*). Gorenzel et al. (2002) found that crows returned to roost locations after the use of lasers. Therefore, the use of both lethal and non-lethal methods may require repeated use of those methods. The return of birds to areas where damage management methods were previously employed does not indicate previous use of those methods were ineffective since the intent of those methods would be to reduce the number of birds present at a site where damage was occurring at the time those methods were employed.

Cooper (1991) reported that the removal of geese posing or likely to pose a hazard to air safety at airports considerably reduced the population of local geese, decreased the number of goose flights through airport operations airspace, and significantly reduced goose-aircraft collisions at Minneapolis-St. Paul International Airport. In addition, Dolbeer et al. (1993*a*) demonstrated that an integrated approach (including removal of offending birds) reduced bird hazards at airports and substantially reduced bird collisions with aircraft by as much as 89%. Jensen (1996) also reported that an integrated approach that incorporated the removal of geese, reduced goose-aircraft collisions by 80% during a two year period. Boyd and Hall (1987) showed that a 25% reduction in a local crow roost resulted in reduced hazards to a nearby airport.

Most lethal and non-lethal methods currently available provide only short-term benefits when addressing bird damage. Those methods are intended to reduce damage occurring at the time those methods are employed but do not necessarily ensure birds would not return once those methods are discontinued or the following year when birds return to an area. Long-term solutions to resolving bird damage are often difficult to implement and can be costly. In some cases, long-term solutions involve exclusionary devices, such as wire grids, or other practices such as closing garbage cans. When addressing bird damage, long-term solutions generally involve modifying existing habitat or making conditions less attractive to birds. To ensure complete success, alternative sites in areas where damage is not likely to occur are often times required to achieve complete success in reducing damage and avoid moving the problem from one area to another. Modifying a site to be less attractive to birds would likely result in the dispersal of those birds to other areas where damage could occur or could result in multiple occurrences of damage situations.

WS may recommend that birds be harvested during the regulated hunting season for those species in an attempt to reduce the number of birds causing damage. Managing bird populations over broad areas could lead to a decrease in the number of birds causing damage. Establishing hunting seasons and the allowed take during those seasons is the responsibility of the NCWRC under frameworks developed by the USFWS. WS does not have the authority to establish hunting seasons or to set allowed harvest numbers during those seasons.

As discussed previously, the analysis for magnitude of impact from lethal take can be determined either quantitatively or qualitatively. Quantitative determinations are based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations are based on population trends and harvest trend data. Information on bird populations and trends are often derived from several sources including the BBS, the CBC, the Partners in Flight Landbird Population database, published literature, and harvest data.

The issue of the potential impacts of conducting the alternatives on the populations of target bird species is analyzed for each alternative below.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

The proposed action/no action alternative would continue the current implementation of an adaptive integrated approach utilizing non-lethal and lethal techniques, as deemed appropriate using the WS Decision Model, to reduce damage and threats associated with birds in North Carolina. WS would work with those people experiencing bird damage to address those birds responsible for causing damage as expeditiously as possible. To be most effective, damage management activities should begin as soon as birds begin to cause damage. Bird damage that has been ongoing could be difficult to alleviate using available methods since birds would be conditioned to feed, roost, loaf, and would be familiar with a particular location. Subsequently, making that area unattractive using available methods could be difficult to achieve once damage was ongoing. WS would work closely with those entities requesting assistance to identify situations where damage could occur and begin to implement damage management activities under this alternative as early as possible to increase the likelihood of those methods achieving the level of damage reduction requested by the cooperating entity.

WS could employ and/or recommend those methods described in Appendix C in an adaptive approach that would integrate methods to reduce damage and threats associated with birds in the State. Under the proposed action alternative, non-lethal methods would be given priority when addressing requests for assistance (see WS Directive 2.101) and WS could employ only non-lethal methods when determined to be appropriate for each request for assistance to alleviate damage or reduce threats of damage using the WS Decision Model. However, WS could also use or recommend the use of lethal methods under this alternative. When employing lethal methods, a depredation permit may be required from the USFWS and/or the NCWRC.

As previously stated, the lethal take of birds can occur without a permit if those species are non-native, under depredation/control orders, through the issuance of depredation permits by the USFWS and/or the NCWRC, or people can harvest some bird species during hunting seasons. The USFWS can issue permits for those species of birds protected under the MBTA while the NCWRC may also issue permits to take bird species, including non-migratory resident bird species, such as wild turkey.

The USFWS could issue depredation permits to WS and to those entities experiencing bird damage when requested and when deemed appropriate by the USFWS for those species that require a permit. When applying for a depredation permit, the requesting entity would submit with the application the number of birds requested to be taken to alleviate the damage. Therefore, under this alternative, the USFWS could: 1) deny an application for a depredation permit when requested to alleviate bird damage, 2) could issue a depredation permit at the take levels requested, or 3) could issue permits at levels below those take levels requested. Concurrently, the NCWRC could issue a permit to take the same number of birds authorized by the USFWS or the NCWRC could issue a permit authorizing the lethal removal of less than the number permitted by the USFWS. However, the take authorized by the NCWRC would not exceed the take level authorized by the USFWS.

The property owner or manager may choose to apply for their own depredation permit from the USFWS to lethally take birds, as required by the implementing regulations of the MBTA for depredation control (see 50 CFR 21.41). The USFWS requires non-lethal methods be used and shown ineffective or impractical before the USFWS will issue a depredation permit for lethal take. In this situation, WS could evaluate the damage and complete a Migratory Bird Damage Report, which would include information on the extent of the damages, the number of birds present, and a recommendation for the number of birds that should be taken to best alleviate the damages.

Following review by the USFWS of a complete application for a depredation permit from a property owner or manager and the Migratory Bird Damage Report, a depredation permit could be issued to authorize the lethal take of a specified number of birds as part of an integrated approach. Upon receipt of a depredation permit, the property owner, manager, or appropriate subpermittee could commence the authorized activities and would be required to submit a written report of their activities upon expiration of their permit. Permits may be renewed annually as needed to alleviate damage or reduce threats to human safety. Property owners or managers could conduct management using those methods legally available. Most methods discussed in Appendix C that are available for use to manage bird damage would be available to all entities. The only methods currently available that would not be available for use by those persons experiencing bird damage would be the immobilizing drug alpha chloralose, the avicide DRC-1339, and the repellent mesurol, which are methods that can only be used by WS.

Under this alternative, WS would submit an application to the USFWS for a one-year depredation permit in anticipation of receiving requests for assistance to manage bird damage. The application submitted by WS would estimate the maximum number of birds of each species that could be lethally removed as part of an integrated approach. When submitting an application for a depredation permit each year, WS would use adaptive management principles to adjust the requested number of birds that could be lethally removed. Adjustments on the requested lethal take levels would be made based on anticipated needs using activities conducted previously as a guide. WS would not submit a Migratory Bird Damage Report as part of the application process. The USFWS would conduct an independent review of the application, and if acceptable, would issue a permit as allowed under the depredation permit regulations. WS could request an amendment to a permit to increase the number of birds that could be taken to address unpredicted and emerging damage or threats. The NCWRC would also issue a permit to WS to possess and take protected wildlife according to limits designated by the USFWS.

Therefore, the USFWS and/or NCWRC could: 1) deny WS' application for a depredation/scientific collecting permit, 2) issue a depredation permit for the take of birds at a level below the number requested by WS, or 3) issue a depredation permit for the number of birds requested by WS. In addition, WS could be listed as subpermittees under depredation permits issued to other entities.

Under the proposed action alternative, WS could destroy nests and the associated eggs of certain target bird species as part of an integrated approach to managing damage. Many bird species have the ability to identify areas with regular human disturbance and low reproductive success, which may cause them to relocate and nest elsewhere when confronted with repeated nest failure. Although there may be reduced fecundity for the individuals affected by destroying eggs in nests and nest destruction, this activity generally has no long-term effect on breeding adult birds when conducted in limited situations. WS would not use nest and egg removal as a population management method. WS would use this method to inhibit nesting in an area experiencing damage due to the nesting activity in a localized area. As with the lethal take of birds, the USFWS and/or the NCWRC must authorize the take of nests. Therefore, the number of nests that WS destroys would occur at the discretion of the USFWS and/or the NCWRC.

WS could also address requests for assistance using live-capture methods and the subsequent translocation of target bird species. Any of the target birds could be live-captured using live-traps, cannon nets, rocket nets, mist nests, bow nets, or other methods and translocated; however, translocation would most often be used for raptor species, waterfowl species, and bird species that were harvestable (*e.g.*, wild turkeys). Translocation of birds could only occur under the authority of the USFWS and/or the NCWRC, when required. Therefore, the translocation of birds by WS would only occur as directed by those agencies. Translocation sites would be identified and have to be approved by the USFWS, the NCWRC, and/or the property owner where the translocated birds would be placed prior to live-capture. When authorized by the USFWS and/or the NCWRC, WS could translocate birds under this alternative and recommend translocation under Alternative 2. When birds were released into appropriate habitat and when translocation occurred during the migration periods, WS does not anticipate translocation to affect target bird populations adversely or to affect individual birds adversely.

As part of translocating birds and for other purposes (*e.g*., movement studies), WS could band target birds for identification purposes using appropriately sized leg bands. Banding would occur pursuant to a banding permit issued by the USGS. Fair et al. (2010) stated "[w]*hen appropriate* [leg] *band sizes are used, the occurrence and rate of adverse effects on the subjects is ordinarily very low*". Therefore, WS does not expect the use of appropriately sized leg bands to adversely affect populations or individual birds.

The issue of the effects on target bird species arises from the use of non-lethal and lethal methods to address the need for reducing damage and threats; however, the primary concern would be from the use of lethal methods to address damage. The lethal take of birds would be monitored by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of take is maintained below the level that would cause significant adverse effects to the viability of native species' populations. Management actions taken by non-federal entities would be considered the *environmental status quo*. The potential impacts on the populations of target bird species from the implementation of the proposed action are analyzed for each species below.

CANADA GOOSE BIOLOGY AND POPULATION IMPACT ANALYSIS

Canada geese are the most widely distributed goose species in North America (Mowbray et al. 2002). Canada geese occur in a broad range of habitats including prairie, arctic plains, mountain meadows, agricultural areas, reservoirs, sewage lagoons, parks, golf courses, lawn-rich suburban areas, or other similar areas not far from permanent sources of water (Mowbray et al. 2002). Their diet consists of grasses, sedges, berries, and seeds, including agricultural grain (Mowbray et al. 2002). Canada geese are highly social birds that often gather and feed in flocks, with some flocks exceeding 1,000 birds (Mowbray et al. 2002).

In the past, most authorities recognized one species of the Canada goose with 11 subspecies, which differed primarily in body size and color (Bellrose 1980). Today, there are generally two recognized, distinct species of geese instead of just a single species. Those two distinct species are the smaller cackling goose and the larger Canada goose (Mowbray et al. 2002, Willcox and Giuliano 2012). There are four recognized subspecies of cackling geese, which generally occur within western and northwestern North America. In North America, there are seven subspecies of Canada geese recognized (Willcox and Giuliano 2012).

There are primarily four bird migration routes in North America, each of which has a Flyway Council governing migratory game bird management. Those councils are comprised of representatives from member States and Canadian Provinces, which make recommendations to the USFWS on the management of bird populations. The flyway system consists of four administrative units: the Atlantic, Mississippi, Central, and Pacific Flyway. North Carolina is part of the Atlantic Flyway. The Atlantic Flyway is comprised of 17 states in the eastern United States along the Atlantic Coast, the Canadian territory of Nunavut, and the Canadian providences of Newfoundland, New Brunswick, Nova Scotia, Ontario, Prince Edward Island, and Quebec. One of the migratory game birds the Flyway Councils governs is the Canada goose population.

Historically, the breeding range of Canada geese occurred along the northern portion of the United States and across most of Canada and they migrated south to spend the winter in more temperate climates (Mowbray et al. 2002). Canada geese did not historically breed in many of the states in the southern United States. Overharvest and habitat loss nearly extirpated the native breeding populations of Canada geese in the United States following settlement in the 19th century (Mowbray et al. 2002). In the mid-1900s, state and federal agencies began efforts to restore historic breeding populations and to establish breeding populations of Canada geese in new locations, including North Carolina (Atlantic Flyway Council 2011). Due to those restoration and pioneering efforts, Canada geese now breed and reside throughout the year in the continental United States, including North Carolina (Mowbray et al. 2002, Atlantic Flyway Council 2011). Today, many of the breeding populations of geese that state and federal agencies established do not migrate and generally occur in the same area throughout the year (Mowbray et al. 2002, Atlantic Flyway Council 2011).

Other subspecies of Canada geese augment the breeding population of Canada geese in the State during the migration periods and during the winter. Therefore, depending on the time of year, there are two behaviorally distinct types of Canada goose populations present in the State. People generally label the two distinct types of geese that could be present as "*resident*" and "*migratory*" geese. Discussion on resident and migratory geese that could be present in the State occurs below.

Resident Canada Geese

Canada geese are "*resident*" when they nest and/or reside on a year round basis within the contiguous United States. Resident geese nest within the lower 48 States during the months of March, April, May, or June and reside within the lower 48 States and the District of Columbia in the months of April, May, June, July, and August (see 50 CFR 20.11, 50 CFR 21.3) (Rusch et al. 1995, Ankney 1996). The Atlantic Flyway Council defines resident Canada geese as geese nesting in states comprising the Atlantic Flyway as well as Canada at or below 48° N latitude and east of 80° W longitude, excluding Newfoundland (Atlantic Flyway Council 2011). Therefore, during much of the year, the majority of Canada geese present in the State would be resident geese, not migratory. However, when migrant populations are present in the State, distinguishing a resident Canada goose from a migratory Canada goose by appearance can be difficult.

In the Atlantic Flyway, resident Canada Geese consist of several subspecies that state agencies and other entities introduced and established during the early 1900s after extirpation of native birds (Atlantic Flyway Council 2011). Today, most Atlantic Flyway resident Canada Geese are non-migratory or travel only short distances between wintering and breeding areas (Atlantic Flyway Council 2011). Resident Canada geese are not simply geese that stopped migrating but geese with very different population growth rates, management needs, and opportunities (Atlantic Flyway Council 2011). For example, most resident Canada geese in the Atlantic Flyway are reluctant to leave the areas in which they breed, moving less than 22 miles on average, when winter weather makes it necessary to find open water and food. These moves to wintering areas typically occur in late November or December, with birds returning to nest in March (Atlantic Flyway Council 2011). Resident Canada geese have a relatively high nesting success compared to migratory Canada geese (Mowbray et al. 2002, Atlantic Flyway Council 2011). Resident Canada geese primarily nest from March through May each year. Resident Canada geese nest in traditional sites (*e.g.*, along shorelines, on islands and peninsulas, small ponds, lakes, and reservoirs), as well as on rooftops, adjacent to roadways, swimming pools, and in parking lots, playgrounds, planters, and abandoned property (*e.g.*, tires, automobiles).

As resident goose populations have increased across the United States, including the resident population in North Carolina, the number of requests for assistance to manage damage associated with geese has also increased (Atlantic Flyway Council 2011). Damage and the threat of damage associated with increasing populations of resident Canada geese are well documented (*e.g.*, see Mississippi Flyway Council Technical Section 1996, Atlantic Flyway Council 2011). Those potential impacts include damage to property, concerns about human health and safety, and impacts to agriculture and natural resources. Damage to property can occur when geese congregate on lawns or mowed areas, including athletic fields, golf courses, lawns, and parks, as well as beaches and marinas, depositing their droppings and feathers (Mississippi Flyway Council Technical Section 1996, Atlantic Flyway Council 2011). Concerns to human health and safety from Canada geese can arise in several ways. At airports, geese can create a threat to aircraft and to human life (Mississippi Flyway Council Technical Section 1996, Atlantic Flyway Council 2011). In addition, during the nesting season, geese aggressively defend the area around their nests and goslings from other animals and people (Mississippi Flyway Council Technical Section 1996, Atlantic Flyway Council 2011). Agricultural and natural resource impacts include losses to corn, soybeans, and winter wheat, as well as overgrazing of pastures and a degradation of water quality (Mississippi Flyway Council Technical Section 1996, Atlantic Flyway Council 2011).

The development of the first management plans for resident Canada geese in the Atlantic Flyway occurred in 1989 to help manage harvest and manage human/goose conflicts. The current management plan addressing resident Canada geese in the Atlantic Flyway outlines the main goals of state and federal agencies "*...to achieve a socially acceptable balance between the positive values and negative conflicts associated with* [resident Canada Geese]" (Atlantic Flyway Council 2011). The main subject areas covered in the current plan as they relate to population management focusing on population objectives, harvest management, and population control.

Population objectives, as outlined in the management plan, are to reduce the resident Canada goose population in the Atlantic Flyway to 700,000 geese by 2020. During the development of the current resident Canada goose management plan, the population of resident Canada geese in the Atlantic Flyway was approximately 1.4 million geese (Atlantic Flyway Council 2011). The spring 2017 estimate for the Atlantic Flyway resident Canada goose population was 933,300 geese, which was similar to the 2016 estimate of 950,000 geese (USFWS 2017*a*), but was 33% above the population objective recommended by the Atlantic Flyway Council in their current resident Canada goose management plan (Atlantic Flyway Council 2011). In 2010, the population of resident Canada geese in North Carolina was thought to be approximately 111,000 geese (Atlantic Flyway Council 2011). In June 2014, the NCWRC marked 2,102 adult geese and used a Lincoln-Peterson formula to derive a breeding population estimate of 148,839 Canada geese (McAlister et al. 2017).

To relieve damage and conflicts, the plan called for the maximum opportunities for the use and appreciation of resident Canada geese that are consistent with population goals. The plan also called for the management of resident Canada goose populations to be compatible with management criteria established for migrant geese and to monitor populations, harvest, and conflict levels to evaluate the effectiveness of the management plan (Atlantic Flyway Council 2011).

The USFWS modified existing regulations by including the definition of a resident Canada goose (see 50 CFR 20.11, 50 CFR 21.3). The USFWS has established several mechanisms to allow the states to further manage resident goose populations and goose damage. The USFWS established regulations that created specific control and depredation orders designed to address resident Canada goose depredation, damage, and conflicts. The USFWS has also expanded hunting opportunities and methods to increase the number of resident Canada geese harvested during existing September seasons and authorized the implementation of a resident Canada goose population control program. The USFWS made modifications by allowing the use of shotguns holding more than three shells during resident Canada goose hunting seasons, and by allowing the use of electronic calls during harvest seasons targeting resident Canada geese (see 50 CFR 20.21). The USFWS also added to the regulations a control order for resident Canada geese at airports (see 50 CFR 21.49), a depredation order for nests and eggs (see 50 CFR 21.50), a depredation order for resident Canada geese at agricultural facilities (see 50 CFR 21.51), and a public health control order for resident Canada geese (see 50 CFR 21.52). Finally, the USFWS established the resident Canada goose population control program (see 50 CFR 21.61).

Most requests for assistance received by WS to address damage caused by Canada geese occurs during those months when geese present in the State are resident geese. From FY 2011 through FY 2016, the WS program in North Carolina employed several different non-lethal techniques to capture or disperse Canada geese, including vehicles, firearms, pyrotechnics, paintballs, and live-capture traps. Using non-lethal methods, the WS program in North Carolina dispersed 24,970 geese and translocated three geese from FY 2011 through FY 2016 (see Table 4.1). In addition, WS employed lethal methods to take 3,211 geese in response to damage or threats of damage from FY 2011 through FY 2016. WS' personnel lethally removed geese using firearms, cervical dislocation, and euthanasia using carbon dioxide after personnel live captured geese using cannon/air nets, and corral traps.

Table 4.1 – Canada geese addressed by WS in North Carolina, FY 2011 – FY 2016

Fiscal Year	WS' Activity		
	Take	**Translocated**	**Dispersed**
2011	902	0	3,593
2012	843	0	3,623
2013	428	0	3,930
2014	345	0	5,764
2015	403	0	3,204
2016	290	3	4,856
TOTAL	**3,211**	**3**	**24,970**

Under this alternative, the WS program in North Carolina would continue to use an integrated method approach when addressing requests for assistance. WS would continue to consider the use of non-lethal methods before considering the use of lethal methods. As discussed previously, WS has employed several non-lethal methods to address requests for assistance associated with geese. However, WS may employ lethal methods when personnel deem those methods as appropriate using the WS' Decision Model. The Atlantic Flyway Council (2011) stated, "... [non-lethal methods] *are not always practical, effective, or affordable, and most of them simply move problem birds to other locations*".

Based on the number of requests that WS has previously received for assistance and in anticipation of additional efforts to manage damage, WS anticipates that up to 3,000 Canada geese could be taken annually in the State. Under this alternative, WS' personnel could also destroy the nests and/or eggs of resident Canada geese as part of an integrated approach to managing damage. WS anticipates that personnel could destroy up to 1,000 nests in the State based on previous requests for assistance and in anticipation of receiving additional requests for assistance.

As stated previously, distinguishing between resident and migratory Canada geese is not possible through visual identification. Based on the type of damage that occurred, the locations where requests for assistance occurred, and the months that WS received those requests, the geese addressed by WS previously to alleviate damage were likely resident geese (*i.e.*, geese present in the State throughout the year). To evaluate a worst-case scenario, the analysis will evaluate the anticipated take of up to 3,000 geese by WS annually as though all of those geese were resident geese. Most requests for assistance received by WS are associated with airports and urban areas where geese are present throughout the year. Therefore, WS anticipates future requests for assistance to involve primarily resident geese. In addition, resident Canada geese molt and are flightless from mid-June through mid-July each year. Molting is the process whereby geese annually replace their primary and secondary flight (wing) feathers (Welty 1982). Portions of a flock of geese can be flightless from about one week before until two weeks after the primary molt period because individual birds molt at slightly different times. Because geese are flightless, WS' personnel can live-capture target geese by slowly guiding them into corral traps. From FY

2011 through FY 2016 most geese addressed by WS were live-captured using corral traps during the period when they were flightless.

In 2014, the NCWRC estimated the adult resident Canada goose population to be 148,839 geese (McAlister et al. 2017). However, the overall population of resident geese is higher as this figure does not include the addition of hatching year geese (*i.e.*, immature geese). The take of 3,000 resident geese by WS would represent 2.0% of the overall resident goose population in North Carolina. However, trend data from the BBS shows an increasing trend for Canada geese present in the State during the breeding season estimated 17.56% annually from 2005 through 2015. Therefore, based on BBS trend data, the actual statewide breeding population has likely increased and may exceed 148,839 geese.

Under current frameworks, the USFWS currently allows states to implement an annual September harvest season to target resident Canada geese in addition to the harvest of Canada geese that can occur during the annual regular waterfowl season. Based on those frameworks, the NCWRC currently allows people in the state to harvest geese during the September resident Canada goose season and the regular waterfowl harvest season. Although migratory Canada geese are likely present in the State during the regular waterfowl harvest season, the number of resident Canada geese and the number of migratory geese that people harvest annually during the regular waterfowl harvest season is unknown. However, people likely harvest some resident Canada geese in the State during the regular waterfowl harvest season. For example, during the regular waterfowl hunting seasons, Klimstra and Padding (2012) estimated that 62% of the geese harvested in the Atlantic Flyway were resident Canada geese.

Table 4.2 shows the known cumulative removal of Canada geese, which includes removal by WS, harvest during the annual hunting seasons, and removal by other entities. During the September hunting season intended to target resident populations of Canada geese, hunters harvested an average of nearly 12,400 geese annually in the State from 2011 through 2016. The average annual harvest of geese during the September hunting season represents 8.3% of the 2014 statewide breeding population estimated at 148,839 resident geese.

Table 4.2 - Cumulative removal of Canada Geese in North Carolina, 2011 – 2016

Year	**WS' Take[1]**	**Hunter Harvest[2]**		**Other Take[3]**	**TOTAL**
		September	**Regular**		
2011	902	8,900	20,900	715	**31,417**
2012	843	37,700	36,000	452	**74,995**
2013	428	7,200	48,700	641	**56,969**
2014	345	11,400	25,800	337	**37,882**
2015	403	9,000	27,000	188	**36,591**
2016	290	0	51,800	385	**52,475**

[1]WS' take is reported by federal fiscal year

[2]Data from Raftovich and Wilkins (2013), Raftovich et al. (2015), and Raftovich et al. (2017)

[3]Take under depredation permits by other entities reported by calendar year provided by the USFWS (M. Outlaw, USFWS pers. comm. 2017).

However, the harvest estimates for geese are likely biased high (Padding and Royle 2012). Using a harvest derivation analysis (Munro and Kimball 1982), McAlister et al. (2017) estimated the proportion of migrant and non-local resident Canada geese in the 2014 harvest estimate for Canada geese in North Carolina following methods described by Klimstra and Padding (2012). Before applying correction factors, the initial USFWS harvest estimate in 2014 for North Carolina was 37,267 Canada geese (Raftovich et al. 2015). Using band recoveries, McAlister et al. (2017) estimated that 1,192 geese harvested in North Carolina during the 2014 hunting season were migratory geese and nonlocal, temperate-nesting geese. In addition, McAlister et al. (2017) calculated Raftovich et al. (2015)

overestimated the 2014 harvest in North Carolina by 11,444 geese. During the 2014 hunting season for geese in North Carolina, McAlister et al. (2017) estimated that hunters harvested 24,631 resident geese consisting of 7,923 hatch-year geese and 16,708 adult geese.

In addition to hunter harvest, the USFWS has authorized other entities to take Canada geese in the State under depredation permits. Between 2011 and 2016, entities other than WS lethally removed 2,718 Canada geese in the State pursuant to depredation permits issued by the USFWS, which is an average annual removal 453 geese. The number of those geese lethally removed by other entities that were resident geese is unknown. For this analysis, WS will consider those geese lethally removed by other entities to be resident geese.

Therefore, any removal by WS to alleviate damage would be occurring along with harvest during the September hunting season; harvest during the regular waterfowl hunting season; and lethal take by other entities under depredation permits and depredation/control orders. As discussed previously, a common issue is whether the cumulative lethal removal would adversely affect the populations of target bird species, including Canada geese. If the WS program in North Carolina had lethally removed 3,000 resident Canada geese annually in the State from FY 2011 through FY 2016, the take by WS would have represented 3.9% to 9.0% of the total take of geese in the State from 2011 through 2016.

If WS' annual take had reached 3,000 resident Canada geese from 2011 through 2016 and if 62% of the geese harvested during the regular waterfowl season were resident Canada geese (Klimstra and Padding 2012) and all take by other entities involved resident Canada geese, the cumulative take would have represented 17.2% to 42.7% of a statewide breeding population estimated at 148,839 Canada geese. Data collected from 2005 through 2015 during the BBS continues to show an increasing population trend for resident Canada geese in the State estimated at 17.56% annually (Sauer et al. 2017), which indicates that cumulative take of resident Canada geese has not caused the population to decline in the State.

All take by WS occurs under depredation permits issued by the USFWS and the NCWRC. WS' take of up to 3,000 geese annually would be dependent upon the USFWS and the NCWRC authorizing the take at that level annually. Take by WS would not exceed the permitted take allowed under depredation permits issued by the USFWS and the NCWRC. With management authority for migratory birds, the USFWS and the NCWRC can adjust allowed take through the regulated harvest season and take under depredation permits and orders to meet population objectives. Therefore, the USFWS and the NCWRC would authorize all take by WS and would have the opportunity to consider cumulative take as part of population objectives for geese.

In addition, WS could destroy the nests and/or eggs of resident Canada geese as part of an integrated approach to managing damage. In anticipation of addressing additional requests for assistance associated with geese, WS could destroy up to 1,000 nests (including eggs within the nests) annually. WS' take of nests and/or eggs would only occur when permitted by the USFWS and the NCWRC through the issuance of depredation permits. WS' take of nests and/or eggs would not exceed 1,000 nests annually and would not exceed the level permitted under depredation permits.

Impacts due to nest and egg destruction should have little adverse effect on the resident goose population in North Carolina. Geese are a long-lived species and have the ability to identify areas with regular human disturbance and low reproductive success, which causes them to relocate and nest elsewhere when confronted with repeated nest failure. Although there may be reduced fecundity for the individual geese affected, nest/egg removal has no long-term effect on breeding adult geese. WS would not use nest and egg removal as a population management method. WS would destroy nests (and eggs within the nest) in a localized area to inhibit nesting where the nests or the presence of nesting geese were causing damage or posing a threat of damage. Treatment of 95% of all Canada goose eggs each year would result in only a 25% reduction in the population over 10 years (Allan et al. 1995).

The EPA has authorized the use of the reproductive inhibitor known as nicarbazin to manage Canada goose and domestic waterfowl populations on a local scale by reducing the likelihood that eggs laid will hatch. However, products containing the active ingredient nicarbazin are not currently available to manage localized goose populations. Label requirements of previously commercially available products containing nicarbazin for geese restricted the application of the product to urban areas, which limits the extent of the products use for reducing localized waterfowl populations. The resultant reduction in local Canada goose population from the use of nicarbazin would be highly variable given the variability in the effectiveness of the product to reduce egg hatch in waterfowl. However, given that the effects of nicarbazin are only temporary if the applicator does not feed birds an appropriate dose of nicarbazin daily, the reduction in the population could reverse if applicators no longer supplied treated bait and other conditions (*e.g.*, food, disease) were favorable for population growth.

At this time, products containing nicarbazin as the active ingredient are not available for use to manage localized Canada goose populations in North Carolina. If the NCDACS approves a product containing nicarbazin as the active ingredient for use to manage localized Canada goose populations, WS could use the product to manage damage by reducing localized goose populations.

An additional concern identified is the potential affects that removing resident geese by WS to resolve requests for assistance could have on the ability of people to harvest geese during the annual hunting seasons. The Atlantic Flyway Council (2011) stated, "*Adult resident Canada geese are long-lived and subject to negligible mortality other than hunting*". In addition, the Atlantic Flyway Council (2011) stated, "*Current adult harvest rates (≤15%) through sport hunting are far below what is needed to maintain a stable population (~30%). Since hunting is the most practical and cost effective way to reduce survival on a large scale, continued efforts are needed to design hunting regulations that will increase hunter harvest rates, especially in areas where problem geese are most likely to be taken*." However, Balkcom (2010) suggested that hunting had limited potential to reduce the resident goose population size in areas where entities restrict or prohibit hunting.

The Atlantic Flyway Council (2011) stated, "*…managers often cannot target [resident] geese in urban and suburban areas because of local firearm ordinances, which is problematic given that geese in those areas typically have high survival rates (Balkcom 2010). This in turn can make reducing population size difficult given that reducing adult survival is one of the most effective methods of controlling overabundant geese (Ankney 1996). Thus, it is unlikely that hunter harvest alone will be able to reduce [resident goose] numbers to attain the [Atlantic Flyway] population objective (Klimstra and Padding* [2012]*).*" The Atlantic Flyway Council (2011) further stated, "*Where hunting is not practical, or cannot achieve desired harvest rates, other removal options, including capture and euthanasia of geese from problem areas, will be necessary to accomplish population objectives*". The Atlantic Flyway Council (2011) also stated "*The most immediate and effective way to reduce resident goose numbers in such areas is through culling programs, typically involving capture and removal (killing or relocation) of flightless geese during the summer molting period (Swift et al. 2009)*".

Most requests for assistance that WS receives in North Carolina are associated with urban areas and airports where entities prohibit hunting or restrict the use of firearms. In addition, the removal of geese by WS has ranged from 0.6% to 2.9% of the total removal of resident geese in the State from 2011 through 2016, with an annual average removal of 1.2% of the total cumulative removal in the State. If the annual lethal removal of resident geese by WS reached 3,000 resident geese and if harvest and take by other entities pursuant to depredation permits remains similar to removal that occurred from 2011 through 2016, WS' removal would represent 3.9% to 9.0% of the cumulative removal of geese with an average of

6.4% per year. WS' annual removal would be a small component of the cumulative removal that occurs during the hunting seasons for geese and under depredation permits issued to other entities.

Migratory Canada Geese

Migratory Canada geese nest across the arctic, subarctic, and boreal regions of Canada and Alaska that migrate south to winter in the United States and Mexico (Mowbray et al. 2002). Canada goose migrations may encompass up to 3,000 miles, like that of the Richardson's Canada goose (*B. c. hutchinsii*), which nests as far north as Baffin Island, Nunavut, Canada and winters as far south as the eastern States of Mexico. Migratory Canada geese that could occur in the State during the migration periods and during the winter are primarily from three breeding populations. Those populations include the Atlantic Flyway resident population, the Atlantic population, and the Southern James Bay population (Fuller and Howell 2013, USFWS 2017*a*). The wintering migratory population in North Carolina is mostly comprised of geese from the Atlantic Flyway resident population and the Southern James Bay population (Fuller and Howell 2013, USFWS 2015).

In 2016, biologists with the USFWS modified the annual surveys for Canada geese and now conduct a combined survey that consolidates survey data for several breeding areas in Canada along the Hudson and James Bays, which includes the Southern James Bay population (USFWS 2017*a*). Currently, the USFWS (2017*a*) combines the survey data for the Southern James Bay population with survey data from other areas and is included in estimates for the Mississippi Flyway Interior population. The Mississippi Flyway Interior population of geese nests primarily in the Hudson Bay Lowlands to the west and south of James Bay in Canada (USFWS 2017*a*). The estimated number of breeding Canada geese in the Mississippi Flyway Interior population during the spring of 2017 was 71,600 geese, which was 10% higher than the 2016 estimate of 65,100 geese. The Atlantic Population of geese nests throughout much of Quebec in Canada along Ungava Bay, the eastern shore of Hudson Bay and the Ungava Peninsula (USFWS 2017*a*). In the winter, geese from the Atlantic Population occur from New England to South Carolina, with the largest concentrations occurring on the Delmarva Peninsula (USFWS 2017*a*). The number of breeding pairs in the Atlantic Population was 161,200 in 2017, which was similar to the estimate in 2016 of 191,500. The total population estimate for the Atlantic Population was 705,900 geese, which was also similar to the 2016 estimate of 663,500 geese. Over the past 10 years, the breeding pair estimates from spring surveys remain stable but the total population estimates have decreased an average of 4% per year (USFWS 2017*a*).

The number of Canada geese observed in the State during the CBC has shown a general increasing trend from 1966 through 2016 (National Audubon Society 2010). The number of migratory Canada geese present in the State during the winter or during the spring and fall migration is unknown because both resident and non-resident geese are present in the State during those periods.

Based on increasing requests for assistance to manage geese, WS may receive requests to address geese during those months when migratory geese could be present in the State. WS anticipates that requests for the lethal take of geese during those months when geese present in the State may be migratory geese would occur primarily at airports where geese can pose a threat to human safety and to property. However, WS could receive requests to reduce damage or threats to other resources during those months. Based on an increase in the number of requests received for the lethal take of geese during those periods of time when migratory geese may be present in the State, WS may take up to 200 geese annually during those periods when migratory geese could be present in the State.

Under frameworks for the harvest of waterfowl developed by the USFWS, the NCWRC allows hunters to harvest Canada geese during regulated seasons in the State. From 2011 through 2016, hunters harvested an estimated 210,200 geese, or an average of 35,033 geese per year, in the State during the regular season when those geese present in the State could be migratory (see Table 4.2). For example, Klimstra and Padding (2012) estimated that 38% of the geese harvested in the Atlantic Flyway during the regular waterfowl hunting seasons were migratory geese.

Cumulative impacts of the proposed action on migratory Canada geese would be based upon anticipated WS' take, take by other entities under depredation permits, and hunter harvest. The number of migratory geese lethally removed annually in the State is unknown. As shown in Table 4.2, other entities lethally removed 2,718 geese in the State under depredation permits issued by the USFWS, which is an annual removal of 453 geese. The number of those geese that were migratory is unknown. From 2011 to 2016, hunters harvested an average of 35,033 geese annually during the regular hunting season. If 38% of those geese harvested during the regular season between 2011 and 2016 were migratory geese, hunters harvested 13,313 migratory geese per year on average in the State.

WS' take of up to 200 geese that could be migratory would represent 1.5% of the average number of geese taken during the regular hunting season that could also be migratory. If all of the geese lethally removed by other entities under depredation permits were migratory and if 38% of the harvest of geese during the regular waterfowl season were migratory, the annual lethal removal of 200 geese by WS would represent 1.5% of the cumulative removal. McAlister et al. (2017) estimated that hunters harvested 1,192 geese that were migratory and nonlocal, temperate-nesting geese during the 2014 hunting season for Canada geese in the State. The take of up to 200 geese that could be migratory by WS would represent 16.8% of the 1,192 migratory geese estimated by McAlister et al. (2017).

The number of migratory geese potentially removed by WS on an annual basis in North Carolina is likely to be relatively low. The majority of WS' lethal activities would occur when migratory geese were not present in the State (*i.e*., from April through August). Most, if not all, of damage management activities that WS could conduct under this alternative would involve the resident Canada geese population. WS' proposed take is of low magnitude when compared with the number of geese that people harvest annually in the State. WS' limited proposed take would not limit the ability of people to harvest Canada geese in the State based on the limited portion of the overall take that could occur by WS and the locations where WS conducts activities. The take of migratory Canada geese could only occur when authorized through the issuance of depredation permits by the USFWS and the NCWRC. The permitting of the take by the USFWS pursuant to the MBTA and the NCWRC would ensure take by WS and by other entities occurred within allowable take levels to achieve the desired population objectives for geese.

MALLARD BIOLOGY AND POPULATION IMPACTS ANALYSIS

Found across most of North America, the mallard is the most abundant and one of the most recognizable waterfowl species (Drilling et al. 2002). In North Carolina, mallards occur statewide throughout the year (Drilling et al. 2002). Mallards are often associated with wetlands, streams, ponds, and lakes; however, mallards are flexible and adaptable and can occur in a variety of habitats (Drilling et al. 2002). An omnivorous and opportunistic duck, mallards will consume a wide variety of invertebrates, vegetation, seeds, and human provided food (Drilling et al. 2002). With the exception of the mating season, mallards are highly social, congregating in flocks that can number in the thousands during the winter and during the spring and fall migrations (Drilling et al. 2002).

The number of mallards observed in North Carolina during the BBS has increased an estimated 5.51% each year since 1966 and 3.48% annually from 2005 through 2015 (Sauer et al. 2017). Across all BBS routes surveyed in the United States, the number of mallards observed annually has increased at an estimated rate of 1.6% annually since 1966 (Sauer et al. 2017). Breeding population estimates provided by the USFWS (2017*a*) estimate mallard abundance in areas surveyed during the spring of 2017 to be around 10.5 million mallards, which was 11% lower than the 11.6 million mallards estimated during 2016 and 34% above the long-term average of 7.9 million mallards. The statewide population of mallards is unknown. The number of mallards observed in the State during the CBC has shown a general decreasing trend since 1966 (National Audubon Society 2010).

In North Carolina, most requests for assistance involving mallards are associated with alleviating damage to property (*e.g.*, turf and landscaping), unsightly accumulations of feces, or threats to human safety at airports. Table 4.3 lists the number of mallards addressed by WS from FY 2011 through FY 2016. In addition to the harvest of mallards during the hunting seasons, the WS program in North Carolina lethally removed 24 mallards to alleviate damage from FY 2011 through FY 2016, including two mallards that WS' personnel lethally removed unintentionally during activities targeting other animals. From FY 2011 through FY 2016, the WS program has employed non-lethal harassment methods to disperse 4,918 mallards in the State. Between 2011 and 2016, all other entities lethally removed 35 mallards in the State pursuant to depredation permits issued by the USFWS and the NCWRC.

Table 4.3 – Mallards addressed in North Carolina, 2011 – 2016

Year	Addressed by WS[1]		Other Take[3]	Hunter Harvest[4]		TOTAL TAKE[5]
	Dispersed	Take[2]		Mallard	Domestic Mallard	
2011	8	0	0	36,525	769	**37,294**
2012	14	3	7	42,303	516	**42,829**
2013	339	6	5	24,439	0	**24,450**
2014	1,643	6	8	34,163	985	**35,162**
2015	1,480	7	11	34,770	1,434	**36,222**
2016	1,434	2	4	60,296	239	**60,541**
TOTAL	**4,918**	**24**	**35**	**232,496**	**3,943**	**236,498**

[1]WS' data is reported by federal fiscal year

[2]Includes mallards lethally removed by WS unintentionally during activities targeting other animals

[3]Data reported by calendar year and provided by the USFWS and NCWRC (M. Outlaw, USFWS pers. comm. 2017, and J. Fuller, NCWRC pers. comm. 2017).

[4]Data from Raftovich and Wilkins (2013), Raftovich et al. (2015), and Raftovich et al. (2017)

[5]Total take does not include the number of mallards dispersed by WS

From the number of requests received for assistance previously and in anticipation of additional efforts to manage damage, an annual take of up to 300 mallards by WS could occur under this alternative, which would include the limited take that could occur unintentionally during activities targeting other animals. Between 2011 and 2016, the average number of mallards harvested in the State has been 39,407 mallards and domestic mallards. Based on this average, the annual take of 300 mallards by WS would represent 0.8% of the estimated average harvest in the State.

Under the proposed action, WS could also destroy the nests and/or eggs of mallards as part of an integrated approach to managing damage. WS anticipates that requests for assistance could result in the destruction of up to 50 nests annually in the State, including eggs in the nests. All lethal take or destruction of active nests/eggs by WS would occur pursuant to depredation permits issued by the USFWS and the NCWRC, which would ensure the USFWS and the NCWRC had the opportunity to evaluate the cumulative take of mallards from all known sources when establishing population objectives for mallards. WS would also continue to use non-lethal harassment methods to disperse mallards to alleviate damage. In addition, annual take by WS would not limit the ability of hunters to harvest mallards in the State. WS' proposed take would continue to be a limited component of the overall harvest of mallards occurring annually in the State.

FERAL WATERFOWL BIOLOGY AND POPULATION IMPACT ANALYSIS

Feral waterfowl refers to captive-reared, domestic, of some domestic genetic stock, or domesticated breeds of ducks, geese, and swans. Examples of domestic waterfowl include, but are not limited to mute swans, Muscovy ducks, Pekin ducks, Rouen ducks, Cayuga ducks, Swedish ducks, Chinese geese, Toulouse geese, khaki Campbell ducks, Embden geese, and pilgrim geese. Feral ducks may include a combination of mallards, Muscovy ducks, and mallard-Muscovy hybrids. All domestic ducks, except for Muscovy ducks, originated from the mallard (Drilling et al. 2002).

People have released many waterfowl of domestic or semi-wild genetic backgrounds into rural and urban environments, including numerous species of ducks, geese, and swans. Selective breeding has resulted in the development of numerous domestic varieties of the mallard that no longer exhibit the external characteristics or coloration of their wild mallard ancestors. An example of a feral duck is the "*urban*" mallard duck. The coloration of the feathers of urban ducks can be highly variable and often does not resemble that of the wild mallard. Urban mallard ducks in the State often display a variety of physical characteristics. For example, males may be missing the white neck ring or the neck ring will be an inch wide instead of the narrow 1/4 inch wide ring found on wild mallards. Males may have purple heads instead of green heads and heavily mottled breast feathers while females may have a blonde coloration instead of mottled brown. The bills of females may be small and black instead of orange mottled with black and either sex may have white coloration on the wings, tail, or body feathers. In addition, urban ducks may weigh more than wild ducks.

Domestic waterfowl have been purchased and released by property owners for their aesthetic value or as a food source, but may not always remain at the release sites; thereby, becoming feral. Feral waterfowl are domestic species of waterfowl that cannot be linked to a specific ownership. Examples of areas where people have released domestic waterfowl are business parks, universities, wildlife management areas, recreational parks, military bases, residential communities, and housing developments. Many times, people release those birds with no regard or understanding of the consequences that releasing domestic waterfowl can have on the environment or the local community.

Federal law does not protect domestic varieties of waterfowl (see 50 CFR 21), nor are domestic waterfowl specifically protected by State law in North Carolina. Domestic and feral waterfowl in the State may be of mixed heritage and may show feather coloration of wild waterfowl. Some domestic and feral ducks are incapable of sustained flight, while some are incapable of flight at all due to hybridization. Domestic waterfowl may at times crossbreed with migratory waterfowl species creating a hybrid cross breed (*e.g.*, mallard X domestic duck, Canada goose X domestic goose). WS would address those types of hybrid waterfowl species in accordance with definitions and regulations provided in 50 CFR 10 and 50 CFR 21.

Feral domestic ducks, geese, and swans are non-indigenous species considered by many wildlife biologists and ornithologists to be an undesirable component of North American wild and native ecosystems. Any reduction in the number of those domestic waterfowl species could provide some benefit to other native bird species because they compete with native wildlife for resources. Domestic and feral waterfowl usually occur near water, such as ponds, lakes, retaining pools, and waterways. Domestic and feral waterfowl generally reside in the same area throughout the year with little to no migration occurring. Currently, there are no population estimates for domestic and feral waterfowl in North Carolina. Federal and State laws do not protect domestic and feral waterfowl from take and are not considered for population goal requirements, including the MBTA, except for certain portions of the Muscovy duck population.

The Muscovy ducks located in the State are from non-migratory populations that originated from domestic stock. Because Muscovy ducks occur naturally in southern Texas, the USFWS has added the species to the list of migratory birds provided protections under the MBTA; however, people have introduced the domesticated Muscovy duck into other parts of the United States where Muscovy ducks are not native, including the State of North Carolina. The USFWS now prohibits sale, transfer, or propagation of Muscovy ducks for hunting and any other purpose other than food production and allows their removal in locations where the species does not occur naturally in United States, including North Carolina. The USFWS has revised 50 CFR 21.14 (permit exceptions for captive-bred migratory waterfowl other than mallards), 50 CFR 21.25 (waterfowl sale and disposal permits), and has added 50 CFR 21.54, a control order to allow the take of Muscovy ducks, their nests, and eggs without a permit.

People introduced mute swans to North America in the 1800s for their aesthetic value (Ciaranca et al. 1997). The bright, orange-red bill distinguishes the mute swan from the native trumpeter swans and tundra swans, both of which have black bills. This adaptable species can occur in a variety of aquatic habitats from municipal parks, coastal ponds, lakes, and slow-moving rivers (Ciaranca et al. 1997). There are some concerns regarding the effects on native ecosystems (*e.g.*, overgrazing of aquatic vegetation, displacing native waterfowl, and contamination of water supplies with fecal waste) from mute swans (Ciaranca et al. 1997). Due to the species' non-native status, the MBTA does not afford protection to the species and people can remove mute swans at any time without a depredation permit from the USFWS. From FY 2011 through FY 2016, WS employed lethal methods to address 35 feral waterfowl. The number of feral waterfowl addressed by other entities in the State is currently unknown. The reporting of feral waterfowl take is not currently required.

Based on previous efforts to alleviate the threat of damage associated with feral waterfowl and in anticipation of continued release or escape from captivity, WS could lethally remove up to 200 feral waterfowl annually in the State. In addition, WS could destroy up to 100 feral waterfowl nests and eggs annually, when requested. The number of feral waterfowl present in the State is currently unknown, but because feral waterfowl often compete with native wildlife species for resources, any reduction of the feral waterfowl population in the State, even to the extent of complete eradication from the natural environment, could provide some benefit.

WILD TURKEY BIOLOGY AND POPULATION IMPACT ANALYSIS

A non-migratory bird, wild turkeys can be found from southern Canada south across the United States (McRoberts et al. 2014). Wild turkeys found in North Carolina consist of the eastern wild turkey subspecies that is endemic to the eastern half of the United States (Kennamer 2010). The eastern wild turkey can be found in 38 States and four Canadian provinces, ranging from southern Canada and New England to northern Florida and west to Texas, Missouri, Iowa, and Minnesota (Kennamer 2010). There are five distinct subspecies of wild turkeys in North America, with the Eastern wild turkey subpopulation being the most abundant and most widely distributed. In the Eastern United States, wild turkeys inhabit hardwood, mixed, and pine forests foraging on a variety of acorns, fruit, seeds, and insects. Turkeys are permanent residents in States where they are present and are non-migratory. There are an estimated 6 million to 6.1 million wild turkeys in the United States and Canada (National Wild Turkey Federation 2016).

Once nearly extirpated from the State from over-hunting and habitat loss, the wild turkey now occurs nearly statewide in suitable habitat. From the 1950s through 2005, the NCWRC released more than 6,000 wild turkeys in the State, which resulted in the reestablishment of wild turkey populations across the State. Turkeys now occupy all 100 counties of the State. The number of turkeys observed in areas surveyed in the State during the BBS has shown an increasing trend estimated at 12.92% since 1966, with a 14.5% annual increase observed from 2005 through 2015 (Sauer et al. 2017). The number of turkeys observed in areas of the State surveyed during the CBC has been cyclical but has shown an overall increasing trend since 1966 (National Audubon Society 2010). The turkey population in the State in 1970 was approximately 2,000 turkeys. The wild turkey population has increased from an estimated 2,000 birds in 1970 to an estimated 265,000 birds in 2015 (NCWRC 2015*b*). Wild turkeys now occur throughout the State in suitable habitat with populations continuing to increase in many parts of the State (C. Kreh, NCWRC pers. comm. 2016).

The NCWRC allows people to harvest turkeys during an annual hunting season. Figure 4.1 shows the reported turkey harvest in the State during the annual hunting season from 2011 through 2016. People have harvested an estimated 101,008 turkeys in the State between 2011 and 2016, which is an annual average of 16,835 turkeys. The highest annual reported harvest occurred during 2013 when people harvested 18,409 turkeys in the State while the lowest annual harvest occurred in 2011 when people harvested 14,476 turkeys in the State. Figure 4.1 shows the reported harvest by hunters in the State, which are legally required to report their harvest via phone or internet. The NCWRC also estimates harvest for turkeys through an annual mail survey. Estimated harvest through the annual mail survey is normally substantially higher than reported harvest.

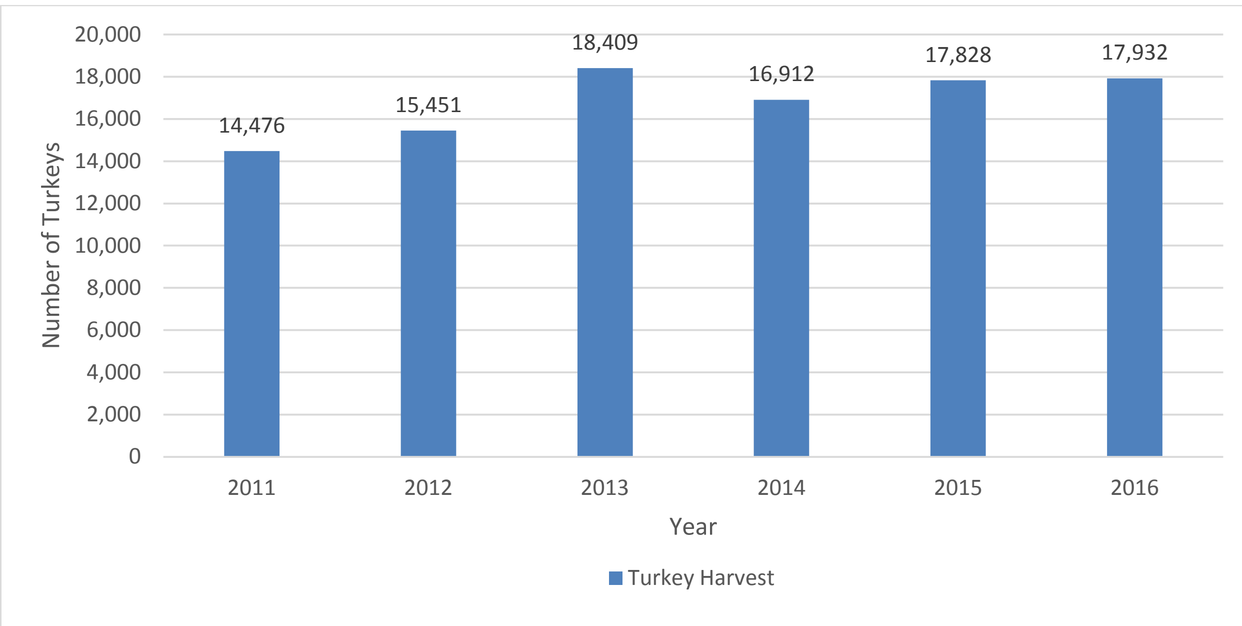

Figure 4.1 – Reported harvest of wild turkeys in North Carolina during the spring hunting season, 2011-2016

Because wild turkeys are non-migratory, they are permanent residents in States where they are present and the MBTA does not afford protection to non-migratory bird species. Therefore, the overall management of the species is the responsibility of the individual states where they occur. The NCWRC manages and regulates wild turkeys as a game species in North Carolina. Because the MBTA does not provide protection to turkeys, the lethal take of turkeys does not require a depredation permit from the USFWS.

Requests for assistance received by the WS program in North Carolina to manage damage or threats of damage associated with wild turkeys occur primarily at airports where turkeys can pose strike risks to aircraft by feeding or loafing on active runways and/or taxiways or moving across runways and/or taxiways. Turkeys can also cause damage to windows, siding, and vehicles when turkeys, primarily males during the breeding season, mistake their reflection as another turkey and attempt to attack the image, which can scratch paint on vehicles and siding on houses.

Between FY 2011 and FY 2016, WS has dispersed 1,346 turkeys to manage damage or threats of damage occurring within the State. In addition, WS has also employed lethal methods to remove 14 wild turkeys in the State between FY 2011 and FY 2016. The removal of wild turkeys by WS to alleviate damage or threats of damage primarily occurred at airports in the State where those turkeys posed a threat of aircraft strikes.

Based on previous requests for assistance and in anticipation of receiving an increasing number of requests for assistance as the turkey population increases, WS could lethally take up to 30 wild turkeys annually under this alternative. With a statewide population estimated at 265,000 turkeys, the lethal removal of up to 30 turkeys by WS would represent 0.01% of the estimated statewide population if the population in the State remains at least stable. As shown in Figure 4.1, during the annual harvest season, the lowest annual reported harvest occurred in 2011 when people harvested 14,476 turkeys in the State. People have harvested an average of 16,835 turkeys per year between 2011 and 2016. If WS had lethally removed 30 turkeys in FY 2011, the removal would have represented 0.2% of the number of turkeys harvested in the State in 2011. The lethal removal of 30 turkeys by WS would represent 0.2% of the average number of turkeys harvested in the State during the annual hunting season. The lethal removal of wild turkeys in the State by WS would only occur when authorized by the NCWRC and only at levels authorized by the NCWRC.

WS anticipates that most requests for assistance will continue to be primarily associated with threats occurring at airports where turkeys pose as a strike risk to aircraft. Airports and air facilities are generally restricted areas and are not open to public use, including hunting. Therefore, if WS implemented this alternative, the potential removal of turkeys by WS would not limit the ability of people to harvest turkeys in the State because WS would primarily remove turkeys at airports and air facilities in the State. When compared to the estimated statewide population and the number of turkeys that people harvest in the State, the potential removal of up to 30 turkeys by WS to alleviate damage would be of low magnitude.

ROCK PIGEON BIOLOGY AND POPULATION IMPACT ANALYSIS

Rock pigeons are a non-indigenous species that European settlers first introduced into the United States as a domestic bird for sport, carrying messages, and as a source of food (Schorger 1952, Lowther and Johnston 2014). Many of those birds escaped and eventually formed the feral pigeon populations that now occur throughout the United States, southern Canada, and Mexico (Lowther and Johnston 2014). Because pigeons are an introduced species and not native to North America, the MBTA does not provide the pigeon protection from take and take can occur at any time.

Pigeons are non-migratory and closely associated with people where human structures and activities provide them with food and sites for roosting, loafing, and nesting (Williams and Corrigan 1994, Lowther and Johnston 2014). Thus, pigeons can be common around city buildings, bridges, parks, farmyards, grain elevators, feed mills, and other manmade structures (Williams and Corrigan 1994, Lowther and Johnston 2014). Additionally, although pigeons are primarily grain and seed eaters, they will readily feed on garbage, livestock manure, spilled grains, insects, and any other available bits of food (Williams and Corrigan 1994, Lowther and Johnston 2014).

The number of pigeons observed along routes surveyed during the BBS in the State have shown a decreasing trend since 1966, which has been estimated at -1.10% annually. However, from 2005 through 2015, the number of rock pigeons observed during the BBS show an increasing trend estimated at 1.21% annually (Sauer et al. 2017). Based on data from the BBS, the Partners in Flight Science Committee (2013) estimated the statewide breeding population at 90,000 pigeons. The number of pigeons observed in areas surveyed during the CBC is showing a general increasing trend in the State since 1966; however, since the late 1990s, the number of rock pigeons observed during the CBC has shown a general declining trend (National Audubon Society 2010).

Between FY 2011 and FY 2016, WS employed non-lethal harassment methods to disperse 4,906 rock pigeons to alleviate damage or threats of damage and employed lethal methods to remove 585 pigeons (see Table 4.4). Requests for assistance received by WS often arise from airports where the gregarious flocking behavior of pigeons can pose risks to aircraft at or near airports. Pigeons also cause damaging situations when the buildup of their droppings at nesting and roosting sites pose a health risk to the public, for example at a sport facility.

Table 4.4 –Rock pigeons addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed
2011	167	537
2012	71	920
2013	34	1,302
2014	45	1,012
2015	101	492
2016	167	643
TOTAL	**585**	**4,906**

Because the MBTA does not afford pigeons protection from any take, the take of pigeons to alleviate damage or to reduce threats can occur without the need for a depredation permit from the USFWS or the NCWRC; therefore, take by other entities in North Carolina is unknown. Because pigeons are a non-native species that often competes with native wildlife species for food and habitat, any take that occurs could provide some benefit to the native environment in North Carolina.

Based on the gregarious behavior of pigeons (*i.e.*, forming large flocks) and in anticipation of the number of requests received by WS to increase, WS could annually take up to 3,000 rock pigeons and up to 500 nests annually to alleviate damage or threats throughout the State. Based on a breeding population estimated at 90,000 pigeons, take of up to 3,000 pigeons by WS would represent 3.3% of the estimated statewide breeding population. As previously stated, pigeons are a non-native species and any removal of pigeons could improve conditions and reduce competition for food and habitat between pigeons and native species. Activities conducted by WS would be pursuant to Executive Order 13112 to reduce invasion of exotic species and the associated damages.

MOURNING DOVE BIOLOGY AND POPULATION IMPACT ANALYSIS

Mourning doves are migratory game birds with substantial populations throughout much of North America. They occur in all 48 contiguous states of the United States and the southern portions of Canada with the northern populations being more migratory than the southern populations (Otis et al. 2008). LeGrand et al. (2017) considered mourning doves to be permanent residents within North Carolina that were common to very common in all regions of the State.

According to trend data provided by Sauer et al. (2017), the number of mourning doves observed on routes surveyed in the State has shown an increasing trend of 0.40% since 1966, with an estimated annual increase of 0.48% occurring from 2005 through 2015. Between 2007 and 2016, Seamans (2017) estimated the mourning dove population increased annually in the State at a rate of 0.3% using data from the BBS. Based on BBS data, the Partners in Flight Science Committee (2013) estimated the statewide breeding population at 2.1 million mourning doves. The number of mourning doves observed in areas of the State surveyed during the CBC has shown a general declining trend since 1966 (National Audubon Society 2010).

Many states have regulated annual hunting seasons for doves with generous bag limits, including North Carolina. Hunters harvested nearly 13.2 million mourning doves during the 2015 hunting season and 13.5 million doves during the 2016 hunting season (Raftovich et al. 2017). In North Carolina, hunters harvested 734,300 doves during the 2015 hunting season and 662,300 doves during the 2016 hunting season (Raftovich et al. 2017). Table 4.5 shows the number of doves harvested in North Carolina during the annual hunting season from 2011 through 2016.

From FY 2011 through FY 2016, WS has addressed 46,579 doves to alleviate damage and threats (see Table 4.5). Of those doves addressed by WS from FY 2011 through FY 2016, WS lethally removed 4,750 doves while WS dispersed 41,829 doves using non-lethal methods. Requests for assistance received by WS often arise from airports where the gregarious flocking behavior of doves can pose risks to aircraft at or near airports. Migrating doves often augment local populations of mourning doves in the State during the migration periods and during the winter months. WS could also receive requests for assistance to alleviate threats or damage to electrical utilities from roosting mourning doves.

From 2011 through 2016, other entities reported removing 4,881 mourning doves pursuant to depredation permits issued by the USFWS and the NCWRC. Therefore, on average, other entities reported the lethal removal of 814 doves per year in the State pursuant to depredation permits issued by the USFWS and the NCWRC. The highest annual reported take of mourning doves by other entities occurred in 2012 when other entities reported the take of 1,548 doves.

The USFWS publishes a report on the population status of mourning doves annually based upon survey data. The USFWS reported an estimated population of 62.3 million to 102.4 million mourning doves in the Eastern Management Unit[18] over the past ten years, and there was no evidence of change in dove abundance in the Unit (Seamans 2017). All estimates from the surveys seem to reveal a stable mourning dove population throughout the eastern United States (Seamans 2017).

Table 4.5 – Mourning doves addressed in North Carolina, 2011-2016

Year	Dispersed by WS[1]	Take of Mourning Doves			TOTAL TAKE
		WS' Take[1]	Other Take[2]	Hunter Harvest[2,3]	
2011	2,954	906	652	719,800	**721,358**
2012	2,231	758	1,548	1,020,600	**1,022,906**
2013	10,640	982	815	555,200	**556,997**
2014	7,734	763	718	626,100	**627,581**
2015	9,987	740	842	734,300	**735,882**
2016	8,283	601	306	662,300	**663,207**
TOTAL	**41,829**	**4,750**	**4,881**	**4,318,300**	**4,327,931**

[1]WS' data reported by federal fiscal year
[2]Take by other entities besides WS; Data reported by calendar year
[3]Data taken from Raftovich and Wilkins (2013), Raftovich et al. (2015), Raftovich et al. (2017)

Based on the number of requests to manage damage associated with doves received previously and based on the gregarious behavior of doves in the State during the migration periods, up to 2,000 mourning doves could be lethally taken by WS annually in the State to address damage or threats. In addition, WS could destroy up to 100 mourning dove nests annually to alleviate damage or threats of damage.

[18]The Eastern Management Unit consists of those states east of the Mississippi River and includes North Carolina.

The take of 2,000 mourning doves by WS would represent 0.1% of the estimated breeding population in North Carolina and 0.3% of the 662,300 doves that hunters harvested in the State during the 2016 hunting season. As shown in Table 4.5, people have harvested over 4.3 million mourning doves in the State from 2011 through 2016. The lowest harvest levels in the State occurred during 2013 when people harvested 555,200 doves in the State. If WS had lethally removed 2,000 doves in FY 2013, the removal by WS would have represented 0.4% of the number of doves harvested in the State. If WS had lethally removed 2,000 mourning doves annually from 2011 through 2016, WS' annual removal would have ranged from 0.2% to 0.4% of the total take of doves in the State.

If other entities in the State continued to take an average of 814 doves per year under depredation permits issued by the USFWS and the NCWRC, the combined take by WS and by other entities would represent 0.1% of the estimated breeding population in the State and 0.4% of the number of doves harvested during the 2016 season. If take by other entities reached 1,548 doves annually, which was the highest reported take from 2011 through 2016, the combined take by WS and the take by other entities would represent 0.2% of estimated breeding population in the State and 0.5% of the number of doves harvested during the 2016 season. Like other bird species, the take of mourning doves by WS to alleviate damage would only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits and when authorized by the NCWRC. Therefore, the take of mourning doves by WS would only occur at levels authorized by the USFWS and the NCWRC, which ensures the USFWS and the NCWRC have the opportunity to consider WS' take and take by all entities, including hunter harvest, to achieve the desired population management levels of doves in North Carolina.

AMERICAN COOT BIOLOGY AND POPULATION IMPACT ANALYSIS

American coots are the most abundant and widely distributed species of rail in North America (Brisbin and Mowbray 2002). Coots are also likely one of the most recognizable rail species in the United States with their boisterous behaviors and vocalizations. Coots commonly occur on a variety of freshwater wetlands near the shoreline where they often are foraging in cattails, bulrushes, and reeds (Brisbin and Mowbray 2002).

LeGrand et al. (2017) indicated that American coots are primarily a winter resident in North Carolina and a sporadic breeder with the highest concentrations occurring in the eastern portion of the State. Although coots may be present in the State during the breeding season, most coots present in the State during the breeding season are likely non-breeders. Therefore, data from the BBS is not available for North Carolina. Across all BBS routes surveyed in the United States, the number of coots observed has shown a declining trend estimated at -1.01% annually since 1966; however, from 2005 through 2015, the number of coots observed has increased 6.67% annually (Sauer et al. 2017). The number of coots observed in the Eastern BBS Region, which includes North Carolina, has shown an annual decline of -2.03% between 1966 and 2015 and a -1.79% annual decline from 2005 through 2015 (Sauer et al. 2017). From 1966 to 2016, the number of coots observed in areas of the state surveyed during the CBC has shown a general stable to slightly increasing trend (National Audubon Society 2010).

Requests for assistance that WS has received regarding coots have occurred during the migration periods when coots are concentrated in larger numbers across the State. From FY 2011 through FY 2016, the WS program in North Carolina employed lethal methods to remove 38 American coot in the State, and used non-lethal methods to disperse 1,246 coots to alleviate damage or threats of damage (see Table 4.6). Based on previous requests for assistance associated with coots, the flocking behavior of coots during the migration periods, and in anticipation of additional efforts to address damage or threats associated with coots, the WS program could lethally remove up to 100 coots per year under this alternative.

Table 4.6 – American coots addressed in North Carolina, 2011 - 2016

Year	Dispersed by WS[1]	Take of American Coots: WS' Take[1]	Other Take[2]	Hunter Harvest[3]	TOTAL TAKE
2011	0	0	0	6,300	**6,300**
2012	0	0	0	400	**400**
2013	0	0	0	11,700	**11,700**
2014	250	0	2	1,500	**1,502**
2015	16	1	5	0	**6**
2016	980	37	11	0	**48**
TOTAL	**1,246**	**38**	**18**	**19,900**	**19,956**

[1]WS' data reported by federal fiscal year

[2]Data reported by calendar year and provided by the USFWS (M. Outlaw, USFWS pers. comm. 2017).

[3]Data taken from Raftovich and Wilkins (2013), Raftovich et al. (2015), Raftovich et al. (2017)

In addition to take by WS, other entities reported the lethal removal of 18 American coots from 2011 through 2016 to alleviate damage or threats of damage. American coots maintain sufficient densities within North America to allow for annual hunting seasons. In North Carolina, people can harvest coots during a regulated hunting season under frameworks established by the USFWS and implemented in the State by the NCWRC. In the United States, hunters harvested 253,200 coots during the 2015 hunting season and 138,200 coots during the 2016 season (Raftovich et al. 2017). Raftovich et al. (2017) estimated that no harvest of American coots occurred in North Carolina during the 2015 and the 2016 hunting season.

During the CBC conducted in 2016, observers counted 8,621 coots in areas of the State surveyed, which compares to 6,014 coots observed during the CBC conducted in 2015 (National Audubon Society 2010). On average, observers counted 9,226 coots per year from 2007 through 2016 in areas of the State surveyed during the CBC with the highest annual count occurring in 2007 when observers recorded 23,502 coots. The lowest annual count occurred in 2009 when observers counted 3,602 coots (National Audubon Society 2010). If WS lethally removed 100 coots, the take would represent 1.1% of the average number of coots observed in areas of the State surveyed from 2007 through 2016 during the CBC. The lethal take of 100 coots by WS would represent 2.8% of the 3,602 coots observed in areas surveyed during the CBC in 2009, which is the lowest annual count from 2007 through 2016.

CBC data provides as an indication of long-term trends in the number of birds observed wintering in the State and does not represent population estimates of wintering bird populations because people only count birds in a very small percentage of the land area within the State. However, the analysis compares the number of coots observed in the State during the CBC with WS' proposed take to evaluate the magnitude of the take. The CBC would be a minimum population estimate given the survey parameters of the CBC and the survey covering only a small portion of the State. Therefore, the proposed annual take of up to 100 coots would represent a smaller percentage of the actual wintering population in the State. Like all bird species, the actual number of coots present in the State likely fluctuates throughout the year and varies from year to year.

People harvested 19,900 coots in the State between 2011 and 2016, which is an average harvest of 3,317 coots. However, Raftovich et al. (2017) estimated that no harvest of American coots occurred in the State during the 2015 and the 2016 hunting season. Therefore, hunters harvested an average of 4,975 American coots in the State from the 2011 through the 2014 hunting seasons. If the WS program in North Carolina implemented this alternative, the lethal removal of up to 100 coots would represent 3.0% of the average number of coots harvested in the State by hunters from 2011 through 2016 and 2.0% of the average number of coots harvested from 2011 through 2014.

Like other bird species, the take of American coots by WS to alleviate damage would only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits and when authorized by the NCWRC. Therefore, the take of coots by WS would only occur at levels authorized by USFWS and the NCWRC, which ensures the USFWS and the NCWRC have the opportunity to consider WS' take and take by all entities, including hunter harvest, to achieve the desired population management levels of coots in North Carolina. Based on the low magnitude of take that could occur annually by WS, the lethal removal of coots by the WS program in North Carolina would not limit the ability of people to harvest coots during the annual hunting season in the State.

KILLDEER BIOLOGY AND POPULATION IMPACT ANALYSIS

Killdeer occur over much of North America from the Gulf of Alaska southward throughout the United States and extending from the Atlantic Coast to the Pacific Coast (Hayman et al. 1986, Jackson and Jackson 2000). Although killdeer are technically in the family of shorebirds, they are unusual shorebirds in that they often nest and live far from water. Killdeer commonly occur in a variety of open areas, even concrete or asphalt parking lots at shopping malls, as well as fields and beaches, ponds, lakes, roadside ditches, mudflats, airports, pastures, and gravel roads and levees but they seldom occur in large flocks. Killdeer use those open habitats to prepare a ground scrape where they lay their eggs (Jackson and Jackson 2000).

Killdeer are present statewide throughout the year with northern migrants arriving in the State during the annual migration periods (Jackson and Jackson 2000, LeGrand et al. 2017). Since 1966, the number of killdeer observed during the breeding season in the State has shown an increasing trend estimated at 5.17% annually, with a 0.25% annual increase estimated between 2005 and 2015 (Sauer et al. 2017). In those areas of the State surveyed during the CBC, the number of killdeer observed has shown a general stable to increasing trend between 1966 and 2016 (National Audubon Society 2010). A breeding population estimate from the Partners in Flight landbird database is not available for North Carolina (Partners in Flight Science Committee 2013). Based on broad-scale surveys, the United States Shorebird Conservation Plan estimated the population of killdeer in the United States to be approximately 2 million birds in 2001 (Brown et al. 2001).

Requests for assistance associated with killdeer occur primarily at airports in the State. In the United States, there have been reports of 4,509 aircraft strikes involving killdeer from 1990 through 2015 (Dolbeer et al. 2016). Those aircraft strikes resulted in 949 hours of aircraft downtown and required nearly $4.1 million in repairs to aircraft (Dolbeer et al. 2016). In North Carolina, there have been 88 reports of aircraft striking killdeer at airports in the State from January 1990 through August 2016 (FAA 2017).

Between FY 2011 and FY 2016, the WS program in North Carolina employed non-lethal methods to disperse 8,772 killdeer to alleviate threats of damage (see Table 4.7). In addition, the WS program employed firearms to remove 688 killdeer from FY 2011 through FY 2016. WS would continue to use primarily non-lethal methods to address requests for assistance involving killdeer. Based on previous requests for assistance to manage damage associated with killdeer and in anticipation of additional efforts to reduce aircraft strike risks involving killdeer, WS could lethally take up to 250 killdeer annually in the State to alleviate damage and threats when non-lethal techniques were unsuccessful.

In addition, WS' personnel could destroy up to 100 killdeer nests annually. Destroying the nests could cause killdeer to abandon the nesting location and disperse from the site. Eggs would be destroyed using addling and by breaking open the eggs. WS' personnel would remove nests by hand and/or using hand tools. Egg laying in killdeer occurs from March through October with mid-March through mid-July being the primary period when they lay eggs (Jackson and Jackson 2000). Nestlings can be present in nests from late March through mid-November with the peak occurring from early-April through early August (Jackson and Jackson 2000). The removal of the nest and eggs would occur in an attempt to cause the killdeer to abandon the nest site and to disperse from the area. The MBTA prohibits the take of active killdeer nests, including the removal of killdeer eggs, unless the USFWS authorizes the take through the issuance of a depredation permit.

Table 4.7 – Killdeer addressed in North Carolina, 2011 – 2016

Year	Dispersed by WS[1]	Take of Killdeer		TOTAL TAKE
		WS' Take[1]	Other Take[2]	
2011	876	115	96	**211**
2012	470	72	70	**142**
2013	781	109	133	**242**
2014	2,831	125	166	**291**
2015	1,404	110	126	**236**
2016	2,410	157	15	**172**
TOTAL	**8,772**	**688**	**606**	**1,294**

[1]WS' data reported by federal fiscal year

[2]Data reported by calendar year and provided by the USFWS (M. Outlaw, USFWS pers. comm. 2017).

From 2011 through 2016, other entities reported removing 606 killdeer pursuant to depredation permits issued by the USFWS and the NCWRC. Therefore, on average, other entities reported the lethal removal of 101 killdeer per year in the State pursuant to depredation permits issued by the USFWS and the NCWRC. The highest annual reported take of killdeer by other entities occurred in 2014 when other entities reported the take of 166 killdeer.

Most requests for assistance that occur during the breeding season would be associated with the nesting behavior of killdeer; therefore, direct operational assistance would likely involve the removal of a nest prior to egg laying or prior to the eggs hatching. In many cases, requests for assistance that occur during the breeding season would not involve the lethal removal of a breeding adult killdeer or a breeding pair of killdeer. However, an entity could request that WS euthanize nestlings when found in a nest. The clutch size for killdeer is typically four eggs (Jackson and Jackson 2000). Therefore, WS could address up to four killdeer eggs and/or nestlings when removing a nest. The destruction of a limited number of nests and eggs generally does not have an adverse effect on bird populations.

With a population estimated at two million killdeer in the United States, the take of up to 250 killdeer by WS in North Carolina would represent 0.01% of the population. Although a population estimate is not available for North Carolina, survey data from the BBS and the CBC show increasing trends since 1966. Like other bird species, the actual population in the State likely fluctuates throughout the year.

Given the increasing population trends for killdeer in the State and the limited take proposed by WS to alleviate damage and threats, WS' proposed take should not have an adverse effect on killdeer populations. The take of killdeer could only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the NCWRC. The permitting of take by the USFWS pursuant to the MBTA and the NCWRC would ensure take by WS and other entities occurred within allowable take levels to achieve desired population objectives for killdeer. The destruction of a limited number of nests, including eggs that may be in active nests, generally has no adverse effects on bird populations. WS would continue to assist airport personnel in identifying habitat and other attractants to killdeer on airport property. Killdeer would continue to be addressed using primarily non-lethal harassment and dispersal methods. All take of killdeer would occur within the levels permitted by the USFWS pursuant to the MBTA and authorized by the NCWRC.

UPLAND SANDPIPER BIOLOGY AND POPULATION IMPACT ANALYSIS

Unlike most shorebirds that are associated with water, upland sandpipers are associated with grassland habitats (Houston et al. 2011). Upland sandpipers are a grassland breeding species associated with the prairie regions of south central Canada and the northern United States extending from the Rocky Mountains across the Great Lakes region into the northeastern United States. Isolated breeding populations also occur in the high-altitude meadows west of the Rocky Mountains with breeding populations also occurring in Alaska and extreme northwest Canada (Houston et al. 2011). Populations likely expanded eastward as settlers cleared forests for agricultural purposes and was a locally common breeder in the northeastern United States around the 1860s. However, populations soon began a rapid decline from excessive market hunting and habitat loss across their breeding and wintering range (Houston et al. 2011). Although populations began to rebound following a prohibition on hunting sandpipers in the early 1900s, populations have not reached prior levels as habitat loss accelerated due to the conversion of native grasslands to farmland, changes in agricultural practices, and human development (Houston et al. 2011).

Today, some of the largest breeding populations of upland sandpipers in the northeastern United States occur at airports (Houston et al. 2011). The open grassland environments associated with airports are often attractive to upland sandpipers. Houston et al. (2011) stated, "*…airports now supply half or more of this species' nesting sites in several northeastern U.S. states, where larger, contiguous tracts of grasslands are otherwise in short supply*". Upland sandpipers generally begin arriving on their breeding grounds in April and depart by August after chicks have fledged (Houston et al. 2011). Upland sandpipers nest in loose colonies and feed, rest, and fly in small groups (Houston et al. 2011). As soon as hatchlings are able to fly, birds begin to form small flocks of 10 to 25 individuals (Houston et al. 2011). Their diet consists primarily of invertebrates, mostly insects (Houston et al. 2011).

Across all routes surveyed during the BBS, the number of upland sandpipers observed has shown an annual increasing trend estimated at 0.4% since 1966, with a 1.5% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). Along routes surveyed during the BBS in the United States, the number of upland sandpipers are showing increasing trends estimated at 0.52% annually since 1966, with a 1.37% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). However, the number of upland sandpipers observed along all routes surveyed across the Eastern BBS Region have shown declining trends estimated at -4.16% annually since 1966 and -2.5% annually between 2005 and 2015 (Sauer et al. 2017). Brown et al. (2001) ranked the upland sandpiper as a "*species of high concern*" and estimated the upland sandpiper population to be 350,000 birds with a target population objective of 470,000 birds. Hunter et al. (2002) estimated the upland sandpiper population in the southeastern coastal plain and the Caribbean to be 10,500 sandpipers and assigned a "*high*" priority level to sandpipers in the region.

Upland sandpipers migrate through North Carolina during the spring and fall, with no known breeding or wintering populations occurring in the State (LeGrand et al. 2017). During the migration periods, upland sandpipers found in North Carolina occur in short to medium grass in upland habitats, such as pastures, grasslands at airports, large lawns, and large turf farms (LeGrand et al. 2017). Upland sandpipers tend to migrate through the State inland more during the spring and more toward the coast during the fall migration (LeGrand et al. 2017). The peak period for sandpipers passing through the State during the spring migration appears to be mid-April while the peak periods during the fall occur from late July through early September (LeGrand et al. 2017). However, LeGrand et al. (2017) considered sandpipers rare to locally uncommon in the State during the migration periods, depending on the migration period and location. Sandpipers are most common in the fall along the Tidewater and coastal areas of the State, with the biggest concentrations occurring at airports in late summer and early fall (LeGrand et al. 2017). However, the number of upland sandpipers that migrate through the State annually is unknown.

Requests for assistance associated with upland sandpipers originate from airports in the State where migrants can pose aircraft strike hazards. From 1999 through 2015, Dolbeer et al. (2016) identified 233 reported records involving civil aircraft striking upland sandpipers in the United States. Dolbeer et al. (2016) also indicated seven of those strikes resulted in damage to the aircraft and seven strikes had a negative effect on the flight of the aircraft. In addition, 21 reported strikes involved a civil aircraft striking multiple upland sandpipers at once (Dolbeer et al. 2016).

From FY 2011 through FY 2016, WS lethally removed 59 upland sandpipers in the State to reduce threats associated with aircraft striking sandpipers with the highest take occurring in FY 2012 when WS' personnel lethally removed 22 upland sandpipers (see Table 4.8). WS also employed non-lethal methods to disperse 119 sandpipers between FY 2011 and FY 2016 in the State to alleviate damage threats. The take of upland sandpipers by WS from FY 2011 through FY 2016 occurred pursuant to depredation permits issued to other entities in the State where WS' personnel were acting as agents of the entity granted a permit by the USFWS and the NCWRC. The USFWS did not receive reports of additional upland sandpiper take occurring by other entities from 2011 through 2016.

Table 4.8 – Upland sandpipers addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed
2011	9	5
2012	22	23
2013	18	20
2014	0	2
2015	8	9
2016	2	60
TOTAL	**59**	**119**

WS anticipates continuing to receive requests for assistance from airports and military facilities where upland sandpipers are posing a strike risk to aircraft. Based on the previous number of requests for assistance received by WS and the number of upland sandpipers addressed annually from FY 2011 through FY 2016, WS could lethally remove up to 30 upland sandpipers annually to alleviate damage and threats when non-lethal techniques were unsuccessful.

Upland sandpipers are present in the State during the migration periods and the number of sandpipers present in North Carolina fluctuates. The best available data estimates that the population of upland sandpipers in North America at 350,000 sandpipers (Brown et al. 2001, Hunter et al. 2002). In the southeastern coastal plain region, Hunter et al. (2002) estimated the upland sandpiper population at 10,500 birds. Currently, no other data is available on upland sandpiper populations in North Carolina, including trend information from the BBS or the CBC (National Audubon Society 2010, Sauer et al. 2017). The lethal removal of up to 30 sandpipers by WS to alleviate aircraft strike risks would represent 0.01% of the estimated population in North America and 0.3% of the population estimated in the southeastern coastal plain region. The lethal removal of upland sandpipers would only occur when authorized by the USFWS and the NCWRC and only at permitted levels.

BONAPARTE'S GULL BIOLOGY AND POPULATION IMPACT ANALYSIS

Bonaparte's gulls are a small gull species characterized by their size, pink legs, and black beak (Burger and Gochfeld 2002). Bonaparte's gulls nest in trees of sparsely wooded areas around ponds, bogs, and bays in the taiga and boreal forests of Alaska and northern Canada (Burger and Gochfeld 2002). Bonaparte's gulls are an abundant migrant and winter visitor over much of North America with large flocks occurring in the coastal areas close to human activity. The gulls will also frequent inland lakes and rivers, coastal bays, estuaries, and inshore waters where aquatic organisms comprise a large portion of their diet (Burger and Gochfeld 2002). The spring migration begins in mid-March and continues through the end of May while the fall migration begins in late-July and can continue through January (Burger and Gochfeld 2002). Freezing inland waters during the winter often pushes Bonaparte's gulls further south and toward the coastal areas (Burger and Gochfeld 2002). Non-breeding gulls often linger south of their breeding range during the nesting season (Burger and Gochfeld 2002). Like most gulls, Bonaparte's gulls are highly social. Bonaparte's gulls form flocks in the tens of thousands to migrate, roost, and forage during the non-breeding season (Burger and Gochfeld 2002).

LeGrand et al. (2017) classified Bonaparte's gulls as transient and a winter resident in North Carolina. During the winter, Bonaparte's gulls occur near the coastal areas of the State, but also occur inland sporadically at larger reservoirs (LeGrand et al. 2017). Peak numbers of gulls along the coast occur in February and March, with peak counts of up to 20,000 gulls occurring (LeGrand et al. 2017). There are no breeding colonies of Bonaparte's gulls in North Carolina. The number of Bonaparte's gulls present in the State during the winter is unknown. The number of Bonaparte's gulls observed in areas surveyed during the CBC conducted annually in the State has shown a cyclical pattern since 1966 but an overall general increasing trend (National Audubon Society 2010). The cyclical pattern is likely a result of the severity of winters and the availability of open water for foraging. Given the gulls isolated breeding location and wide winter distribution, population information is limited. Burger and Gochfeld (2002) indicated the population has "*increased greatly in numbers since early 1990s*". The Mid-Atlantic, New England, Maritimes Waterbird Conservation Plan (2006) estimated the total population of Bonaparte's gulls at 255,000 to 525,000 gulls and assigned a conservation rank of "*moderate concern*" to the total population in North America. BirdLife International (2016) ranks Bonaparte's gulls in a category of "*least concern*" based on their wide geographical distribution, increasing population trend, and large population estimate.

From FY 2011 through FY 2016, WS lethally removed five Bonaparte's gulls in the State to reduce threats associated with aircraft striking gulls with the highest take occurring in FY 2015 when WS' personnel lethally removed four Bonaparte's gulls (see Table 4.9). WS also employed non-lethal methods to disperse 16 gulls between FY 2011 and FY 2016 in the State to alleviate damage threats. In addition, other entities reported the lethal removal of five Bonaparte's gulls in the State from 2011 through 2016 pursuant to depredation permits issued by the USFWS and the NCWRC.

Although requests for assistance associated with Bonaparte's gulls have been infrequent previously, WS could receive additional requests for assistance. Data from the CBC indicates Bonaparte's gulls present in areas of the State surveyed are generally increasing (National Audubon Society 2010); therefore, as the number of gulls present in the state increases, WS could receive additional requests to address gulls when they pose a strike hazard at airfields in the State. In addition, Bonaparte's gulls are a flocking species during the migration periods; therefore, requests for assistance may involve hundreds or thousands of gulls. In anticipation of receiving requests for assistance, WS would continue to employ an integrated methods approach using non-lethal and lethal methods. As stated previously, WS would not employ non-lethal methods at such intensity that adverse effects would occur to the population of Bonaparte's gulls.

Table 4.9 – Bonaparte's gulls addressed in North Carolina, 2011 - 2016

Year	WS' Activities[1]		Other Take[2]
	Take	Dispersed	
2011	0	0	0
2012	0	0	0
2013	1	1	1
2014	0	0	1
2015	4	12	3
2016	0	3	0
TOTAL	**5**	**16**	**5**

[1]WS' data reported by federal fiscal year

[2]Data reported by calendar year and provided by the USFWS (M. Outlaw, USFWS pers. comm. 2017).

To address requests for assistance to manage damage and threats associated with Bonaparte's gulls in the future, WS could remove up to 25 Bonaparte's gulls annually as part of an integrated approach to resolving damage. As stated previously, the number of Bonaparte's gulls present in the State likely fluctuates throughout the year. The best available data estimates the population of Bonaparte's gulls in North America at 255,000 to 525,000 gulls (Mid-Atlantic, New England, Maritimes Waterbird Conservation Plan 2006). Based on this estimate, the annual removal of up to 25 Bonaparte's gulls by WS under this alternative would represent 0.005% to 0.01% of that population. The lethal removal of Bonaparte's gulls can only occur when permitted by the USFWS and the NCWRC through the issuance of depredation permits. Therefore, the USFWS and the NCWRC must authorize all take, including take by WS, and would occur at the discretion of the USFWS and the NCWRC. The take of Bonaparte's gulls would only occur at levels authorized by the USFWS and the NCWRC.

LAUGHING GULL BIOLOGY AND POPULATION IMPACT ANALYSIS

The laughing gull is a common gull species found throughout the year in the southeastern United States with breeding colonies occurring along the coastal areas of the Atlantic Ocean, Gulf of Mexico, and the coastal areas of the Caribbean Islands (Burger 2015). Localized breeding colonies can also occur along the Gulf of California and the Pacific Coast of Mexico (Burger 2015). Characterized by a black hood, laughing gulls are often associated with human activities near coastal areas where food sources are readily available (Burger 2015). Burger (2015) cites several sources that indicate laughing gulls are opportunistic foragers feeding on a wide-range of aquatic and terrestrial invertebrates, small vertebrates, garbage, and plant material, such as berries.

Belant and Dolbeer (1993*a*) estimated the population of breeding laughing gulls in the United States was 258,851 pairs based on state population records. The breeding population estimate by Belant and Dolbeer (1993*a*) did not consider non-breeding and sub-adult gulls. The Waterbird Plan for the Southeastern United States estimated the breeding laughing gull population in the southeastern United States at 170,000 breeding pairs (Hunter et al. 2006). In the Southeastern Coastal Plain (BCR 27), Hunter et al. (2006) estimated the breeding populations of laughing gulls to be 46,300 pairs.

Laughing gulls occur throughout the year along the coastal areas of the State (Belant and Dolbeer 1993*a*, Berger 2015, LeGrand et al. 2017). Nesting colonies occur on coastal islands and man-made structures along the coast. Although not as common, laughing gulls do occur further inland in North Carolina at inland lakes, especially during the migration periods (LeGrand et al. 2017). LeGrand et al. (2017) considered the laughing gull to be a summer breeding and early winter resident in the Coastal Plain region of the State and transient in the Piedmont and Mountain regions of the State. The number of laughing gulls observed in areas of North Carolina surveyed during the BBS has shown an annual increasing trend of 2.25% since 1966, with a 1.09% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). Approximately 17,000 to 22,900 breeding pairs of laughing gulls nested in North Carolina between 1983 and 1989 (Belant and Dolbeer 1993*b*). Hunter et al. (2006) estimated the breeding population of laughing gulls in North Carolina at 32,000 breeding pairs. However, more recent survey data estimated the breeding population at 8,840 breeding pairs in North Carolina (S. Schweitzer, NCWRC, unpublished data, 2017), which would represent 17,680 breeding adult laughing gulls. Therefore, the number of laughing gulls nesting in North Carolina appears to be declining. The breeding population in North Carolina estimated at 8,840 breeding pairs does not include non-breeding laughing gulls that are also present in the State during the breeding season. Dolbeer (1998) estimated that the number of non-breeding laughing gulls equaled about 50% of the nesting population.

The number of gulls present in the State may increase during the migration period as gulls begin arriving within the State. However, the exact population of laughing gulls in North Carolina is currently unknown and likely varies throughout the year and from year to year. The number of laughing gulls observed in areas of the State surveyed during the CBC has shown a general declining trend since 1966 (National Audubon Society 2010). Belant and Dolbeer (1993*b*) estimated a minimum of 230,000 adult laughing gulls might winter in States along the Gulf Coast.

Of the five tiers of action levels for waterbirds in the southeastern United States, Hunter et al. (2006) assigned laughing gulls to the "*planning and responsibility*" tier, which includes birds that require some level of planning to maintain sustainable populations in the region. The "*planning and responsibility*" tier is the second lowest tier in terms of action priority ahead of only the last tier, which includes those waterbirds that are above management levels and could require population management (Hunter et al. 2006). Hunter et al. (2006) placed the breeding population of laughing gulls in the southeastern United States in the "*planning and responsibility*" category of the waterbird conservation plan for the southeastern United States due to the large portion of the breeding population that occurs in the region. Hunter et al. (2006) acknowledged that laughing gull populations in the southeastern United States have increased "*dramatically*", which could be having adverse effects on other nesting high priority bird species at a local level. The waterbird plan for the southeastern United States recommended reducing the population of laughing gulls from the estimated 170,000 breeding pairs to 100,000 breeding pairs to reduce predation on higher priority beach nesting species such as plovers, oystercatchers, and terns (Hunter et al. 2006). The waterbird plan also recommended reducing the number of laughing gulls in the southeastern coastal plain from the current estimate of 46,116 breeding pairs to 25,000 breeding pairs (Hunter et al. 2006). Hunter et al. (2006) recommended localized control measures in areas where laughing gulls were affecting nesting terns and plovers.

From FY 2011 through FY 2016, the WS program in North Carolina has responded to requests for assistance to manage damage or threats associated with laughing gulls. Table 4.10 shows the number of laughing gulls addressed by WS from FY 2011 through FY 2016 to alleviate damage or threats of damage when requested. From FY 2011 through FY 2016, WS has employed non-lethal methods to disperse 85,884 laughing gulls in the State to alleviate damage or threats of damage. In addition, WS' personnel used lethal methods to remove 1,000 laughing gulls between FY 2011 and FY 2016, which is an average removal of 167 laughing gulls per year.

Based on the number of gulls addressed previously by WS in response to requests for assistance, WS could lethally remove up to 500 laughing gulls annually and WS could destroy up to 20 nests annually, including eggs in those nests, to alleviate damage or threats of damage if WS implemented this alternative. The lethal take of up to 500 laughing gulls by WS would include gulls that WS' personnel could lethally remove pursuant to permits issued to other entities. For example, an airport authority may request WS' assistance with managing threats of aircraft strikes associated with laughing gulls at an airport. If the airport authority has a depredation permit issued by the USFWS and the NCWRC, WS could operate as a subpermittee pursuant to the depredation permit issued to the airport authority. Therefore, the take of laughing gulls by WS at the airport to alleviate aircraft strike risks could occur pursuant to the depredation permit issued to the airport authority. Based on a breeding population estimated at 8,840 pairs (which does not include non-breeding laughing gulls that are also present in the State), a take of up to 500 gulls annually would represent 2.8% of the estimated breeding population if the population remains at least stable and does not continue to decline.

Table 4.10 – Laughing gulls addressed in North Carolina, 2011 - 2016

Year	WS' Activities[1]		Other Take[2]
	Take	Dispersed	
2011	85	13,989	117
2012	73	14,700	190
2013	119	6,106	271
2014	466	26,115	662
2015	142	19,888	217
2016	115	5,086	190
TOTAL	**1,000**	**85,884**	**1,647**

[1]WS' data reported by federal fiscal year

[2]Data reported by calendar year and provided by the USFWS (M. Outlaw, USFWS pers. comm. 2017).

In addition, the USFWS and the NCWRC have authorized other entities in the State to take laughing gulls to alleviate damage or threats of damage. From 2011 through 2016, other entities issued depredation permits for laughing gulls reported the lethal take of 1,647 laughing gulls, which is an average lethal take of 275 laughing gulls per year. If the cumulative take of laughing gulls reached 775 gulls (*i.e.*, WS' take of 500 gulls plus the take of 275 gulls by other entities), the cumulative take would represent 4.4% of the estimated breeding population of 8,840 breeding pairs. The cumulative take of laughing gulls is likely to represent a smaller percentage of the actual population in the State because the breeding population estimate of 8,840 breeding pairs does not include non-breeding laughing gulls. In addition, the lethal take of laughing gulls would primarily occur during the migration periods and during the winter when migrants from other areas are present in the State.

No take of laughing gulls would occur by WS in the State without the issuance of a depredation permit by the USFWS and authorization from the NCWRC. Therefore, take would only occur as determined and analyzed by the USFWS and the NCWRC to achieve the desired population objectives for laughing gulls. The permitting of the take by the USFWS through the issuance of a depredation permit pursuant to the MBTA and the permitting of the take by the NCWRC would ensure the proposed removal of up to 500 laughing gulls by WS would not adversely affect populations in the State. Additionally, impacts due to nest removal and egg destruction should have little adverse effect on the laughing gull population. Although there may be reduced fecundity for the individuals affected by nest and egg destruction, this activity would not have long-term effects on breeding adult gulls based on the limited activities proposed. The destruction of up to 20 laughing gull nests annually by WS, including eggs that may be in nests, would occur in localized areas where nesting takes place and would not reach a level where adverse effects on the laughing gull population would occur.

RING-BILLED GULL BIOLOGY AND POPULATION IMPACT ANALYSIS

The ring-billed gull is a medium-sized gull with a white head and a characteristic black ring around the bill (Pollet et al. 2012). Ring-billed gulls are inland, colonial ground nesters on sparsely vegetated islands in large lakes with occasional colonies on mainland peninsulas and near-shore oceanic islands (Pollet et al. 2012). Ring-billed gulls commonly occur in large numbers at garbage dumps, parking lots, and coastal beaches during the winter. Ring-billed gulls are opportunistic feeders that feed primarily on fish, insects, earthworms, rodents, and grains (Pollet et al. 2012).

The eastern breeding population of ring-billed gulls in the United States includes ring-billed gulls that nest in New York, Vermont, Ohio, Illinois, Michigan, Wisconsin, and Minnesota (Blokpoel and Tessier 1986). Ring-billed gulls nest in high densities and, in the Great Lakes region, nesting colonies may be located on islands, parklands, slag yards, rooftops, break walls, and landfills (Blokpoel and Tessier 1986, Pollet et al. 2012). Blokpoel and Tessier (1992) found that the nesting population of ring-billed gulls in the Canadian portion of the lower Great Lakes system increased from 56,000 pairs to 283,000 pairs from 1976 through 1990. The number of ring-billed gulls nesting on Lake Erie increased by 161% from 1976 through 2009 (Morris et al. 2011). Wires et al. (2010) estimates the ring-billed gull population in North America at 1.7 million breeding individuals.

Currently there are no known breeding ring-billed gull colonies in North Carolina and there were no nests found during the 2014 and 2017 colonial water bird surveys in coastal North Carolina (S. Schweitzer, NCWRC, unpublished data, 2017); however, non-breeding ring-billed gulls occur in the State during the breeding season (Pollet et al. 2012, LeGrand et al. 2017). LeGrand et al. (2017) considered ring-billed gulls to be transient and a winter resident throughout most of the State. Ring-billed gulls are one of the most abundant bird species present in the State during the winter, with populations occurring primarily in areas near large water sources of the State, especially along the coast (LeGrand et al. 2017). The highest concentrations of gulls occur from September through May in the State, with a peak count of 500,000 gulls occurring in late December along the coast (LeGrand et al. 2017). Ring-billed gulls can also occur along the coast and inland at agricultural fields, on golf courses, at landfills, and shopping malls throughout the State (Pollet et al. 2012, LeGrand et al. 2017).

Across all BBS routes in the United States, the number of ring-billed gulls observed has shown an increasing trend estimated at 0.99% since 1966 (Sauer et al. 2017). Between 2005 and 2015, the number of gulls observed across all routes surveyed in the United States has shown an increasing trend estimated at 6.02% annually (Sauer et al. 2017). In the eastern BBS region, the number of ring-billed gulls observed has increased 3.34% annually since 1966, with an 5.75% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). The number of ring-billed gulls observed in areas surveyed during the CBC has shown a general stable to slightly increasing trend in North Carolina (National Audubon Society 2010). An estimate of the number of ring-billed gulls present in the State during the migration periods is currently unavailable.

Requests for direct operational assistance received by WS in North Carolina associated with ring-billed gulls occurs primarily at airports where those gulls pose aircraft strike hazards; however, WS could also receive requests for assistance associated with gulls feeding on aquaculture stock and causing damage at waste facilities. Large concentrations of gulls on aquaculture ponds can consume enough fish to pose economic concerns to aquaculture producers. Gulls at waste facilities can carry trash and debris away from facilities and leave the refuse in residential neighborhoods. During times of migration (as evidenced by observations during the CBC), numbers of ring-billed gulls in the State can be highly variable. It is not uncommon to see an influx of thousands of gulls at airports or waste management facilities during those periods.

Between FY 2011 and FY 2016, the WS program in North Carolina employed non-lethal methods to disperse 124,509 ring-billed gulls and lethal methods to remove 743 ring-billed gulls to alleviate damage or threats of damage (see Table 4.11). In addition, the USFWS issued depredation permits to other entities in the State to alleviate damage or threats of damage associated with ring-billed gulls. From 2011 through 2016, all entities issued depredation permits by the USFWS removed 1,462 ring-billed gulls in the State.

Based on previous requests for assistance and the possibility of addressing a large number of gulls that are present in flocks, WS could lethally remove up to 250 ring-billed gulls in the State annually to alleviate damage or threats of damage. Between 2007 and 2016, observers have counted an average of 97,349 ring-billed gulls in areas surveyed during the CBC. The highest count during the CBC conducted between 2007 and 2016 occurred in 2010 when observers counted 123,675 gulls. The lowest number of gulls observed in areas surveyed during the CBC conducted from 2007 through 2016 occurred in 2015 when participants counted 49,391 gulls (National Audubon Society 2010). Therefore, if WS had lethally removed 250 ring-billed gulls annually from 2007 through 2016 in the State, the annual take by WS would have ranged from 0.2% to 0.5% of the number of gulls observed in the State during the CBC. The annual take of 250 ring-billed gulls would represent 0.3% of the average number of ring-billed gulls observed in areas of the State surveyed during the CBC from 2007 through 2016. If other entities in the State lethally remove 244 ring-billed gulls per year under depredation permits issued by the USFWS, the combined take by WS and by other entities would continue to represent 0.5% of the average number of ring-billed gulls observed in areas of the State surveyed between 2007 and 2016. If take by other entities reached 384 gulls annually, the combined take by WS and the take by other entities would represent 0.7% of the average number of ring-billed gulls observed in areas of the State surveyed between 2007 and 2016.

Table 4.11 – Ring-billed gulls addressed in North Carolina, 2011 - 2016

Year	WS' Activities[1]		Other Take[2]
	Take	Dispersed	
2011	55	16,560	191
2012	23	4,681	198
2013	154	10,133	303
2014	174	28,272	384
2015	236	18,985	235
2016	101	45,878	151
TOTAL	**743**	**124,509**	**1,462**

[1]WS' data reported by federal fiscal year

[2]Data reported by calendar year and provided by the USFWS (M. Outlaw, USFWS pers. comm. 2017).

Data from the CBC provides an indication of long-term trends in the number of birds observed wintering in the State and is not representative of estimates for wintering bird populations. However, the analysis will use this information to evaluate the magnitude of lethal take that could occur by WS. The number of gulls observed in areas of the State surveyed during the CBC would be a minimum estimate given the survey parameters of the CBC and that it covers a small portion of the State.

WS' lethal take of gulls would occur under permits issued to WS by the USFWS and the NCWRC or under permits issued to cooperators where WS acts as an agent on the permit. The permitting of take by the USFWS and the NCWRC would ensure the cumulative take of ring-billed gulls annually occurred within allowable take levels to achieve desired population objectives for the species; therefore, the take of gulls by WS would only occur at levels permitted by the USFWS and the NCWRC through the issuance of depredation permits.

HERRING GULL BIOLOGY AND POPULATION IMPACT ANALYSIS

Herring gulls are large, white-headed gulls with a wide distribution in North America, Europe, and Central Asia (Pierotti and Good 1994). Herring gulls are the most widely distributed gull species in the Northern Hemisphere. Herring gulls breed in colonies near bodies of water, such as oceans, lakes, or rivers (Pierotti and Good 1994). Herring gulls nest across the northern and eastern parts of Canada, with breeding populations in Alaska, the Great Lakes, and along the Atlantic coast in the United States. North Carolina is the southern limit of the Atlantic coast nesting range of herring gulls; however, populations of herring gulls have been expanding their range in North Carolina and increasing in numbers (Hunter et al. 2006). Herring gulls are increasingly nesting on man-made structures, particularly on rooftops, break walls, or in areas with complete perimeter fencing such as electrical substations.

Hunter et al. (2006) estimated the breeding population of herring gulls in North Carolina to be 1,000 breeding pairs. In addition, Hunter et al. (2006) recommended reducing the number of nesting herring gulls from 1,000 breeding pairs in the State to 750 pairs to reduce competition for nest sites between herring gulls and other higher priority waterbirds. According to the NCWRC, the number of herring gull pairs in North Carolina have been below 750 pairs in 13 survey years except for 1993 (n=960) and 2001 (n=881). Herring gulls are predatory, feeding on eggs and nestlings of other waterbird species, including terns and plovers (Hunter et al. 2006). In the mid-1980s, the North Carolina Waterbird Committee began development of a management plan for colonial-nesting waterbirds (Schweitzer 2011). The colonial-nesting waterbird plan provided estimates of desired population sizes for colonial-nesting waterbirds along the coast of North Carolina. For herring gulls, the target for nesting pairs was set at ≤1,000 (Schweitzer 2011).

In North Carolina, the number of herring gulls observed during the BBS conducted in the State has shown an increasing trend estimated at 3.32% annually since 1966 with a 3.19% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). Based on current colonial waterbird surveys conducted in the State, the number of breeding pairs appears to be stable to decreasing. Currently, the NCWRC estimates there to be 596 nesting pairs of herring gulls in the State, which equates to 1,192 breeding adults. The NCWRC estimates that 98% of the herring gull nesting pairs in North Carolina nest on dredged-material islands, which are not on any BBS route. Therefore, those nesting areas are missed during the BBS. In addition, non-breeding herring gulls may be present in the State during the breeding season. However, the number of non-breeding herring gulls present in the State during the breeding season in unknown. Herring gulls are commonly observed wintering along the coastal region of the State (Pierotti and Good 1994) as large numbers of herring gulls migrate south through the Atlantic Flyway. Data gathered in North Carolina during the CBC indicates the number of herring gulls observed during the survey has shown a general declining trend in the State (National Audubon Society 2010).

In total, the WS program in North Carolina has lethally removed 635 herring gulls in the State from FY 2011 through FY 2016 to manage damage and threats of damage (see Table 4.12). During this period, WS has also dispersed 13,231 herring gulls using non-lethal methods as part of an integrated approach to resolving gull damage in North Carolina. Based on the level of take since FY 2011, WS reasonably expects the need to lethally take herring gulls to increase but will not exceed 400 herring gulls annually. The increase in the estimated annual take level by WS in the State when compared to take by WS previously arises primarily from the increased requests to address damage associated with herring gulls at airports.

The USFWS and the NCWRC has also authorized other entities to remove herring gulls within the State to alleviate damage. From 2011 through 2016, other entities in the State lethally removed 1,017 herring gulls pursuant to depredation permits issued by the USFWS and the NCWRC, which is an average take of 170 herring gulls per year.

With a population estimated at 1,192 herring gulls in North Carolina, excluding non-breeding herring gulls that are also present in the State, the take of up to 400 gulls by WS annually would represent 33.6% of the estimated statewide population of breeding adults if the population remains at least stable. However, most activities would likely occur during the migratory periods and during the winter when the number of herring gulls present in the State increases as gulls migrate to and through the State to wintering areas (LeGrand et al. 2017).

Table 4.12 – Herring gulls addressed in North Carolina, 2011 - 2016

Year	WS' Activities[1] Take	WS' Activities[1] Dispersed	Other Take[2]
2011	4	1,238	99
2012	309	438	103
2013	248	351	229
2014	8	679	226
2015	27	1,854	219
2016	39	8,671	141
TOTAL	**635**	**13,231**	**1,017**

[1]WS' data reported by federal fiscal year

[2]Data reported by calendar year and provided by the USFWS (M. Outlaw, USFWS pers. comm. 2017).

From 2007 through 2016, observers have counted an average of 7,464 herring gulls annually in areas of the State surveyed during the CBC. WS' take of up to 400 herring gulls annually would represent 5.4% of the average number of herring gulls observed per year in the State during the CBC from 2007 through 2016. The average annual take by other entities within in the State has averaged 170 gulls annually between 2011 and 2016. If WS' annual take reached 400 herring gulls and take by other entities was 170 herring gulls, the cumulative annual take would be 570 herring gulls. When the proposed take by WS of 400 gulls is included with the 170 gulls taken annually by other entities, the cumulative take would represent 7.6% of the average number of gulls observed in the State during the CBC conducted from 2007 through 2016.

WS' lethal take of gulls would occur under permits issued to WS by the USFWS and the NCWRC or under permits issued to cooperators where WS acts as an agent on the permit. The permitting of take by the USFWS and the NCWRC would ensure the cumulative take of herring gulls annually occurred within allowable take levels to achieve desired population objectives for the species; therefore, the take of gulls by WS would only occur at levels permitted by the USFWS and the NCWRC through the issuance of depredation permits.

GREAT BLACK-BACKED GULL BIOLOGY AND POPULATION IMPACT ANALYSIS

The great black-backed gull is the largest gull in the world and is primarily a coastal species. A bird of the North Atlantic, the great black-backed gull has been expanding its breeding and wintering ranges further south along the East Coast and into the Great Lakes. Along the coast of North Carolina, LeGrand et al. (2017) considered the great black-backed gull a permanent resident, with movements occurring during the migration period, while further inland, the black-backed gull is a rare winter visitor. During the breeding season, LeGrand et al. (2017) describes the abundance of black-backed gulls along the coastal plain region north of Cape Hatteras as "*fairly common*" and a "*slowly increasing coastal breeder…northward*". Black-backed gulls are "*uncommon to fairly common*" during the breeding season along the central coastal areas and are "*rare to uncommon*" along the southern coastal region during the breeding season (LeGrand et al. 2017).

The number of great black-backed gulls observed in areas of the State surveyed during the BBS has shown a declining trend estimated at -2.10% annually since 1966, with a -3.04% annual decline occurring from 2005 through 2015 (Sauer et al. 2017). Hunter et al. (2006) estimated the breeding population of great black-backed gulls in North Carolina to be 100 breeding pairs, which equates to a breeding population of 200 adults. Various entities have conducted a periodic coast-wide survey of colonial-nesting waterbirds in North Carolina since 1977. The NCWRC coordinates the colonial waterbird surveys, while the counts are conducted by several partner organizations. During the 2011 survey, observers counted 254 nesting pairs of great black-backed gull in areas surveyed (Schweitzer and Abraham 2014). Additional data from colonial waterbird surveys include 181 nesting pairs in 2014 and most recently 80 nesting pairs in 2017 (S. Schweitzer, NCWRC, unpublished data 2017). The Southeast United States Regional Waterbird Conservation Plan ranked great black-backed gulls in the "*population control*" action level that included those species' populations that were increasing to a level where adverse effects to populations of other species were occurring (Hunter et al. 2006).

During other seasons, LeGrand et al. (2017) indicates a similar pattern to the breeding season with great black-backed gulls "*very common to abundant*" along the northern portion of the coastal plain and "*uncommon to fairly common*" along the southern coastal plain. The number of great black-backed gulls present in the State begins to increase in September and October as northern gulls arrive and decreases in April as gulls depart for breeding areas further north (LeGrand et al. 2017). Trend information from the CBC indicates the number of great black-backed gulls observed in areas of the State surveyed since 1966 has shown a general declining trend (National Audubon Society 2010).

Requests for assistance associated with great black-backed gulls primarily occur at airports in the State where gulls pose an aircraft strike hazard. Table 4.13 shows the number of great black-backed gulls lethally removed or dispersed by WS to alleviate damage and threats from FY 2011 through FY 2016. Since FY 2011, WS has employed non-lethal harassment methods to disperse 683 great black-backed gulls in the State to address requests for assistance to manage damage. WS addressed nearly 93% of the great black-backed gulls from FY 2011 through FY 2016 using non-lethal harassment methods, such as pyrotechnics, the noise associated with the discharge of a firearm, and vehicle harassment. The WS program in North Carolina also used lethal methods to remove great black-backed gulls that employees identified as causing damage or the threat of damage. The highest level of annual take of great black-backed gulls by WS to alleviate damage and threats of damage occurred in FY 2013 when WS lethally removed 40 great black-backed gulls to alleviate damage or threats of damage. In addition to the take by WS, the USFWS and the NCWRC have issued depredation permits to other entities for the take of great black-backed gulls. From 2011 through 2016, other entities in the State lethally removed 10 great black-backed gulls pursuant to depredation permits issued by the USFWS and the NCWRC.

Table 4.13 - Great black-backed gulls addressed in North Carolina, 2011 - 2016

Year	Dispersed by WS[1]	Take by Entity	
		WS' Take[1]	Other Take[2]
2011	150	0	0
2012	126	16	0
2013	0	40	10
2014	54	1	0
2015	2	0	0
2016	351	0	0
TOTAL	683	57	10

[1]WS' data reported by federal fiscal year

[2]Data reported by calendar year and provided by the USFWS (M. Outlaw, USFWS pers. comm. 2017).

To assist other entities with managing gull predation on other ground nesting birds, WS destroyed 44 black-backed gull nests and 96 eggs during June and July of 2012. During June and July of 2013, WS destroyed 109 black-backed gull nests and 255 eggs. Gulls are a long-lived species that have the ability to identify areas with regular disturbance and low reproductive success, which can cause gulls to relocate and nest elsewhere when confronted with repeated nest failure.

WS could continue to receive requests for assistance to reduce threats associated with gulls to ground nesting bird species on barrier islands in the State. As part of an integrated approach to managing damage and threats using both lethal and non-lethal methods, the number of gulls WS addresses annually to alleviate damage is also likely to increase during the implementation of the proposed action. WS anticipates addressing more gulls based on those requests to assist with managing nest predation and nest site competition and other requests for assistance, such as at airports. Based on previous activities requested of WS, WS could destroy up to 200 great black-backed gull nests and 400 eggs annually to disperse gulls. In addition, WS could lethally remove up to 100 great black-backed gulls annually to address damage and threats of damage.

In the mid to late 1980s, the North Carolina Waterbird Committee began development of a management plan for colonial-nesting waterbirds (Parnell and Shields 1990). The colonial-nesting waterbird plan provided estimates of desired population sizes for colonial-nesting waterbirds along the coast of North Carolina. For great black-backed gulls, the target for nesting pairs was set at ≤200 (Parnell and Shields 1990). To alleviate competition for nest sites and to reduce predation, Hunter et al. (2006) recommended reducing the number of nesting great black-backed gulls in North Carolina to 75 pairs. The Conservation Plan recommended reducing the breeding populations of great black-backed gulls in North Carolina because they "*...are serious predators on higher priority beach nesting species such as plovers, oystercatchers, and terns*" (Hunter et al. 2006). Hunter et al. (2006) also stated, "*Where…Great Black-backed Gulls are considered to be serious predators of other beach-nesting species, population control measures such as egg-addling and other disruptions of nesting may be necessary*". The North Carolina Waterbird Committee established a population management goal of ≤200 great black-backed gull breeding pairs, which equates to a breeding population of ≤400 gulls. However, the specific impact of nesting great black-backed gulls on other ground-nesting waterbirds on the beaches of North Carolina is largely unknown but the presence of great black-backed gulls is likely resulting in competition for nest sites with other species and resulting in reduced productivity from predation (Hunter et al. 2006).

The breeding population estimates would not include non-breeding gulls that would also be present in the State. Using the number of nests observed during the 2011 waterbird survey (n=254 nests), a statewide breeding population could be estimated at 508 adults, which exceeds the management objective of the North Carolina Waterbird Committee (Schweitzer 2011) and the Southeast United States Waterbird Conservation Plan (Hunter et al. 2016).

If WS removed 100 great black-backed gulls to alleviate damage, the removal would reduce the breeding population to 408 adults in the State. As stated previously, the management objective established by the North Carolina Waterbird Committee was a statewide breeding population of ≤200 adults; therefore, reducing the number of adults to 408 great black-backed gulls would be within the population management objective established by the North Carolina Waterbird Committee. The Southeast United States Regional Waterbird Conservation Plan established a breeding population objective of 150 adults (Hunter et al. 2006). If the removal of 100 adult black-backed gulls reduced the breeding population to 408 adult gulls, the statewide population would continue to be above the population objective established by the Southeast United States Waterbird Conservation Plan. In addition, the breeding population estimate does not include non-breeding gulls that may also be present in the State. Non-breeding gulls would also likely be predators of other ground-nesting waterbirds.

The permitting of the take by the USFWS through the issuance of a depredation permit pursuant to the MBTA and the permitting of the take by the NCWRC would ensure the proposed removal of up to 100 great black-backed gulls by WS would not adversely affect populations in the State. Additionally, impacts due to nest removal and egg destruction should have little adverse effect on the great black-backed gull population. Although there may be reduced fecundity for the individuals affected by nest and egg destruction, this activity would not have long-term effects on breeding adult gulls based on the limited activities proposed. The destruction of up to 200 great black-backed gull nests annually by WS, including eggs that may be in nests, would occur in localized areas where nesting takes place and would not reach a level where adverse effects on gull populations would occur. WS would only conduct activities when requested by other entities. Other entities could conduct the removal activities or destroy nests/eggs in the absence of WS' involvement. Therefore, WS' involvement would not change the environmental status quo because other entities would likely remove those gulls or destroy nests/eggs whether WS participated or not.

DOUBLE-CRESTED CORMORANT BIOLOGY AND POPULATION IMPACT ANALYSIS

Double-crested cormorants are large fish-eating colonial waterbirds widely distributed across North America (Dorr et al. 2014). Since the late 1970s, the double-crested cormorant population has increased in many regions of North America (Wires et al 2001). Jackson and Jackson (1995) and Wires et al. (2001) suggested that the current cormorant resurgence may be, at least in part, a population recovery following years of DDT-induced reproductive suppression and unregulated take prior to protection under the MBTA. Between the late 1970s and early 1990s, the double-crested cormorant population expanded to an estimated 372,000 nesting pairs (Tyson et al. 1999, Wires et al. 2001). Tyson et al. (1999) estimated the double-crested cormorant population (breeding and non-breeding birds) in the United States to be greater than 1 million cormorants. Tyson et al. (1999) found that the cormorant population increased about 2.6% annually during the early 1990s. The greatest increase was in the Interior region, which was the result of a 22% annual increase in the number of cormorants in Ontario and those states in the United States bordering the Great Lakes (Tyson et al. 1999). From the early 1970s to the early 1990s, the Atlantic population of double-crested cormorants increased from about 25,000 pairs to 96,000 pairs (Hatch 1995). While the number of cormorants in this region declined in the early to mid-1990s by 6.5% overall, some populations were still increasing during this period (Tyson et al. 1999). The number of breeding pairs of double-crested cormorants in the Atlantic and Interior population was estimated at over 85,510 and 256,212 nesting pairs, respectively (Tyson et al. 1999).

Based on 2012 data, the Wetlands International (2017) estimated the continental population of double-crested cormorants to be between 1,078,280 and 1,160,590 cormorants. In Northeast and Central North America, the Wetlands International (2017) estimated the population of double-crested cormorants to be between 947,000 and 1,020,000 cormorants. The USFWS recently estimated the double-crested cormorant population in the central and eastern United States and Canada to be 731,880 to 752,516 double-crested cormorants with approximately 250 breeding pairs in North Carolina (see Table 4-1 and Table A-1 in USFWS (2017*b*)).

Double-crested cormorants occur throughout the year in North Carolina but they are more common and more widely distributed during the migration and wintering period (Atlantic Flyway Council and Mississippi Flyway Council 2010, LeGrand et al. 2017). The fall migration period for double-crested cormorants generally occurs from August through early November with the peak occurring from late August through mid-October (Dorr et al. 2014). The spring migration period generally occurs from late March through the end of May with the peak occurring from mid-April through early March (Dorr et al. 2014). LeGrand et al. (2017) stated, "*Hardly any bird in North Carolina has increased in recent decades as dramatically as has the double-crested cormorant.*" In addition, LeGrand et al. (2017) stated, "*The highest counts on CBCs are often from North Carolina waters, especially in the vicinity of Hatteras and Ocracoke inlets, where sandbars and shallow waters can be blackened by thousands upon thousands of cormorants*."

The number of double-crested cormorants that nest in North Carolina likely ranges from 250 breeding pairs (Atlantic Flyway Council and Mississippi Flyway Council 2010) to 500 breeding pairs (Hunter et al.

2006), which equates to 500 to 1,000 breeding adults and does not include non-breeding double-crested cormorants that are also present in the State during the breeding season. During the 2017 colonial waterbird survey conducted in North Carolina, observers counted 16 double-crested cormorant nests at one location on a dredged-material island in Pamlico Sound (S. Schweitzer, NCWRC, unpublished data, 2017). Nesting colonies may also occur further inland in the Piedmont region of the State (LeGrand et al. 2017). The number of double-crested cormorants observed along routes surveyed during the BBS has shown an increasing trend estimated at 5.88% annually since 1966 with a 7.95% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). As migrants begin arriving in the State from breeding areas further north, the number of double-crested cormorants increases throughout the State with the highest concentrations occurring along the coastal areas. The number of double-crested cormorants observed in areas of the State surveyed during the CBC has shown a general increasing trend since 1966 (National Audubon Society 2010). From 2007 through 2016, observers have counted an average of 65,102 double-crested cormorants per year in areas of the State surveyed during the CBC (National Audubon Society 2010). The actual number of double-crested cormorants present in the State fluctuates throughout the year and varies from year to year.

The recent increase in the double-crested cormorant population in North America and the subsequent range expansion of cormorants has been well-documented along with concerns of the negative impacts associated with the expanding population (*e.g*., see Taylor and Dorr 2003, Hunter et al. 2006, Atlantic Flyway Council and Mississippi Flyway Council 2010). The Southeast United States Regional Waterbird Conservation Plan ranks cormorants in the "*population control*" action level, which includes those species' populations that are increasing to a level where damages to economic ventures or adverse effects to populations of other species are occurring (Hunter et al. 2006). One of the objectives in the Southeast United States Regional Waterbird Conservation Plan is to maintain no more than 15,000 pairs of double-crested cormorants with no more than 4,000 breeding pairs occurring in the Southeastern Coastal Plain (BCR 27), which includes the eastern portion of North Carolina (Hunter et al. 2006). Cormorants are considered a species that "*...may impact either native species or economic interests in portions of the Southeastern U.S. Region for which no increase and potentially population decreases may be recommended*" (Hunter et al. 2006).

Requests for assistance that WS receives in North Carolina associated with double-crested cormorants are primarily associated with cormorants that pose a strike risk with aircraft at airports and military facilities. From FY 2011 through FY 2016, WS has addressed 7,292 cormorants in the state using non-lethal methods to alleviate damage or threats of damage (see Table 4.14). WS did not destroy any nests or eggs from FY 2011 through FY 2016. WS also used lethal methods to remove 111 double-crested cormorants in North Carolina to alleviate damage or threats from FY 2011 through FY 2016. Nearly 99% of the double-crested cormorants addressed by WS from FY 2011 through FY 2016 were addressed using non-lethal methods. Other entities have also addressed double-crested cormorants to address damage and threats of damage. From 2011 through 2016, other entities lethally removed 6,862 double-crested cormorants to reduce damage in the State, which is an average removal of 1,143 double-crested cormorants.

Based on previous efforts to alleviate damage and the threat of damage associated with cormorants conducted by WS in North Carolina, additional efforts could occur based on the increasing number of cormorants observed in the State during the breeding season and the increasing number observed during winter surveys. If WS implements Alternative 1, WS' anticipates removing up to 250 cormorants per year to alleviate damage or threats of damage in the State. In addition, WS could destroy up to 100 double-crested cormorant nests, including eggs, to discourage nesting in areas where the nesting is causing damage or posing a threat of damage.

Table 4.14 – Double-crested cormorants addressed in North Carolina, 2011 – 2016

Year	Dispersed by WS†	Take by Entity	
		WS' Take[1]	Other Entities[2]
2011	448	0	512
2012	306	6	1,265
2013	1,275	53	1,652
2014	2,141	1	1,265
2015	1,947	11	2,153
2016	1,175	40	15
TOTAL	**7,292**	**111**	**6,862**

[1]WS' data reported by federal fiscal year

[2]Data reported by calendar year

In North Carolina, requests for assistance are likely to originate from airports and aquaculture facilities. In addition, requests for assistance are likely to occur during the migration periods and during the winter when the number of double-crested cormorants present in the State increases. As stated previously, observers counted an average of 65,102 double-crested cormorants per year in areas of the State surveyed during the CBC from 2007 through 2016 (National Audubon Society 2010). The number of double-crested cormorants observed from 2007 through 2016 has ranged from 30,102 cormorants observed in 2009 to 101,261 cormorants observed in 2016 (National Audubon Society 2010). Take of up to 250 cormorants by WS would represent 0.4% of the average number of cormorants observed annually during the CBC conducted from 2007 through 2017 and would likely range from 0.3% to 0.8% of the double-crested cormorants observed in areas of the State surveyed during the CBC.

As shown in Table 4.14, other entities have lethally removed an average of 1,369 double-crested cormorants per year from 2011 through 2015 (excludes data from 2016). If WS' annual take reached 250 double-crested cormorants and take by other entities was 1,369 double-crested cormorants, the cumulative annual take would be 1,619 double-crested cormorants. The cumulative annual take of 1,619 double-crested cormorants would represent 2.5% of the average 65,102 cormorants observed per year in areas of the State surveyed during the CBC conducted from 2007 through 2016. The cumulative take of 1,619 double-crested cormorants would likely range from 1.6% to 5.4% of the double-crested cormorants observed in areas of the State surveyed during the CBC.

Although the breeding population of double-crested cormorants in the State likely ranges from 500 to 1,000 double-crested cormorants, most activities to alleviate damage or threats of damage occurring during periods when migratory double-crested cormorants are present in the State (Hunter et al. 2006, Atlantic Flyway Council and Mississippi Flyway Council 2010). Therefore, take by WS and other entities is not likely to have an adverse effect on the breeding population in the State because the take of double-crested cormorants is likely to involve cormorants that breed further north in the eastern Great Lakes and the northeastern United States. WS could destroy up to 100 double-crested cormorant nests, including eggs in the nest, to discourage double-crested cormorants from nesting in areas where damages or threats of damage were occurring. For example, the destruction of nests and/or eggs could occur in areas where double-cormorants compete with other species of high conservation concern. The destruction of nests and/or eggs would occur in limited areas to discourage further nesting and to disperse those double-crested cormorants to other areas. Therefore, the limited take of up to 100 nests, including eggs, is not likely to reach a magnitude where adverse effects to the breeding double-crested cormorant population in the State would occur.

Based on the known take of double-crested cormorants in the State by WS and other entities, take of up to 250 cormorants annually by WS to alleviate damage would not adversely affect double-crested cormorant populations. All take of double-crested cormorants by WS would occur as allowed by the USFWS and the NCWRC, which would ensure the cumulative take of cormorants from all known sources was considered when establishing population objectives in North Carolina. The USFWS recently concluded an evaluation of allowed cumulative take levels for double-crested cormorants in the central and eastern United States and determined the allowed cumulative take levels authorized in the central and eastern United States, including allowed cumulative take in North Carolina, would not impact the double-crested cormorant population (see Section 5.4, Table 5-2, and Appendix 1 in USFWS (2017*b*)).

BROWN PELICAN BIOLOGY AND POPULATION IMPACT ANALYSIS

With their dark feather coloration, large body, long bill, and their large gular pouch, the brown pelican is a conspicuous waterbird. The brown pelican is a coastal marine species found along the coasts from central North America into northern South America, with breeding and wintering populations occurring in North Carolina (Shields 2002). Brown pelicans primarily feed on marine fish and people often recognize them for their headfirst dives into the water to capture prey, often diving down from as high as 65 feet (Shields 2002). Brown pelicans typically forage in the shallow waters near the coastline along beaches, sandbars, docks, and dredge-spoil islands but will forage on inland waters (Shields 2002). Due to many factors, including overharvest, pesticide use, and fisheries collapse, the USFWS designated the brown pelican as endangered under the ESA in 1970 across the entire range of the species in the United States (Shields 2002; see 50 FR 4938-4945). Due in part to less drastic declines in the population observed along the Atlantic Coast, the population of pelicans in those areas, including populations in North Carolina, were delisted in 1985 (see 50 FR 4938-4945). The USFWS removed populations elsewhere in the United States from the list in 2009 (see 74 FR 59444-59472). Today, the USFWS no longer lists populations of brown pelicans under the ESA; however, the MBTA continues to afford brown pelicans protection from take unless permitted by the USFWS.

In North Carolina, the number of brown pelicans observed in areas surveyed during the BBS has shown an increasing trend from 1966 through 2015, which has been estimated to be a 6.62% annually increase (Sauer et al. 2017). From 2005 through 2015, the number of brown pelicans observed in areas of the State surveyed during the BBS has shown an increasing trend estimated at 6.26% annually (Sauer et al. 2017). During surveys conducted in 2017, observers counted 5,455 nesting pairs estimated from counts of nests at 13 sites with 99.6% of pelican nesting colonies occurring on dredged-material islands (S. Schweitzer, NCWRC, unpublished data, 2017). Observers counted an average of 3,394 pelican nests annually during the previous 11-year colonial waterbird surveys. The number of pelican nests observed during the 2017 colonial bird survey exceeded the population goal for pelicans of 4,000 nests and the 13 nesting sites exceeded the habitat goal of pelicans nesting at five sites (S. Schweitzer, NCWRC, unpublished data, 2017).

Across the southeastern United States, the breeding population of brown pelicans has been estimated at 42,551 breeding pairs, with 14,600 pairs occurring in the southeastern coastal plain region, 9,527 pairs occurring in Peninsular Florida, and 18,424 breeding pairs occurring elsewhere in the southeast (Hunter et al. 2006). The population objective for the southeastern United States is to maintain 40,000 to 60,000 breeding pairs of brown pelicans (Hunter et al. 2006).

The number of pelicans observed in the State during the CBC has shown an increasing trend since 1966; however, recent downward trends have been observed since early 2000 (National Audubon Society 2010). Between 2007 and 2016, observers have counted on average 5,703 brown pelicans in areas surveyed during the CBC, ranging from a high of 9,219 pelicans observed in 2013 to a low of 2,535 pelicans during 2010.

Of the five tiers of action levels for waterbirds outlined in the Southeast United States Waterbird Conservation Plan, Hunter et al. (2006) assigned brown pelicans to the "*planning and responsibility*" tier, which included bird species that require some level of planning to maintain sustainable populations in the region. The planning and responsibility tier is the second lowest tier in terms of action priority ahead of only the last tier, which includes those waterbirds that Hunter et al. (2006) considered above management levels. The North American Waterbird Conservation Plan classified the brown pelican in a category of conservation concern considered as "*moderate*" (Kushlan et al. 2002).

Brown pelicans are highly social during all seasons and often nest, roost, fly, and forage in groups (Shields 2002). This gregarious behavior and their large size can increase aircraft strike risks at airports within the State, especially airfields located near marine environments. Most requests for assistance received by WS involving brown pelicans would be associated with aircraft strike risks. WS did not receive requests for assistance associated with brown pelicans in FY 2011. However, WS received requests for assistance to reduce aircraft strike risks associated with pelicans from FY 2012 through FY 2016. To address requests for assistance associated with aircraft strike hazards from FY 2012 to FY 2016, WS dispersed 263 pelicans using trained dogs, pyrotechnics, paintballs, vehicle harassment, and the sound associated with the discharge of a firearm (see Table 4.15). In addition, WS employed firearms to remove 12 pelicans.

Table 4.15 – Brown pelicans addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed
2011	0	0
2012	1	3
2013	6	141
2014	0	3
2015	5	57
2016	0	59
TOTAL	**12**	**263**

Based on the number of brown pelicans addressed previously and in anticipation of additional efforts, WS could lethally remove up to 10 brown pelicans annually within the State to alleviate damage or threats of damage. As stated previously, the USFWS no longer considers the brown pelican as an endangered species under the ESA; however, the MBTA affords brown pelicans protection from take unless permitted by the USFWS. Therefore, any lethal removal by WS would occur pursuant to the MBTA through the issuance of a depredation permit by the USFWS authorizing the take of pelicans. If the USFWS did not issue a permit, no lethal removal would occur. In addition, the take of pelicans would only occur when authorized by the NCWRC and only at levels the NCWRC authorizes, which can only be equal to or lower than allowed by the USFWS. WS anticipates continuing to address brown pelicans using primarily non-lethal harassment methods; however, if pelicans habituate to non-lethal methods or pose an immediate threat of an aircraft strike, WS could employ lethal methods to alleviate strike risks.

If two adult pelicans were associated with each nest counted during the 2017 colonial waterbird surveys, the breeding population in the State would be 10,910 pelicans. Similarly, if two adult pelicans were associated with each of the average 3,394 nests observed annually during the 11-year survey, the average breeding population would be 6,788 pelicans. The statewide breeding population goal for North Carolina is 4,000 nests or 8,000 pelicans (Schweitzer 2011). If WS removed 10 pelicans, the removal would represent 0.1% of the breeding population in 2017, 0.2% of the average breeding population over the 11 years of the survey, and 0.1% of the statewide population objective.

If WS removed up to 10 pelicans, the removal would represent 0.2% of the average number of pelicans observed in areas surveyed during the CBC from 2007 through 2016. When compared to the lowest number of pelicans observed in areas surveyed from 2007 to 2016 during the CBC, removal of up to 10 pelicans would represent 0.4% of the lowest number observed. The data from the CBC provides an indication of long-term trends in the number of birds observed wintering in areas surveyed. Based on the survey parameters of the CBC, the data does not represent statewide population estimates of wintering bird populations. However, to evaluate the magnitude of lethal removal activities that could occur by WS, this analysis compares the number of pelicans observed in areas of the State surveyed during the CBC with the proposed annual removal that could occur by WS. Data from the CBC would be a minimum estimate given the survey parameters of the CBC and the survey only covering a small portion of the State.

The lethal removal of brown pelicans by WS to alleviate damage risks would only occur when authorized by the USFWS and the NCWRC and only at levels permitted. WS would continue to address pelicans using primarily non-lethal methods. The lethal removal of pelicans would only occur when non-lethal dispersal methods were ineffective at alleviating damage or reducing the risk of damage or when pelicans posed an immediate risk to aircraft and human safety.

GREAT BLUE HERON BIOLOGY AND POPULATION IMPACT ANALYSIS

The great blue heron is a common, widespread wading bird that occurs throughout most of North America. Herons occur throughout the year in most of the United States, including North Carolina (Vennesland and Butler 2011). Great blue herons are most often located in freshwater and brackish marshes, lakes, rivers, and lagoons (MANEM Regional Waterbird Working Group 2006, Vennesland and Butler 2011). Herons nest in trees, on rock ledges, and coastal cliffs and may travel up to 30 km to forage, with a mean forage distance of 2.6 to 6.5 km (MANEM Regional Waterbird Working Group 2006). Great blue herons feed mainly on fish but they will also feed on invertebrates, amphibians, reptiles, birds, and mammals (Vennesland and Butler 2011).

Kushlan et al. (2002) estimated the population size of great blue herons to be 83,000 breeding pairs across North America. In 2006, Hunter et al. (2006) estimated the breeding population of great blue herons at 69,331 breeding pairs or 138,662 adult herons in the southeastern United States. The overall population objective for herons in the southeastern United States is 50,000 to 100,000 breeding pairs (Hunter et al. 2006). In the Southeastern Coastal Plain region (BCR 27), the breeding population of herons was approximately 26,700 breeding pairs in 2006 with a population objective of 39,000 breeding pairs (Hunter et al. 2006). Approximately 2,300 breeding pairs are estimated to occur in the Piedmont region (BCR 29) with approximately 3,200 breeding pairs occurring in the Appalachian Mountains region (BCR 28), including those areas of the region in North Carolina. From 2008 through 2012, the NCWRC conducted surveys of herons within the Piedmont Region (BCR 29) of North Carolina and the Southeastern Coastal Plain (BCR 27) region of North Carolina and detected approximately 7,680 nests of great blue herons (S. Schweitzer, NCWRC unpublished data, 2017). In North Carolina, herons observed on BBS routes are showing an increasing trend estimated at 2.24% annually since 1966 and 3.23% annually from 2005 through 2015 (Sauer et al. 2017). Herons observed overwintering in North Carolina have also shown a general increasing trend since 1966 (National Audubon Society 2010).

During a survey of aquaculture facilities in the northeastern United States, 76% of respondents identified the great blue heron as the bird of highest predation concern (Glahn et al. 1999*a*). Great blue herons are also an occasional visitor to airfields where they can pose a strike risk to aircraft. To alleviate damage throughout North Carolina, WS has lethally removed 143 great blue herons and employed non-lethal methods to disperse 1,603 herons from FY 2011 through FY 2016 (see Table 4.16). In addition to the take of herons by WS, the USFWS and the NCWRC has issued depredation permits to other entities for the take of great blue herons. From 2011 through 2016, other entities lethally removed 1,093 great blue herons in the State under depredation permits issued by the USFWS and the NCWRC, which is an average take of 182 great blue herons per year.

Table 4.16 - Great blue herons addressed in North Carolina, 2011 - 2016

Year	Dispersed by WS[1]	Take by Entity	
		WS' Take[1]	Other Take[2]
2011	53	20	231
2012	72	14	253
2013	100	23	212
2014	404	24	153
2015	513	33	227
2016	461	29	17
TOTAL	**1,603**	**143**	**1,093**

[1]WS' data reported by federal fiscal year

[2]Data reported by calendar year and provided by the USFWS (M. Outlaw, USFWS pers. comm. 2017).

Based on previous requests for assistance and in anticipation of additional efforts to manage damage, WS' personnel could lethally remove up to 75 herons annually, including herons that WS' personnel may lethally remove unintentionally during other damage management activities. The increased level of take analyzed when compared to the take occurring by WS from FY 2011 through FY 2016 is in anticipation of requests to address threats of aircraft strikes at airports and to reduce damage to natural resources, such as nest site competition between herons and other colonial nesting waterbirds.

From 2008 through 2012, the NCWRC detected approximately 7,680 nests of great blue herons in areas surveyed in the Piedmont region and the Southeastern Coastal Plain region of North Carolina (S. Schweitzer, NCWRC unpublished data, 2017), which equates to approximately 1,536 nests detected per year. Using two adult great blue herons per nest, the breeding population could be estimated at 3,072 great blue herons in the State.

The take of 75 herons by WS in North Carolina would represent 2.4% of the breeding population estimate in North Carolina of 3,072 great blue herons. If the USFWS and the NCWRC continued to issue permits to entities other than WS for the lethal removal of herons and the take remained similar to take that occurred from 2011 through 2016, the cumulative take of herons by WS and by other entities could reach 257 herons. The cumulative take of 257 herons would represent 8.4% of the breeding population estimate in North Carolina. The permitting of take by the USFWS and the NCWRC ensures the cumulative take of herons in North Carolina, including the take proposed by WS in North Carolina, would not reach a magnitude where undesired adverse effects occur. The take of herons by WS would occur within allowed levels of take permitted by the USFWS through the issuance of depredation permits and authorized by the NCWRC.

BLACK VULTURE BIOLOGY AND POPULATION IMPACT ANALYSIS

Historically, black vultures occurred in the southeastern United States along with Texas, parts of Arizona, and Mexico (Buckley 1999). However, black vultures are expanding their range northward in the eastern United States and now occur as far north as New Jersey, Ohio, Pennsylvania, West Virginia, and rarely into Connecticut and New York (Wilbur 1983, Rabenold and Decker 1989, Buckley 1999). In winter, black vultures migrate south from the most northern part of their range but are a locally resident species throughout most of their range (Parmalee and Parmalee 1967, Rabenold and Decker 1989). Black vultures are a permanent resident that occur statewide in North Carolina (LeGrand et al. 2017).

Black vultures occur in virtually all habitats but are most abundant where forest interrupts open land. Nesting occurs in caves, crevices among rocks, brush piles, thickets, abandoned buildings, and in hollow logs, stumps, and tree trunks (Buckley 1999). In North Carolina, black vultures can nest in old barns and sheds, in caves and rock ledges, and in dense vine tangles or thickets (Legrand et al. 2017). Black vultures are highly social, roosting communally with turkey vultures in trees, electric towers, and other structures (Buckley 1999) where they can cause property damage. Vultures often occupy roosts for many years and in some cases decades (Buckley 1999). The diet of black vultures consists primarily of carrion; however, black vultures can also be predatory, killing and consuming domestic young livestock (pigs, lambs, calves), young birds, mammals, reptiles, and fish (Buckley 1999).

According to BBS trend data provided by Sauer et al. (2017), the number of black vultures observed in the State during the breeding season has increased at an annual rate of 7.91% since 1966, with an 8.63% annual increase occurring from 2005 through 2015. The number of black vultures observed overwintering in the State during the CBC has also shown a general increasing trend since 1966 (National Audubon Society 2010). Rich et al. (2004) estimated the statewide black vulture population at 5,000 vultures based on BBS data available from North Carolina. However, the number of vulture present in the State at any given time is unknown and likely fluctuates throughout the year and may vary from year to year.

Rich et al. (2004) calculated estimates of bird populations from BBS data for individual species. During the BBS, surveyors identify bird species based on visual and auditory cues at stationary points along roadways. Vultures produce very few auditory cues that would allow for identification (Buckley 1999) and thus, surveying for vultures is reliant upon visual identification. For visual identification to occur during surveys, vultures must be either flying or visible while roosting. Coleman and Fraser (1989) estimated that black vultures and turkey vultures spend 12 to 33% of the day in summer and 9 to 27% of the day in winter flying. Avery et al. (2011) found that both turkey vultures and black vultures were most active in the winter (January to March) and least active during the summer (July to September). Avery et al. (2011) found that across all months of the year, black vultures were in flight only 8.4% of the daylight hours while turkey vultures were in flight 18.9% of the daylight hours.

Therefore, observers likely count most vultures while they are flying because counting at roosts can be difficult due to obstructions limiting sight and due to the constraints of boundaries used during the surveys, especially the BBS because observers are limited to counting only those bird species observed or heard within a quarter mile of a survey point along a roadway. Bunn et al. (1995) reported vulture activity increased from morning to afternoon as temperatures increased. Avery et al. (2011) found turkey vulture flight activity peaked during the middle of the day. Three hours after sunrise, Avery et al. (2011) found only 10% of turkey vultures in flight and black vultures lagged about an hour behind turkey vultures in their flight activities. Therefore, surveys for vultures should occur later in the day to increase the likelihood of surveyors observing vultures. Observations conducted for the BBS occur in the morning because mornings tend to be periods of high bird activity. Because the activities of vultures tends to increase from morning to afternoon when the air warms and vultures can find thermals for soaring, vultures are probably under-represented in BBS data. The limitations associated with surveying for vultures under current BBS guidelines likely resulted in lower than expected population estimates of black vultures and turkey vultures. Given the limitations of current survey protocols, populations of vultures in North Carolina are likely higher than derived by Rich et al. (2004) using data from the BBS.

Table 4.17 shows the number of black vultures lethally removed or dispersed by WS to alleviate damage and threats from FY 2011 through FY 2016. Since FY 2011, WS has employed non-lethal harassment methods to disperse 3,374 black vultures in the State to address requests for assistance to manage damage. WS addressed nearly 95% of the black vultures from FY 2011 through FY 2016 using non-lethal harassment methods, such as effigies, lasers, pyrotechnics, propane cannons, and the noise associated with the discharge of a firearm. The WS program in North Carolina also used lethal methods to remove black vultures that employees identified as causing damage or the threat of damage. The highest level of annual take of vultures by WS to alleviate damage and threats of damage occurred in FY 2016 when WS lethally removed 80 black vultures to alleviate damage or threats of damage. In addition to the take by WS, the USFWS has issued depredation permits to other entities for the take of black vultures. From 2011 through 2016, other entities in the State lethally removed 317 black vultures pursuant to depredation permits issued by the USFWS and the NCWRC, which is an average take of 53 black vultures per year.

Table 4.17 - Black vultures addressed in North Carolina, 2011 - 2016

Year	Dispersed by WS[1]	Take of Black Vultures		TOTAL TAKE
		WS' Take[1]	Other Take[2]	
2011	137	11	21	**32**
2012	732	13	31	**44**
2013	449	9	54	**63**
2014	574	20	83	**103**
2015	580	47	85	**132**
2016	902	80	43	**123**
TOTAL	**3,374**	**180**	**317**	**497**

[1]WS' data reported by federal fiscal year

[2]Data reported by calendar year and provided by the USFWS (M. Outlaw, USFWS pers. comm. 2017).

If WS implements Alternative 1, WS could continue to employ non-lethal and/or lethal methods in an integrated methods approach to alleviate damage or threats of damage. Similar to previous activities, the WS program would continue to use primarily non-lethal dispersal methods to address requests for assistance associated with black vultures. However, WS could use lethal methods when determined to be appropriate using the WS Decision Model (*e.g.*, when non-lethal dispersal methods were no longer effective, to address vultures posing imminent strike hazards at airports). Based on previous requests for assistance and in anticipation of additional efforts to address vultures under Alternative 1, WS could lethally remove up to 600 black vultures annually and WS could destroy up to 20 nests annually to alleviate damage and threats, including eggs in those nests.

Increases in requests for assistance would likely be associated with vultures roosting on towers, power structures, and residential buildings, depredation to livestock, and threats of aircraft strikes at airports. Vultures repeatedly roosting on man-made structures can lead to accumulations of fecal droppings, which can be aesthetically displeasing, cause corrosive damage, be slippery, and pose threats of disease transmission when occurring in public-use or work areas. In addition, damages occur to residential structures, vehicles, and other property from vultures pulling and tearing shingles, weather stripping around windows and cars, or tearing seat cushions on mowers and boats. Vultures can prey upon newly born calves and harass adult cattle, especially during the birthing process. The soaring behavior of vultures and their large body size pose risks to aircraft when struck, which can cause damage to aircraft and threaten passenger safety.

Other entities lethally removed an average of 53 black vultures from 2011 through 2016 to alleviate damage. If WS' annual lethal removal reached 600 vultures, the annual take would represent 12.0% of the estimated breeding population in the State, which Rich et al. (2004) estimated at 5,000 black vultures. If the average annual take of black vultures by other entities in North Carolina remains similar to the average annual take of black vultures that occurred from 2011 through 2016 and if WS' removal reached 600 vultures annually, the average annual take of vultures would be 653 vultures. The cumulative annual take of 653 black vultures would represent 13.1% of the estimated statewide breeding population if the population remained at least stable.

From 2011 through 2016, the highest reported annual take by other entities was 85 black vultures. If other entities continued to take 85 black vultures annually in the State, the cumulative take of 600 vultures by WS and the take of 85 black vultures by other entities would represent 13.7% of the estimated statewide breeding population. As stated previously, the statewide population of black vultures is likely higher than the population estimate derived from BBS data by Rich et al. (2004) given vulture behavior and the limitations of the BBS; therefore, the average annual removal of black vultures by WS and other entities would likely represent a smaller percentage of the actual statewide breeding population.

The take of black vultures would only occur when authorized through the issuance of depredation permits by the USFWS and the NCWRC. The permitting of the take by the USFWS and the NCWRC would ensure take by WS and by other entities would occur within allowable take levels to achieve the desired population objectives for black vultures in the State. WS does not expect the take of up to 20 vulture nests to alleviate damage or threats of damage to affect adversely the population of vultures based on previous discussions related to limited nest/egg removal.

TURKEY VULTURE BIOLOGY AND POPULATION IMPACT ANALYSIS

Turkey vultures occur throughout Mexico, across most of the United States, and along the southern tier of Canada (Wilbur 1983, Rabenold and Decker 1989, Kirk and Mossman 1998). Turkey vultures can occur in virtually all habitats but are most abundant where open land interrupts forested areas (Brauning 1992, Kirk and Mossman 1998). Turkey vultures nest on the ground in thickets, stumps, hollow logs, or abandoned buildings (Walsh et al. 1999, Kirk and Mossman 1998). Turkey vultures often roost in large groups near homes or other buildings where they can cause property damage from droppings or by pulling and tearing shingles. Turkey vultures prefer carrion but they will eat virtually anything, including insects, fish, tadpoles, decayed fruit, pumpkins, and recently hatched heron and ibis chicks (Brauning 1992, Kirk and Mossman 1998).

Turkey vultures are a permanent resident across the State (LeGrand et al. 2017). The statewide population of turkey vultures is currently unknown, but the Partners in Flight Science Committee (2013) estimated the breeding population at 110,000 turkey vultures based on BBS data. Trending data from the BBS indicates the number of turkey vultures observed along BBS routes in the State have shown an increasing trend estimated at 7.39% annually from 1966 through 2015, with an estimated 8.24% annual increase occurring between 2005 and 2015 (Sauer et al. 2017). The number of turkey vultures observed in areas surveyed during the CBC in the State is also showing a general increasing trend since 1966 (National Audubon Society 2010).

From FY 2011 through FY 2016, the WS program in North Carolina dispersed 19,949 turkey vultures in the State to alleviate damage or threats of damage (see Table 4.18) using pyrotechnics, physical actions, vehicle harassment, propane cannons, and the noise associated with the discharge of a firearm. In addition, the WS program lethally removed 755 turkey vultures from FY 2011 through FY 2016 to alleviate damage. WS' personnel used non-lethal methods to disperse over 96% of the turkey vultures addressed from FY 2011 through FY 2016. Other entities also lethally removed 594 turkey vultures from 2011 and 2016 pursuant to depredation permits issued by the USFWS and the NCWRC.

Based on previous requests for assistance and in anticipation of additional efforts to manage damage and the subsequent need to address more vultures, WS could lethally remove up to 600 turkey vultures annually in the State to address requests for assistance. In addition, the WS program could destroy up to 20 turkey vulture nests annually under Alternative 1 to alleviate damage and threats.

Table 4.18 - Turkey vultures addressed in North Carolina, 2011 - 2016

Year	Dispersed by WS[1]	Take of Turkey Vultures		TOTAL TAKE
		WS' Take[1]	Other Take[2]	
2011	1,324	106	90	**196**
2012	2,281	168	81	**249**
2013	3,559	110	98	**208**
2014	4,278	136	150	**286**
2015	4,457	137	126	**263**
2016	4,050	98	49	**147**
TOTAL	**19,949**	**755**	**594**	**1,349**

[1]WS' data reported by federal fiscal year

[2]Data reported by calendar year and provided by the USFWS (M. Outlaw, USFWS pers. comm. 2017).

Based on breeding population estimates by the Partners in Flight Science Committee (2013), the take of up to 600 turkey vultures annually by WS would represent 0.6% of the estimated breeding turkey vulture population in the State. Other entities in the State lethally removed 594 turkey vultures to alleviate damage or threats of damage in the State from 2011 through 2016, which is an annual average removal of 99 turkey vultures. If the average annual take of turkey vultures by other entities in North Carolina remains similar to the average annual take of turkey vultures that occurred from 2011 through 2016 and if WS' removal reached 600 turkey vultures annually, the average annual take of vultures would be nearly 700 turkey vultures. The cumulative annual take of 700 turkey vultures would represent 0.6% of the estimated statewide breeding population if the population remained at least stable. Between 2012 and 2016, the highest reported annual take by other entities was 150 turkey vultures. If other entities continued to take 150 vultures annually in the State, the cumulative take of 600 vultures by WS and the take of 150 vultures by other entities would represent 0.7% of the statewide breeding population.

Similar to black vultures, the statewide population of turkey vultures is likely higher than estimated by the Partners in Flight Science Committee (2013) given the limitation of the BBS and the behavior of vultures. Therefore, the cumulative take of vultures is likely to represent a smaller percentage of the actual statewide breeding population. The take of vultures could only occur when authorized through the issuance of depredation permits by the USFWS and the NCWRC. The permitting of the take by the USFWS pursuant to the MBTA and the NCWRC would ensure take by WS and by other entities occurred within allowable take levels to achieve the desired population objectives for turkey vultures in the State. WS does not expect the take of up to 20 vulture nests (including eggs) to alleviate damage or threats of damage to affect the population of vultures adversely. WS would also continue to address requests for assistance associated with turkey vultures using non-lethal dispersal methods.

OSPREY BIOLOGY AND POPULATION IMPACT ANALYSIS

Ospreys are large raptors most often associated with shallow aquatic habitats where they feed primarily on fish (Bierregaard et al. 2016). Historically, osprey constructed nests on tall trees and rocky cliffs. Today, ospreys are most commonly found nesting on man-made structures, such as power poles, cell towers, and man-made nesting platforms (Bierregaard et al. 2016). The breeding range for the osprey stretches from Alaska to Newfoundland, Canada and all but the southernmost population is migratory, leaving after the breeding season to winter in Central and South America (Bierregaard et al. 2016).

In North Carolina, ospreys occur throughout the year along the coastal areas of the State (Poole et al. 2002). Since 1966, the number of osprey observed along routes surveyed in the State during the BBS has shown an increasing trend estimated at 1.87% annually with a 2.94% annual increase occurring from

2005 through 2015 (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the statewide breeding population at 3,000 ospreys.

Ospreys migrating between breeding areas further north and wintering areas further south also pass through the State during the migration periods. The number of osprey observed in areas surveyed during the CBC has also shown increasing trends in the State (National Audubon Society 2010). Requests for assistance received by WS to alleviate damage or the threat of damage associated with ospreys would primarily involve threats to aircraft from strikes along with threats of damage associated with their nesting behavior. From 1990 through 2015, there have been 326 reported aircraft strikes involving osprey in the United States, resulting in 3,220 hours of aircraft downtime and $874,000 in aircraft damages. Of those reported strikes, three caused injuries to people (Dolbeer et al. 2016). In North Carolina, there have been at least four reported aircraft strikes involving osprey (FAA 2017).

Damage can also occur from the nesting behavior of osprey. Osprey nests are constructed of large sticks, twigs, and other building materials that can cause damage and prevent access to critical areas when those nests are built on man-made structures (*e.g.*, power lines, cell towers, boats). Disruptions in the electrical power supply could occur when nests are located on utility structures and could inhibit access to utility structures for maintenance by creating obstacles to workers. For example, the USGS found the average osprey nest in Corvallis, Oregon weighed 264 pounds and was 41-inches in diameter (USGS 2005). In 2001, 74% of occupied osprey nests along the Willamette River in Oregon occurred on power pole sites (USGS 2005). In 2010, 91% of osprey nests observed in Pennsylvania were located on man-made structures (Gross 2012).

Between FY 2011 and FY 2016, the WS program in North Carolina employed non-lethal methods to disperse 337 osprey to alleviate damage and employed lethal methods to remove eight osprey that were causing damage or posing a threat of damage to aircraft (see Table 4.19). WS would continue to use primarily non-lethal methods to address requests for assistance involving ospreys. In addition, other entities lethally removed 11 osprey from 2011 through 2016 in the State pursuant to depredation permits issued by the USFWS and the NCWRC, which is an average take of two osprey per year.

Table 4.19 – Ospreys addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed
2011	2	16
2012	0	11
2013	1	31
2014	1	85
2015	3	119
2016	1	75
TOTAL	**8**	**337**

If WS continues to implement Alternative 1, WS could receive requests for assistance to use lethal methods to remove osprey when non-lethal methods were ineffective or were determined to be inappropriate using the WS Decision Model. An example could include osprey that pose an immediate strike threat at an airport where attempts to disperse the osprey were ineffective. Based on previous requests for assistance to manage damage associated with osprey and in anticipation of additional efforts involving osprey, WS could lethally take up to 20 ospreys annually in the State to alleviate damage and threats when non-lethal techniques were unsuccessful.

In addition, WS could destroy up to 40 osprey nests that were associated with damage to structures, including eggs contained within the nest. Eggs would be destroyed using addling and by breaking open the eggs. WS' personnel would remove nests by hand and/or using hand tools. Egg laying in osprey occurs from mid-April through late-June with late-April through mid-June being the primary period when they lay eggs (Poole et al. 2002). Nestlings can occur in nests from early-June through early-September with the peak occurring from early June through late August (Poole et al. 2002). The removal of the nest and eggs would occur in an attempt to cause the osprey to abandon the nest site and to disperse the osprey from the area. The MBTA prohibits the take of active nests, including the removal of osprey eggs, unless authorized through the issuance of a depredation permit by the USFWS pursuant to the Act.

The take of up to 20 ospreys would represent 0.7% of the breeding population in the State, if the population remains at least stable. However, most requests for assistance that occur during the breeding season would be associated with the nesting behavior of ospreys; therefore, direct operational assistance would likely involve the removal or relocation of the nest prior to egg laying or prior to the eggs hatching. In many cases, requests for assistance that occur during the breeding season would not involve the lethal removal of a breeding adult osprey or a breeding pair of ospreys. However, an entity could request that WS euthanize nestlings when found in a nest[19]. The clutch size for osprey ranges from one to four eggs (Poole et al. 2002). Therefore, WS could address from one to four osprey eggs and/or nestlings when removing a nest.

If other entities continued to take two ospreys per year, the combined take of WS and the take by other entities would cumulatively be 22 ospreys, which would represent continue to represent 0.7% of the estimated breeding population in the State. Given the increasing population trends for osprey and the limited take proposed by WS to alleviate damage and threats, WS' proposed take should not have an adverse effect on osprey populations. The take of osprey could only occur when authorized through the issuance of depredation permits by the USFWS and the NCWRC. The permitting of take by the USFWS pursuant to the MBTA and the NCWRC would ensure take by WS and other entities occurred within allowable take levels to achieve desired population objectives for ospreys.

BALD EAGLE BIOLOGY AND POPULATION IMPACT ANALYSIS

The bald eagle is a large raptor often associated with aquatic habitats across North America with breeding populations occurring primarily in Alaska and Canada; however, documentation exists that eagles have nested in all 48 contiguous States, except Rhode Island and Vermont (Buehler 2000). The bald eagle has been the national emblem of the United States since 1782 and is a key symbol for many Native Americans (Buehler 2000). During the migration period, eagles occur throughout the United States and parts of Mexico (Buehler 2000). Buehler (2000) labelled the migration of eagles as "*complex*", which can make determining migration movement difficult to ascertain. Migration is dependent on many factors, including the age of the eagle, location of the breeding site, severity of the climate at the breeding site, and availability of food (Buehler 2000). Generally, the fall migration period begins in mid-August and extends through mid-November with peak periods occurring from September through October. The spring migration period generally begins in March and extends through May with peak periods occurring from mid-March through mid-May (Buehler 2000).

Bald eagles are opportunistic feeders with a varied diet that consists of mammalian, avian, and reptilian prey; however, eagles are most fond of fish (Buehler 2000). Buehler (2000) describes food acquisition by eagles as "[An eagle] *often scavenges prey items when available, pirates food from other species when it can, and captures its own prey only as a last resort*". Eagles are thought to form life-long pair bonds, but information on the relationship between pairs is not well documented (Buehler 2000). Nesting normally occurs from late-March through September. Eggs are generally present in nests from late May through the end of May. Eaglets occur in nests generally from late May through mid-September (Buehler 2000).

[19]For the purposes of the analysis, WS will consider nestlings euthanized as part of the take of up to 20 ospreys.

Nests of bald eagles occur primarily near the crown of trees with typical nests ranging in size from 1.5 to 1.8 meters in diameter and 0.7 to 1.2 meters tall (Buehler 2000).

Populations of bald eagles showed periods of steep declines in the lower United States during the early 1900s. The loss of nesting habitat, hunting, poisoning, and pesticide contamination likely caused those declines. To curtail steep declining trends in bald eagles, Congress passed the Bald Eagle Protection Act in 1940, which prohibited the taking or possession of bald eagles or any parts of eagles. Congress amended the Bald Eagle Protection Act in 1962 to include the golden eagle and Bald Eagle Protection Act became the Bald and Golden Eagle Protection Act (see Section 1.11). The USFWS listed certain populations of bald eagles as "*endangered*" under the Endangered Species Preservation Act of 1966, which was extended when the modern ESA of 1973 was passed. The USFWS extended the "*endangered*" status to all populations of bald eagles in the lower 48 States, except populations of bald eagles in Minnesota, Wisconsin, Michigan, Washington, and Oregon, which the USFWS listed as "*threatened*" in 1978. After nearly reaching the recovery goals for bald eagle populations in 1995, the USFWS reclassified all populations of eagles in the lower 48 States as "*threatened*". After reaching or exceeding the recovery goals for bald eagles in 1999, the USFWS proposed to remove the eagle listing under the ESA. The USFWS officially de-listed the bald eagle from the ESA on June 28, 2007 except for the Sonora Desert Bald Eagle population, which remained classified as a threatened species. Although officially removed from the protection of the ESA across most of the range of the eagle, the Bald and Golden Eagle Protection Act continues to afford protection to the bald eagle.

As was discussed in Chapter 1, under the Bald and Golden Eagle Protection Act, the definition of "*take*" includes actions that can "*molest"* or *"disturb"* eagles. For the purposes of the Act under 50 CFR 22.3, the term "*disturb"* as it relates to take has been defined as *"to agitate or bother a bald……eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."* The Bald and Golden Eagle Protection Act allows the USFWS to permit the take of eagles when "*necessary for the protection of...other interests in any particular locality*" after determining the take is "*...compatible with the preservation of the bald eagle*" (16 USC 668a).

WS has previously received requests for assistance associated with bald eagles posing threats at or near airports in the State. The large body size and soaring behavior of eagles can pose threats of aircraft strikes when eagles occur in close proximity to airports. At least one aircraft strike has occurred in the State involving bald eagles (FAA 2017). Given the definition of "*molest*" and "*disturb*" under the Bald and Golden Eagle Protection Act as described above, the use of harassment methods to disperse eagles posing threats at or near airports could constitute "*take*" as defined under the Act, which would require a permit from the USFWS to conduct those types of activities.

WS and/or an airport authority could apply for a permit allowing for the harassment of eagles that pose threats of aircraft strikes at airports. If WS continues to implement Alternative 1, WS could employ harassment methods to disperse eagles from airports or surrounding areas when the USFWS authorizes and permits such activities pursuant to the Act. Therefore, if the USFWS did not issue a permit to harass eagles that were posing a threat of aircraft strikes, WS would not conduct any activities associated with bald eagles. WS would only conduct activities after the USFWS issued a permit to WS or to an airport authority allowing for the harassment of eagles. If the USFWS issued a permit to an airport authority, WS could work as a subpermittee under the permit issued to the airport. No lethal take of eagles would occur if WS continues to implement Alternative 1. WS would abide by all measures and stipulations provided by the USFWS in permits issued for the harassment of eagles at airports to reduce aircraft strikes.

GOLDEN EAGLE BIOLOGY AND POPULATION IMPACT ANALYSIS

The golden eagle is a large raptor primarily associated with the open habitats of western North America. Although rare, golden eagles do occasionally occur in the eastern United States, primarily during the winter (Kochert et al. 2002). Historically, the golden eagle nested in isolated areas of several eastern States from Maine to Georgia. Since 1981, there have been management efforts to re-establish breeding populations of golden eagles in North Carolina, Kansas, Tennessee, and Georgia (Kochert et al. 2002).

Golden eagles prey upon a wide variety of mammal, bird, reptile, and fish species, with their primary food source being rabbits and squirrels (Kochert et al. 2002). Eagles will occasionally prey upon livestock, including sheep and goats (Kochert et al. 2002). The golden eagle is the more predatory of the two native eagle species, preferring to hunt prey, but golden eagles are also an opportunistic species and they will feed on carrion (Kochert et al. 2002). The open habitats associated with airports often make ideal locations for golden eagles to forage. From 1990 through 2015, there have been 20 civil aircraft strike reports involving golden eagles in the United States causing over 3,700 hours of aircraft downtime and over $969,000 in damages to aircraft (Dolbeer et al. 2016). Two of those aircraft strikes resulted in injuries to four people (Dolbeer et al. 2016). Requests for assistance associated with golden eagles that WS could receive would primarily occur at airports within the State where those eagles were posing aircraft strike risks.

As was discussed in Chapter 1, under the Bald and Golden Eagle Protection Act, the definition of "*take*" includes actions that can "*molest*" or "*disturb*" eagles. For the purposes of the Act under 50 CFR 22.3, the term "*disturb*" as it relates to take has been defined as "*to agitate or bother a…golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior*."

The WS program in North Carolina has not previously received requests for assistance associated with golden eagles posing threats at or near airports in the State; however, it is possible that golden eagles could occur near airports in the State where they may pose an aircraft strike risk. The large body size and soaring behavior of eagles can pose threats of aircraft strikes when eagles occur in close proximity to airports. Given the definition of "*molest*" and "*disturb*" under the Act as described above, the use of harassment methods to disperse eagles posing threats at or near airports could constitute "*take*" as defined under the Act, which would require a permit from the USFWS to conduct those types of activities.

WS and/or an airport authority could apply for a permit allowing for the harassment of eagles that pose threats of aircraft strikes at airports. If WS implements this alternative, WS could employ harassment methods to disperse eagles from airports or surrounding areas when the USFWS authorizes and permits those activities pursuant to the Bald and Golden Eagle Protection Act. Therefore, if the USFWS did not issue a permit to harass eagles that were posing a threat of aircraft strikes, WS would not conduct activities associated with golden eagles. WS would only conduct activities when the USFWS issued a permit to WS or to an airport authority allowing for the harassment of eagles. If the USFWS issues a permit to an airport authority, WS could disperse golden eagles as a subpermittee under the permit issued to the airport. If WS implements this alternative, no lethal take of golden eagles would occur. WS would abide by all measures and stipulations provided by the USFWS in permits issued for the harassment of eagles at airports to reduce aircraft strikes.

EASTERN KINGBIRD BIOLOGY AND POPULATION IMPACT ANALYSIS

Of the eight species of kingbirds breeding north of Mexico, the eastern kingbird is the most widely distributed, being found throughout much of the United States, except the southwestern United States and the West coast, and into Canada (Murphy 1996). Eastern kingbirds are conspicuous insectivores that are associated with open areas where they often chase insects in mid-flight (Murphy 1996). Kingbirds are also recognizable by their aggressive behaviors toward other birds in defense of their territories (Murphy 1996). After the breeding season, eastern kingbirds migrate southward and overwinter in South America (Murphy 1996).

In North Carolina, LeGrand et al. (2017) classified eastern kingbirds as a "*summer resident*" during the breeding season and a "*transient*" during the migration periods. In North Carolina, eastern kingbirds nest in open habitats interspersed with trees, such as farmyard groves, margins of open woods near fields, and very open stands of trees and generally, with a water supply present within their territory (LeGrand et al. 2017). LeGrand et al. (2017) stated, "*Eastern Kingbirds have slowly declined over its range, and it no longer can be called a common breeding species across the state*". The eastern kingbird nests in nearly every county of the State and is "*common*" to "*fairly common*" over much of the eastern half of North Carolina and generally "*uncommon*" in the mountainous areas of western North Carolina (LeGrand et al. 2017). Eastern kingbirds rarely occur in the State from mid-October through late March (LeGrand et al. 2017). The causes of the population decline are not well known, but may be associated with pesticides and loss of habitat (Murphy 1996).

The number of eastern kingbirds observed in areas surveyed during the BBS has shown an increasing trend in the State estimated at 0.2% annually since 1966 with a 0.09% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). Eastern kingbirds migrate further south after the breeding season and are infrequently observed in those areas surveyed in the State during the CBC (National Audubon Society 2010). The Partners in Flight Science Committee (2013) estimated the statewide breeding population of eastern kingbirds in North Carolina to be 470,000 kingbirds. Most requests for assistance occur during the migration periods when kingbirds begin arriving in the State during their annual migration. In some cases, numerous kingbirds can occur at airports during the migration periods because airports often provide the open habitats preferred by kingbirds.

Between FY 2011 and FY 2016, the WS program in North Carolina used non-lethal harassment methods to disperse 102 eastern kingbirds (see Table 4.20). In FY 2016, WS' personnel used firearms to remove 23 eastern kingbirds at airports in the State to reduce risks associated with aircraft striking kingbirds. Based on previous activities, WS could lethally remove up to 50 kingbirds annually to alleviate damage or reduce threats in the State.

As stated previously, large flocks of kingbirds are present in the State during the migration periods and most requests for assistance are associated with large groups of kingbirds at airports. Based on the statewide breeding population estimated at 470,000 kingbirds, the annual take of 50 Eastern kingbirds by WS would present 0.01% of the estimated breeding population in the State. Although WS could address kingbirds during the breeding season, most activities would occur during the migration periods when kingbirds occur in large flocks; however, the number of kings present in the State during the migration periods is unknown. The USFWS has not received reports of other entities lethally removing eastern kingbirds between 2011 through 2016.

Table 4.20 – Eastern kingbirds addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed
2011	0	0
2012	0	12
2013	0	0
2014	0	2
2015	0	1
2016	23	87
TOTAL	**23**	**102**

The take of eastern kingbirds by WS would only occur after the USFWS and the NCWRC issued permits to WS allowing the take to occur. In addition, take would only occur at levels the USFWS and the NCWRC allow in those permits. Therefore, the cumulative take of eastern kingbirds in the State would occur at the discretion of the USFWS and the NCWRC and those agencies would have the opportunity to restrict take to meet desired population objectives.

AMERICAN CROW BIOLOGY AND POPULATION IMPACT ANALYSIS

American crows have a wide range, are extremely abundant, and found all across the United States (Verbeek and Caffrey 2002). Crows are found in both urban and rural environments and sometimes form large communal roosts in cities. In the United States, some crow roosts may reach a half-million birds (Verbeek and Caffrey 2002). American crows occur throughout the State and are present throughout the year (Verbeek and Caffrey 2002, LeGrand et al. 2017).

Historically, crow populations have benefited from agricultural development because of grains available as a food supply. Crows typically roost in trees with the combination of food and tree availability being favored. In some areas where abundant food and roosting sites are available, large flocks of crows tend to concentrate. In the fall and winter, crows often form large roosting flocks in urban areas. These large flocks disperse to different feeding areas during the day. Crows will fly from six to 12 miles from a roost to a feeding site each day (Johnson 1994). Large fall and winter crow roosts may cause serious problems in some areas particularly when located in towns or other sites near people. Such roosts are objectionable because of the odor of the bird droppings, health concerns, noise, and damage to trees in the roost.

The Partners in Flight Science Committee (2013) estimated the breeding American crow population in North Carolina to be 570,000 crows based on BBS data. From 1966 through 2015, trend data from the BBS indicates the number of crows observed in areas of the State surveyed has increased at an annual rate of 0.93%, with a 2.17% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). The number of crows observed throughout North Carolina in areas surveyed during the CBC has shown a general increasing trend since 1966 (National Audubon Society 2010).

As discussed previously, people can take blackbirds, including crows, without a depredation permit issued by the USFWS when they are committing or about to commit damage or posing a threat to human safety under a blackbird depredation order (see 50 CFR 21.43). A permit is also not required by the NCWRC when crows are causing damage or posing a threat of human safety. Between 2011 and 2016, other entities reported removing 99 American crows at airports in the State, which is an average take of 17 American crows per year. Some annual take is likely to occur by private individuals other than airports, such as agricultural producers. It is reasonable to predict that the number of crows lethally removed by private individuals is minimal because the primary method that people use to alleviate damage is shooting, which has limitations for killing crows. Private individuals use firearms primarily as a form of harassment rather than to remove crows, despite some limited take likely occurring.

In addition, people can harvest crows in the State during a regulated season that allows people to harvest an unlimited number of crows. Similarly, hunters harvesting crows during the regulated hunting season are not required to report their take to the USFWS or the NCWRC. However, the NCWRC does conduct surveys of hunters within the State, which allows the NCWRC to estimate the number of crows that hunters harvest. For example, during the 2014-2015 hunting season, the NCWRC estimates that hunters harvested 60,400 crows in the State (see Table 4.21).

From FY 2011 through FY 2016, WS dispersed 10,382 American crows in North Carolina to manage damage or reduce threats using pyrotechnics, vehicle harassment, and the noise associated with the discharge of a firearm. Between FY 2011 and FY 2016, WS used firearms to remove 146 American crows to alleviate damage or threats of damage. Based on previous requests for assistance and in anticipation of additional efforts, WS' personnel could lethally remove up to 200 American crows annually in the State to address requests for assistance. The WS program in North Carolina would continue to address damage associated with crows using non-lethal dispersal methods; however, if deemed appropriate using the WS Decision Model, WS' personnel could employ lethal methods.

Table 4.21 –WS' activities and hunter harvest of American crows in North Carolina, 2011 - 2016

Year	WS' Activities†		Estimated Hunter Harvest‡
	Take	Dispersed	
2011	20	644	106,941
2012	10	293	98,264
2013	7	907	N/A*
2014	12	1,969	97,504
2015	11	2,645	60,400
2016	86	3,924	N/A

†Data reported by federal fiscal year

‡Harvest data from hunter harvest surveys (NCWRC) and reported by hunting season (*e.g.*, data for 2011 reflects the 2010 to 2011 hunting season because the hunting season for crows began in the 2010 calendar year and ended in the 2011 calendar year)

*N/A=data currently not available

The take of 200 crows would represent 0.04% of the estimated breeding population within North Carolina. Excluding the 2013 and the 2016 hunting seasons, hunters have harvested an average of 90,800 American crows per year in the State during the annual hunting season. As discussed previously, entities reported removing 99 crows to alleviate strike risks at airports in the State between 2011 and 2016, which is an average annual take of 17 crows. If hunters harvested 90,800 American crows in the State, other entities removed 17 crows, and WS' take reached 200 crows, the cumulative take of 91,017 crows would represent 16.0% of the estimated breeding population in the State.

Given the relative abundance of American crows in the State and the long-term increasing population trends observed for the species, the take of crows to alleviate damage or threats of damage and the take of crows during the annual hunting season is likely of low magnitude. The basis for using population trends as an index of magnitude is the assumption that annual harvests do not exceed allowable harvest levels. State wildlife management agencies act to avoid over-harvests by restricting take (either through hunting season regulation and/or permitted take) to ensure that annual harvests are within allowable harvest levels. The numbers of American crows observed during statewide surveys are showing increasing trends (National Audubon Society 2010, Sauer et al. 2017). Therefore, the crow population has likely remained at least stable despite the take of crows by WS and other entities under the depredation order and during the annual hunting season.

FISH CROW BIOLOGY AND POPULATION IMPACT ANALYSIS

The fish crow occurs from Maine to south Florida and west to south Texas where they commonly occur along tidal marshes, beaches, inland lakes, and river systems (McGowan 2001). Inland from the coast, fish crows generally occur in large river drainages, although they may feed in woods or fields a few miles from water (Kaufman 1996). Hamel (1992) specifies viable inland habitats as lakeshores, pinewoods, and occasionally in towns, residential, or other urban areas. Difficulty in identifying this species probably has led to an underestimate of its range, both current and historic. Although the fish crow is slimmer and has a narrower beak and smaller legs, it is difficult to distinguish from the American crow (McGowan 2001).

Fish crows are often confused with American crows with the only reliable distinction between the two species being vocal (McGowan 2001). Crows can form mixed species roosts that can contain both American crows and fish crows. Given the similar physical appearance of the two species, estimating the number of individual fish crows or American crows in a roost or flock of crows based on visual cues can be difficult. Isolating and distinguishing the vocalizations of an individual crow for species identification in a flock of mixed crow species can also be difficult.

Fish crows are not as abundant as American crows and are not as widely distributed across the State. American crows occur throughout the State while fish crows are most common in the eastern portion of North Carolina (LeGrand et al. 2017). Although fish crows and American crows can occur together, most flocks of crows or crow roosts encountered in the State consist primarily of American crows. The number of fish crows observed during the BBS has been decreasing in the State since 1966 estimated at -0.69% annually, with a 0.15% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). The number of fish crows observed during the CBC has shown a general declining since 1966 (National Audubon Society 2010). The Partners in Flight Science Committee (2013) estimated the statewide population of fish crows at 40,000 birds based on BBS data.

To alleviate damage and threats of damage associated with fish crows, WS dispersed 3,512 fish crows and lethally removed 48 fish crows from FY 2011 through FY 2016 (see Table 4.22). When addressing damage or threats of damage associated with fish crows or mixed species flocks of crows, WS anticipates that personnel could lethally remove up to 200 fish crows annually if WS implements Alternative 1. If WS' personnel lethally removed up to 200 fish crows annually, WS' take would represent 0.5% of the estimated statewide breeding population of fish crows.

Table 4.22 – Fish crows addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed
2011	7	447
2012	6	388
2013	3	440
2014	6	823
2015	11	939
2016	15	475
TOTAL	**48**	**3,512**

Like American crows, people can harvest fish crows during the regulated hunting season in the State. In addition, people may lethally remove fish crows to alleviate damage without the need for a depredation permit from the USFWS when causing damage or posing a risk to human safety (see 50 CFR 21.43). A permit is also not required from the NCWRC. The USFWS has received no reports of other entities lethally removing fish crows in the State pursuant to the depredation order. Hunters harvesting crows during the regulated hunting season are not required to report their take to the USFWS or the NCWRC.

The take of fish crows under the depredation order by other entities is likely to be a small contributor to the cumulative take of crows annually. Although some take is likely to occur, WS does not expect the take to reach a high magnitude compared to the statewide breeding population. Similarly, the take of fish crows during the annual hunting season is likely of low magnitude when compared to the statewide population. Given that the number of fish crows observed during the BBS are showing increasing trends from 2005 through 2015 (Sauer et al. 2017), the current breeding population of crows has not declined despite the previous cumulative take that has occurred by WS and other entities, including harvesting crows during the annual hunting season.

BARN SWALLOW BIOLOGY AND POPULATION IMPACT ANALYSIS

Barn swallows are one of the most abundant and widespread of the swallow species. Breeding populations occur throughout North America, Europe, and Asia with wintering populations present in Central and South America, southern Spain, Morocco, Egypt, Africa, the Middle East, India, Indochina, Malaysia, and Australia (Brown and Brown 1999). They feed almost exclusively on flying insects at all times of the year and are very distinguishable by their sharp turns and diving flight patterns used to catch prey (Brown and Brown 1999). They build their cup-shaped mud nests almost exclusively on human-made structures.

Barn swallows will often forage in large groups. The open habitats associated with airports can provide ideal locations for barn swallows to forage where the presence of those swallows can increase the risks of an aircraft strike. Between 1990 and 2015, 4,105 reported civil aircraft strikes have occurred in the United States involving barn swallows resulting in 331 hours of aircraft downtime and over $86,000 in damages to aircraft (Dolbeer et al. 2016). Of the 30 bird species identified most frequently as being struck by civil aircraft in the United States, barn swallows ranked fourth between 1990 and 2015 (Dolbeer et al. 2016).

In addition, active barn swallow nests on bridges can hinder maintenance or replacement. The destruction of active barn swallow nests is a violation of the MBTA without the necessary permits from the USFWS. Therefore, the destruction of active nests, including the loss of eggs or nestlings, caused by any activities associated with maintaining or replacing a bridge or any activities that cause the abandonment of active nests would violate the MBTA without the appropriate depredation permit from the USFWS. Delaying the maintenance or replacement of bridges can put the driving public at risk. Delays can also result in additional costs if contractors are unable to meet deadlines due to the presence of swallow nests.

The spring migration of barn swallows begins in mid-January and continues until mid-May with the peak occurring from early-February through early-May (Brown and Brown 1999). Barn swallows begin nest building shortly after arriving on their breeding grounds. Barn swallows construct nests of mud and other vegetative matter with the construction process taking from six to 26 days to complete (Brown and Brown 1999). Nests of barn swallows are often associated with man-made buildings and structures, such as bridges (Brown and Brown 1999). Eggs may be present in nests of barn swallows from May through mid-August with the peak presence of eggs occurring from mid-May through the end of June. The mean first clutch size for barn swallows is 4.7 eggs (Brown and Brown 1999). Young may be present in barn swallow nests beginning in mid-May through mid-September with the peak occurring from early June through late August (Brown and Brown 1999).

According to BBS trend data, the breeding barn swallow population has increased at an annual rate of 1.11% in North Carolina since 1966 with a 0.58% annual increase occurring from 2005 to 2015 in the State (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the breeding population in the State to be 510,000 barn swallows using data from the BBS. Barn swallows migrate further south after the breeding season and are infrequently observed in those areas surveyed in the State during the CBC (National Audubon Society 2010).

Requests for WS' assistance with managing damage associated with barn swallows usually occurs just before or during the breeding season while they are building nests. During this time, WS has employed both lethal and non-lethal methods to alleviate damage and potentially damaging situations relating to aviation safety. Between FY 2011 and FY 2016, the WS program in North Carolina dispersed 4,214 barn swallows to alleviate damage (see Table 4.23). In addition, WS' personnel employed firearms to take 60 barn swallows from FY 2011 through FY 2016, which is an average take of 10 barn swallows per year. WS also destroyed 160 active barn swallow nests (*i.e.*, nest contained eggs and/or nestlings) and 81 inactive nests (*i.e.*, nests that do not contain eggs or nestlings) in the State to alleviate damage from FY 2011 through FY 2016. Between 2011 and 2016, other entities reported the lethal take of 53 barn swallows, which is an average annual take of nine barn swallows per year.

Table 4.23 – Barn swallows addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed	Active Nests Removed†	Inactive Nests Removed‡
2011	13	524	8	0
2012	0	826	0	0
2013	2	450	1	0
2014	9	821	40	0
2015	4	295	94	0
2016	32	1,298	17	81
TOTAL	**60**	**4,214**	**160**	**81**

†Active nests contained eggs and/or nestlings

‡Inactive nests that do not contain eggs or nestlings

Based on the colonial nesting behavior of barn swallows, WS could lethally remove up to 400 barn swallows annually in the State to alleviate damage and to supplement non-lethal harassment methods. In addition, WS could destroy up to 200 inactive nests and up to 200 active nests annually in the State to discourage nesting in areas where damage or threats of damage were occurring. When WS receives a request for assistance associated with barn swallows nesting on a bridge or another structure, WS' personnel would survey the site to determine whether the nests were active (*i.e.*, contained eggs and/or nestlings). If active, personnel would remove the eggs and/or nestlings from the nest and then destroy the nest by hand or by using high-pressure water. WS' personnel would also destroy inactive nests by hand or by using high-pressure water.

After the initial removal of active or inactive nests, WS' personnel or the cooperating entity would attempt to survey a site at least once a week to monitor for additional nesting activity. If new nesting activity occurred, WS' personnel would continue to destroy the inactive nests by hand. After repeated nesting failures, birds often seek other nesting locations. Monitoring a site for nesting activity would reduce or alleviate the need to destroy eggs and euthanize any nestlings.

WS could remove up to 200 active nests from bridges and other structures as part of attempts to disperse barn swallows. With an average clutch size of 4.7 eggs per nest and if every nest only contained eggs, WS could destroy up to 940 eggs annually under Alternative 1. If the statewide breeding barn swallow population was 64% male[20], every female laid eggs[21], and females only produced one successful nest per

[20]Brown and Brown (1999) reported a male-biased sex ratio in barn swallows with some populations being 54% to 64% males.

[21]Female barn swallows appear to begin breeding their first year (Brown and Brown 1999).

year[22], then barn swallows attempt to build approximately 183,600 nests in the State during the breeding season. With a mean clutch size of 4.7 eggs per nest and 183,600 nests in the State, female barn swallows lay approximately 863,000 eggs in the State. Barn swallows may re-nest and produce a second brood after a nest failure or the successful rearing of the first brood (Brown and Brown 1999). However, the average number of eggs per clutch decreases to 4.1 eggs per second clutch (Brown and Brown 1999).

With barn swallows laying approximately 863,000 eggs in the State during their first nesting attempt, the removal of up to 940 eggs would represent 0.1% of the number of eggs that females lay during their first clutch. If nestlings were present in nests, WS' personnel would use euthanasia methods in accordance with WS Directive 2.505. This analysis considers the lethal removal of barn swallow nestlings by WS as part of the potential annual take of up to 400 barn swallows. Therefore, the annual take of barn swallows by WS would not exceed 400 swallows, including the take of nestlings.

WS' personnel or other entities could monitor known nesting sites and remove any barn swallow nests as swallows construct the nests before they become active nests requiring a depredation permit to remove. In addition, WS' personnel and/or other entities could monitor nesting sites until the end of the breeding season or until the completion of projects to ensure re-nesting does not re-occur and if re-nesting does occur, that WS' personnel remove those inactive nests prior to the laying of eggs. If swallows disperse from the location after the initial nest removal early in the nesting season, re-nesting is likely to occur in other locations. Through monitoring and communication, WS and the cooperating entity can minimize the need to address active nests containing eggs and/or nestlings. The goal would be to reduce the amount of take of adult barn swallows and the take of active nests. Based on the limited take of eggs by WS, the permitting of the take by the USFWS and the NCWRC, and the ability of barn swallows to re-nest after a failed nesting attempt, WS' removal of up to 200 active nests would not adversely affect barn swallow populations in the State.

An annual take by WS of up to 400 barn swallows would represent 0.08% of the estimated statewide breeding population of 510,000 barn swallows. If the annual take by other entities reached nine barn swallows per year and WS' annual take reached 400 barn swallows, the cumulative take would continue to represent 0.08% of the estimated breeding population in the State. WS expects the destruction of nests, including eggs that may be present in active nests, to have little adverse effect on the barn swallow population in North Carolina based on previous discussions.

Like many other bird species, the take of barn swallows by WS to alleviate damage could only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits and when permitted by the NCWRC, including the removal of active nests. In addition, the take of barn swallows, including the take of active nests, would only occur at levels permitted by the USFWS and the NCWRC. Therefore, the USFWS and the NCWRC would have the opportunity to consider cumulative take by all entities to achieve the desired population management levels for barn swallows in the State.

EASTERN BLUEBIRD BIOLOGY AND POPULATION IMPACT ANALYSIS

Eastern bluebirds range throughout the eastern United States and southern Canada, east of the Rocky Mountains (Gowaty and Plissner 2015). Bluebirds are cavity nesters using natural cavities, cavities excavated by other species, or artificial cavities, such a bird boxes. Nesting locations are normally associated with cavities in open habitats where bluebirds forage on insects during the breeding season. In North Carolina, bluebirds occur statewide throughout the year (Gowaty and Plissner 2015) and are permanent residents of the State, with some migratory movements (LeGrand et al. 2017).

[22] Barn swallows often rear two broods per season with the mean seasonal clutch size (both broods) ranging from 5.7 to 6.2 eggs for first-year females and 6.8 to 7.5 eggs for older females (Brown and Brown 1999).

Since 1966, the number of eastern bluebirds observed during the BBS conducted along roadways in North Carolina has increased an average of 3.09% annually, with a 2.02% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the statewide breeding population of bluebirds at 1.2 million birds. Since 1966, the number of bluebirds observed in areas of the State surveyed during the CBC has shown a general increasing trend (National Audubon Society 2010).

WS has received requests for assistance associated with bluebirds at air facilities in the State where bluebirds were attempting to nest inside cavities of aircraft. To alleviate damage and threats of damage associated with bluebirds, WS dispersed 19 eastern bluebirds and lethally removed 40 bluebirds from FY 2011 through FY 2016 (see Table 4.24). In addition, other entities lethally removed 24 eastern bluebirds to alleviate damage pursuant to depredation permits issued from 2011 through 2016. WS anticipates continuing to receive requests for assistance associated with bluebirds at air facilities in the State. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, WS could lethally remove up to 50 bluebirds annually in the State to alleviate damage or threats of damage.

Table 4.24 – Eastern bluebirds addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed
2011	0	0
2012	14	0
2013	20	0
2014	0	0
2015	0	6
2016	6	13
TOTAL	**40**	**19**

If WS removed up to 50 bluebirds to alleviate damage and threats, the lethal removal would represent 0.004% of the estimated statewide breeding population. As stated previously, other entities have also lethally removed bluebirds in the State to alleviate damage. On average, other entities lethally removed four bluebirds per year from 2011 through 2016. If the number of bluebirds lethally removed were representative of the number of bluebirds that other entities could lethally remove in the future, the cumulative take of WS and other entities would represent 0.005% of the estimated statewide breeding population. The permitting of the take by the USFWS and the NCWRC would also ensure lethal removal would not adversely affect bluebird populations.

NORTHERN MOCKINGBIRD BIOLOGY AND POPULATION IMPACT ANALYSIS

Since the early 1900s, the northern mockingbird has been expanding its range northward along the east and west coasts of the United States and into southern Canada. The increased development of farmland and suburban areas, along with the planting of fruit-bearing ornamental shrubs and trees has probably aided their movement northward (Farnsworth et al. 2011). Northern mockingbirds aggressively defend their nest. Mockingbirds can attack and mob potential predators (and people) that approach too close. In North Carolina, northern mockingbirds occur statewide throughout the year (Farnsworth et al. 2011) and are permanent residents of the State (LeGrand et al. 2017).

Since 1966, the number of northern mockingbirds observed along routes surveyed during the BBS in North Carolina has increased an average of 0.43% annually, with a 0.31% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the statewide breeding population of northern mockingbirds at 840,000 birds. The number of northern mockingbirds observed in the State during the CBC conducted since 1966 has shown a general decreasing trend (National Audubon Society 2010).

Requests for WS' assistance associated with mockingbirds occur primarily at airports in the State. WS employed an integrated approach to alleviate damage associated with mockingbirds from FY 2011 through FY 2016. WS dispersed 74 mockingbirds from FY 2011 through FY 2016 in the State to alleviate damage or threats of damage (see Table 4.25). WS' personnel also employed lethal methods to remove 156 northern mockingbirds from FY 2011 through FY 2016 in the State to alleviate damage. Based on previous activities requested of WS, WS could lethally remove up to 100 mockingbirds annually.

Table 4.25 – Northern mockingbirds addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed
2011	5	10
2012	52	19
2013	82	24
2014	4	3
2015	4	2
2016	9	16
TOTAL	**156**	**74**

If WS removed up to 100 mockingbirds to alleviate damage and threats, the lethal removal would represent less than 0.01% of the estimated statewide breeding population of mockingbirds. From 2011 through 2016, other entities reported removing 130 northern mockingbirds, which is an average removal of 22 northern mockingbirds per year. If the annual take by other entities reached 22 northern mockingbirds annually and if WS' take reached 100 mockingbirds, the combined take of WS and other entities would be 122 mockingbirds. The take of 122 Northern mockingbirds would represent 0.02% of the estimated breeding population in the State. The permitting of the take by the USFWS and the NCWRC would also ensure lethal removal would not adversely affect mockingbird populations.

EUROPEAN STARLING BIOLOGY AND POPULATION IMPACT ANALYSIS

As there common name implies, European starlings are native to Europe. Colonization of North America by the European starling began in 1890 when a person with good intentions released 80 starlings into Central Park within New York City. The released birds were able to exploit the resources in the area and have since spread throughout the continent. By 1918, the distribution range of migrant juveniles extended from Ohio to Alabama. By 1926, the distribution of starlings in the United States had moved westward and encompassed an area from Illinois to Texas. Further westward expansion had occurred by 1941 with populations expanding from Idaho to New Mexico. By 1946, the range of starlings had expanded to California and western Canadian coasts (Miller 1975). In just 50 years, the starling had colonized the United States and expanded into Canada and Mexico. After 80 years from the initial introduction, it had become one of the most common birds in North America (Feare 1984).

European starlings occur across the State and throughout the year (Cabe 1993). European starlings are highly adaptable and occur in a wide range of habitats; however, they are most often associated with disturbed areas created by people (Cabe 1993, Johnson and Glahn 1994). European starlings prefer to forage in open country on mown or grazed fields (Cabe 1993, Johnson and Glahn 1994). Their diet consists of insects, fruits, berries, seeds, and spilled grain (Cabe 1993, Johnson and Glahn 1994). European starlings are highly social birds; feeding, roosting, and migrating in flocks at all times of the year (Cabe 1993). European starlings are aggressive cavity nesters that can evict native cavity nesting species (Cabe 1993, Johnson and Glahn 1994). In the absence of natural cavities, European starlings will nest in manmade structures, such as streetlights, mailboxes, and attics (Cabe 1993, Johnson and Glahn 1994). Although few conclusive studies exist, evidence suggests European starlings can have a detrimental effect on native species (Cabe 1993, Johnson and Glahn 1994).

From 1966 through 2015, the number of starlings observed along routes surveyed during the BBS has shown a decreasing trend in the State estimated at -0.64% annually, with a 0.19% increase annually from 2005 through 2015 (Sauer et al. 2017). Using data from the BBS, the Partners in Flight Science Committee (2013) estimated the statewide breeding population of starlings at one million starlings. The number of starlings observed in those areas surveyed during the CBC in the State is showing a general declining trend (National Audubon Society 2010).

The flocking behavior of starlings near airports creates a high risk potential for a bird strike and a threat to human safety. Starlings may also create a health hazard and nuisance for farmers, particularly dairy farmers. In addition to the large amount of droppings accumulated from sizeable flocks that could potentially spread disease to both farm workers and livestock, starlings will also consume all or most of the valuable nutrients in livestock feed, which can result in reduced cattle weights or reduced milk production. Requests for assistance to reduce damage and threats associated with European starlings come from people in urban areas, industrial locations, airports, and agricultural businesses. Starlings gather in roosts numbering from several hundred to more than 1 million birds (Johnson and Glahn 1994). Fecal droppings at these roost sites can damage vehicles, buildings, sidewalks, and other structures, create unsanitary conditions, and transfer diseases (Johnson and Glahn 1994). Starlings can also cause other damage by consuming cultivated fruit and vegetable crops and livestock feed (Johnson and Glahn 1994). Starlings also pose a strike risk to aircraft. In 1960, a commercial aircraft in Boston collided with a flock of starlings and crashed resulting in 62 human fatalities (Johnson and Glahn 1994). From FY 2011 through FY 2016, WS dispersed 38,594 European starlings and personnel lethally removed 1,855 starlings to alleviate damage in North Carolina (see Table 4.26).

Table 4.26 - European starlings addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed
2011	401	7,205
2012	319	7,021
2013	274	6,496
2014	152	4,169
2015	294	6,607
2016	415	7,096
TOTAL	**1,855**	**38,594**

Based on previous requests for assistance and in anticipation of additional efforts to address requests associated with starlings, WS could lethally remove up to 10,000 European starlings and up to 100 nests annually. The take of 10,000 starlings would represent 1.0% of the estimated breeding population in the State. However, most requests to address large concentrations of starlings occur during migration periods and during the winter when the population in the State likely increases above the one million starlings estimated to nest in the State. The increase in the statewide population is a result of migrants arriving in the State and the presence of juveniles in the population.

Starlings are not native to North America and any removal of starlings could improve conditions and reduce competition for food and habitat with native species. Furthermore, neither the MBTA nor any State law protects starlings from take; therefore, neither the USFWS nor the NCWRC require a depredation permit to take starlings to alleviate damage or threats of damage. Because people are not required to report the take of starlings to the USFWS or the NCWRC, the lethal take of starlings in the State by entities other than WS is unknown.

Pursuant to Executive Order 13112, the National Invasive Species Council has designated the European starling as meeting the definition of an invasive species. Lowe et al. (2000) ranked the European starling as one of the 100 worst invasive species in the world. Activities associated with starlings would occur pursuant to Executive Order 13112, which states that each federal agency whose actions may affect the status of invasive species shall reduce invasions of exotic species and the associated damages.

HOUSE SPARROW BIOLOGY AND POPULATION IMPACT ANALYSIS

People introduced house sparrows to North America from England in 1850 and the species has since spread throughout the continent (Fitzwater 1994). House sparrows occur in nearly every habitat, except dense forests, alpine, and desert environments. They prefer human-altered habitats and are abundant on farms and in cities and suburbs (Robbins et al. 1983). House sparrows are not migratory in North America and are year-round residents wherever they occur, including those sparrows found in North Carolina (Lowther and Cink 2006). Nesting locations often occur in areas of human activities and house sparrows are considered "*...fairly gregarious at all times of year*" with nesting occurring in small colonies or clumped distribution (Lowther and Cink 2006). Large flocks of sparrows can also occur in the winter as birds forage and roost together.

In North Carolina, the number of house sparrows observed in areas surveyed during the BBS has shown a downward trend estimated at -4.56% annually since 1966 (Sauer et al. 2017). From 2005 through 2015, the number of house sparrows observed along BBS routes in the State has also shown a declining trend estimated at -4.49% annually (Sauer et al. 2017). Since 1966, the number of house sparrows observed in areas of the State surveyed annually during the CBC has also shown an overall declining trend with a more stable population trend emerging in the late 1980s and early 1990s (National Audubon Society 2010). The Partners in Flight Science Committee (2013) estimated the breeding population of house sparrows in the State to be 530,000 birds.

Robbins (1973) suggested that declines in the sparrow population were occurring because of changes in farming practices, which resulted in cleaner operations with little waste grain. One aspect of changing farming practices that might have been a factor would be the considerable decline in small farms and associated disappearance of a multitude of small feedlots, stables, and barns, a primary source of food for house sparrows in the early part of the 20th century. Ehrlich et al. (1988) suggested that the dramatic declines in the house sparrow population during the 20th century were associated with the decline in the use of horses as transport animals. Grain rich horse droppings were apparently a major food source for house sparrows.

From FY 2011 through FY 2016, WS has employed lethal methods to remove 155 house sparrows in the State to alleviate damage or threats of damage (see Table 4.27). In addition, WS employed non-lethal methods to disperse 267 house sparrows from FY 2011 through FY 2016. Because the MBTA does not afford house sparrows protection from take, a depredation permit from the USFWS and the NCWRC is not required for people to take house sparrows and there are no requirements to report the take of house sparrows to the USFWS or the NCWRC. Therefore, the number of sparrows that other entities lethally remove in the State is unknown. Based on the gregarious behavior of sparrows and in anticipation of receiving additional requests for assistance, WS could take up to 600 house sparrows and up to 200 house sparrow nests in the State annually to alleviate damage or threats of damage.

Table 4.27 - House Sparrows addressed by WS in North Carolina, FY 2011- FY 2016

Fiscal Year	Take	Dispersed
2011	51	41
2012	29	30
2013	32	2
2014	34	73
2015	0	0
2016	9	121
TOTAL	**155**	**267**

If WS' personnel lethally removed up to 600 sparrows annually in the State, the take would represent 0.1% of the estimated statewide breeding population in North Carolina. As stated previously, the annual take of house sparrows by other entities is currently unknown. House sparrows are non-indigenous and often have negative effects on native birds, primarily through competition for nesting sites; therefore, many wildlife biologists and ornithologists consider sparrows to be an undesirable component of North American wild and native ecosystems. Any reduction in house sparrow populations in North America could provide some benefit to native bird species. WS' take of house sparrows to reduce damage and threats would comply with Executive Order 13112.

HOUSE FINCH BIOLOGY AND POPULATION IMPACT ANALYSIS

Historically, the house finch favored the open desert habitats of the southwestern United States. However, people introduced the house finch to eastern North America around 1940 when people brought individuals from California and released those finches onto Long Island, New York (Able and Belthoff 1998, Badyaev et al. 2012). In just a few decades, this predominately sedentary species expanded its range across most of North America (Badyaev et al. 2012). House finches occur throughout the year in North Carolina (Badyaev et al. 2012). Although people introduced house finches into the eastern United States, the species is still native to the western United States; therefore, the MBTA protects house finches from take without a depredation permit issued by the USFWS.

In North Carolina, the number of finches observed in areas surveyed during the BBS shows an increasing trend estimated at 8.15% annually from 1966 through 2015 (Sauer et al. 2017). From 2005 through 2015, the number of house finches observed along BBS routes in the State has also shown an increasing trend estimated at 0.42% annually (Sauer et al. 2017). The number of house finches observed in those areas surveyed during the CBC in the State is showing a cyclical, but relatively stable pattern (National Audubon Society 2010). The Partners in Flight Science Committee (2013) estimated the statewide breeding population of house finches at 700,000 individuals based on data from the BBS.

The flocking behavior of finches near airports creates a high risk potential for a bird strike and a threat to human safety. House finches can also be a nuisance or cause problems due to accumulated droppings from roosting on utility structures or buildings in urban areas. From FY 2011 through FY 2016, WS used non-lethal methods to disperse 145 house finches to reduce strike risk at airports in the State. In addition, the WS program in North Carolina employed lethal methods to remove 197 house finches in the State, which is an average of 33 house finches per year (see Table 4.28). Because of the gregarious behavior of this species and in anticipation of increasing requests for assistance, WS could take up to 175 house finches and up to 50 nests annually to alleviate damage and associated threats. From 2011 through 2016, the USFWS received reports of other entities removing 119 house finches pursuant to depredation permits issued by the USFWS and the NCWRC, which is an average of 20 house finches per year.

Table 4.28 – House finches addressed by WS in North Carolina, FY 2011 – FY 2016

Fiscal Year	Take	Dispersed
2011	0	0
2012	69	145
2013	29	0
2014	70	0
2015	20	0
2016	9	0
TOTAL	**197**	**145**

The take of up to 175 house finches would represent 0.03% of the estimated breeding population in North Carolina. If the annual take by other entities reached 20 house finches annually and if WS' take reached 175 house finches, the combined take of WS and other entities would be 195 house finches. The take of 195 house finches would represent 0.03% of the estimated breeding population in the State. Like other native bird species, the take of house finches by WS to alleviate damage would only occur when permitted by the USFWS pursuant to the MBTA and when permitted by the NCWRC through the issuance of depredation permits. Therefore, take by WS would only occur when the USFWS and the NCWRC issues a depredation permit authorizing the take and take would only occur at levels authorized by USFWS and the NCWRC. Therefore, the USFWS and the NCWRC would have the opportunity to consider all take to achieve the desired population management levels of finches in North Carolina.

EASTERN MEADOWLARK BIOLOGY AND POPULATION IMPACT ANALYSIS

The eastern meadowlark epitomizes the open habitats of the eastern United States, where the conspicuous nature and call of the meadowlark is easily recognizable (Jaster et al. 2012). Eastern meadowlarks occur throughout the eastern United States but their range can be highly dependent on habitat availability. Meadowlarks are associated with grassy fields, pastures, cultivated areas, groves, open pinewoods, and prairies (Jaster et al. 2012). In North Carolina, eastern meadowlarks occur throughout the year in the open, grassy areas of the State where they feed primarily on invertebrates and some plant material, such as weed seeds, grains, and some fruits (Jaster et al. 2012). The open areas found at airports makes the habitat ideal for meadowlarks to forage and nest while providing ample perching areas. Most requests for assistance to reduce threats associated with meadowlarks occur at airports in North Carolina. Meadowlarks found on and adjacent to airport property can pose a strike hazard, causing damage to the aircraft and threatening passenger safety. From 1990 through 2015, there have been 3,284 reported civil aircraft strikes involving meadowlarks in the United States causing $1 million in damages (Dolbeer et al. 2016). Since 1990, 30 reported civil aircraft strikes involving meadowlarks have occurred in North Carolina (FAA 2017).

As reported by the BBS, populations of eastern meadowlarks in North Carolina have decreased since 1966 at an estimated rate of -3.56% annually with a -3.19% annual decline occurring from 2005 through 2015 (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the current statewide breeding population at 300,000 individuals. Since 1966, CBC data shows a general decreasing pattern for meadowlarks in North Carolina (National Audubon Society 2010).

From FY 2011 through FY 2016, the WS program in North Carolina employed lethal methods to remove 177 meadowlarks in the State, which is an average of 30 eastern meadowlarks per year (see Table 4.29). In addition, WS used non-lethal methods to disperse 11,499 meadowlarks to reduce strike risk at airports in the State, which is an average of 1,917 meadowlarks per year. WS has addressed requests associated with meadowlarks using primarily non-lethal dispersal methods. From 2011 through 2016, other entities reported removing 99 eastern meadowlarks pursuant to depredation permits issued by the USFWS, which is an average of 17 meadowlarks per year. Based on the number of requests received to alleviate the threat of damage associated with eastern meadowlarks and the number of eastern meadowlarks addressed previously to alleviate those threats, WS anticipates that personnel could lethally remove up to 150 eastern meadowlarks annually in the State and up to 30 nests could be destroyed to alleviate the threat of damage. WS also anticipates that meadowlarks will continue to be addressed using primarily non-lethal harassment methods, with lethal methods employed to reinforce the use of non-lethal methods to prevent habituation.

Table 4.29 – Eastern meadowlarks addressed by WS in North Carolina, FY 2011 – FY 2016

Fiscal Year	Take	Dispersed
2011	22	1,236
2012	7	209
2013	12	495
2014	23	1,414
2015	23	972
2016	90	7,173
TOTAL	**177**	**11,499**

Based on the estimated breeding population, WS' take of up to 150 meadowlarks would represent 0.05% of the estimated breeding population in North Carolina. The take of meadowlarks to alleviate damage or threats would not likely reach a magnitude where adverse effects to meadowlark populations would occur. The declining trends associated with the BBS and the CBC surveys are likely associated with habitat loss across the range of the meadowlark (Jaster et al. 2012). The International Union for Conservation of Nature and Natural Resources ranks the eastern meadowlark as a species of "*least concern*" (BirdLife International 2017). The International Union for Conservation of Nature and Natural Resources assigned the ranking based on the "*species…extremely large range…*", "*…the population size is extremely large…*", and "*the decline is not believed to be sufficiently rapid*" (BirdLife International 2017). The permitting of the take by the USFWS and the NCWRC through the issuance of depredation permits pursuant to the MBTA ensures those agencies have the opportunity to consider the cumulative take of meadowlarks as part of population management objectives for the species.

RED-WINGED BLACKBIRD BIOLOGY AND POPULATION IMPACT ANALYSIS

The red-winged blackbird is one of the most abundant bird species in North America and is a commonly recognized bird that occurs in a variety of habitats (Yasukawa and Searcy 1995). The breeding habitat of red-winged blackbirds includes marshes and upland habitats from southern Alaska and Canada southward to Costa Rica extending from the Pacific to the Atlantic Coast along with the Caribbean Islands (Yasukawa and Searcy 1995). Red-winged blackbirds are primarily associated with emergent vegetation in freshwater wetlands and upland habitats during the breeding season and will nest in marsh, vegetation, roadside ditches, saltwater marshes, rice paddies, hay fields, pastureland, fallow fields, suburban habitats, and urban parks (Yasukawa and Searcy 1995). Northern breeding populations of red-winged blackbirds migrate southward during the migration periods, but red-winged blackbirds are common throughout the year in most of the United States (Yasukawa and Searcy 1995). During the migration periods, red-winged blackbirds often form mixed species flocks with other blackbird species.

In North Carolina, red-winged blackbirds are year-round residents of the State (Yasukawa and Searcy 1995) with a breeding population estimated at 200,000 birds (Partners in Flight Science Committee 2013). Trend data from the BBS indicates the number of red-winged blackbirds observed in the State during the breeding season has shown a declining trend since 1966 estimated at -1.63% annually (Sauer et al. 2017). More recent trend data from 2005 through 2015 also indicates a downward trend estimated at -

0.48% annually (Sauer et al. 2017). The number of red-winged blackbirds observed during the CBC in the State has shown a cyclical pattern, but an overall increasing trend since 1966 (National Audubon Society 2010).

Northern breeding populations of red-winged blackbirds migrate southward during the migration periods but red-winged blackbirds are common throughout the year in states along the Gulf Coast and parts of the western United States, including North Carolina (Yasukawa and Searcy 1995). The fall migration period for red-winged blackbirds generally occurs from early October through mid-December, with the peak occurring from mid-October through early December (Yasukawa and Searcy 1995). Migratory red-winged blackbirds are present in their wintering areas until departing on their spring migration from mid-February through mid-May with the peak occurring from late February through late April (Yasukawa and Searcy 1995). Therefore, the number of blackbirds, including red-winged blackbirds, increases substantially in the State as northern breeding populations migrate southward during the fall to winter in the southern United States, which augments local breeding populations (Meanley et al. 1966). Like other blackbirds, nothing visual would distinguish red-winged blackbirds that were from the local breeding population and those red-winged blackbirds that migrate into the State from other areas. During the migration periods and during the winter, red-winged blackbirds often form mixed species flocks with other blackbird species and starlings.

Table 4.30 shows the number of red-winged blackbirds addressed by WS from FY 2011 through FY 2016. Nearly 90% of the red-winged blackbirds addressed by WS from FY 2011 through FY 2016 were dispersed using non-lethal harassment methods (*e.g.*, pyrotechnics, noise associated with the discharge of a firearm). Requests for WS' assistance with red-winged blackbirds in the State often arise at airports where the flocking behavior of blackbirds can pose aircraft strike risks and threaten human safety. WS could also receive requests for assistance when crops or livestock feed were damaged by red-winged blackbirds (Dolbeer 1994). Additionally, WS could receive requests when blackbirds congregate into large roosts that pose a threat of property damage or pose threats to human safety.

Table 4.30 – Red-winged blackbirds addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed
2011	4	149
2012	2	66
2013	4	40
2014	10	72
2015	3	120
2016	33	55
TOTAL	**56**	**502**

Red-winged blackbirds often form mixed species flocks with starlings, grackles, and cowbirds during the migration periods and during the winter. Most requests for assistance are associated with large mixed species flocks of blackbirds. From FY 2011 through FY 2016, the WS program in North Carolina dispersed 124,950 blackbirds in mixed species flocks using pyrotechnics and propane cannons; however, the number of red-winged blackbirds or other blackbird species present in those flocks is unknown. In addition, WS' personnel employed firearms to lethally removed 54 blackbirds in mixed species flocks in the State during FY 2013.

Based on the population data for North Carolina and previous activities focused on relieving damage or threats from blackbirds, WS could lethally remove up to 100 red-winged blackbirds annually to alleviate damage or threats of damage. With an estimated statewide population of 200,000 birds, the take of 100 red-winged blackbirds annually would represent 0.05% of the breeding red-winged blackbird population in North Carolina.

The numbers of blackbirds present in the State likely increases as migratory blackbirds begin arriving in the State during the fall and winter. Between 2007 and 2016, surveyors counted an average of 218,000 red-winged blackbirds per year in those areas of the State surveyed during the CBC (National Audubon Society 2010). The take of up to 100 red-winged blackbirds by WS would represent 0.05% of the average number of blackbirds observed in areas of the State surveyed during the CBC between 2007 and 2016. The areas surveyed during the CBC represent a small portion of the State. The number of red-winged blackbirds observed in those areas surveyed during the CBC only represent the number of red-winged blackbirds observed and does not represent statewide population estimates.

From 2011 through 2016, other entities reported removing 39 red-winged blackbirds, which is an average removal of seven red-winged blackbirds per year. If the annual take by other entities reached seven red-winged blackbirds annually and if WS' take reached 100 red-winged blackbirds, the combined take of WS and other entities would be 107 red-winged blackbirds. The take of 107 red-winged blackbirds would represent 0.05% of the estimated breeding population in the State and 0.05% of the average number of red-winged blackbirds observed in areas of the State surveyed during the CBC between 2007 and 2016.

Most activities associated with red-winged blackbirds occur when large concentrations of red-winged blackbirds are present in the winter. However, the number of red-winged blackbirds that winter in the State is unknown and likely fluctuates throughout the year and from year to year. The numbers of red-winged blackbirds present in the State likely increases as migratory blackbirds begin arriving in the State during the fall and winter.

BROWN-HEADED COWBIRD BIOLOGY AND POPULATION IMPACT ANALYSIS

Brown-headed cowbirds are another species in the blackbird family commonly found in mixed species flocks during migration periods. Cowbirds are a common summer resident across the United States and southern Canada (Lowther 1993). Breeding populations in the northern range of the cowbird are migratory with cowbirds present throughout the year in much of the eastern United States and along the West Coast (Lowther 1993). Likely restricted to the range of the bison (*Bison bison*) before the presence of European settlers, cowbirds were likely a common occurrence on the short-grass plains where they fed on insects disturbed by foraging bison (Lowther 1993). Cowbirds expanded their breeding range as people began clearing forests for agricultural practices (Lowther 1993). Cowbirds still commonly occur in open grassland habitats but also inhabit urban and residential areas. Unique in their breeding habits, cowbirds are brood parasites meaning they lay their eggs in the nests of other bird species (Lowther 1993). Female cowbirds can lay up to 40 eggs per season with eggs reportedly being laid in the nests of over 220 species of birds, of which, 144 species have actually raised cowbird young (Lowther 1993). Cowbirds provide no parental care with the raising of cowbird young.

Cowbirds are permanent residents statewide that occur throughout the year in North Carolina, with breeding populations augmented by migrants arriving in the State during the winter (Lowther 1993). During the breeding season, the number of cowbirds observed in areas of the State surveyed during the BBS has shown an increasing trend estimated at 0.61% annually between 1966 and 2015 (Sauer et al. 2017). From 2005 through 2015, the number of cowbirds observed in the State has shown a declining trend estimated at -1.30% annually (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the statewide breeding population of cowbirds at one million cowbirds based on data from the BBS. Similar to other blackbird species, the number of cowbirds observed during the CBC conducted annually in the State has shown a cyclical pattern, with a general declining trend since 1966 (National Audubon Society 2010).

From FY 2011 through FY 2016, WS employed non-lethal methods to disperse 9,937 cowbirds in the State to alleviate damage or threats of damage (see Table 4.31). In addition, WS has employed lethal methods to remove 564 cowbirds in the State from FY 2011 through FY 2016. Based on the previous number of requests to manage damage and threats associated with cowbirds, and in an anticipation of additional efforts to address future damages and threats in the State, up to 500 cowbirds could be lethally removed by WS annually in North Carolina if WS implements Alternative 1. If WS lethally removed up to 500 cowbirds annually, the take would represent 0.05% of the estimated one million cowbirds breeding within the State.

Table 4.31 – Brown-headed cowbirds addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed
2011	52	927
2012	192	2,079
2013	150	1,812
2014	43	4,324
2015	38	607
2016	89	188
TOTAL	**564**	**9,937**

From 2011 through 2016, other entities reported removing 723 brown-headed cowbirds, which is an average removal of 121 brown-headed cowbirds per year. If the annual take by other entities reached 121 cowbirds annually and if WS' take reached 500 brown-headed cowbirds, the combined take of WS and other entities would be 621 cowbirds. The take of 621 brown-headed cowbirds would represent 0.06% of estimated the breeding population in the State.

Most activities associated with brown-headed cowbirds occur when large concentrations of cowbirds are present in the winter. However, the number of brown-headed cowbirds that winter in the State is unknown and likely fluctuates throughout the year and from year to year. The numbers of cowbirds present in the State likely increases as migratory cowbirds begin arriving in the State during the fall and winter.

COMMON GRACKLE BIOLOGY AND POPULATION IMPACT ANALYSIS

Characterized by yellow eyes and iridescent bronze or purple plumage, common grackles are a common conspicuous bird species found in urban and residential environments (Peer and Bollinger 1997). The breeding range of the common grackle includes Canada and the United States east of the Rocky Mountains with grackles found throughout the year in the United States except for the far northern and western portion of the species range in the United States (Peer and Bollinger 1997). Common grackles are a semi-colonial nesting species often associated with human activities. Common grackles have likely benefited from human activities, such as the clearing of forests in the eastern United States, which has provided suitable nesting habitat for grackles. The planting of trees in residential areas has also likely led to an expansion of the species range into the western United States (Peer and Bollinger 1997). Common grackles use a wide range of open or partially open habitat including open woodland, forest edges, and suburban areas (Peer and Bollinger 1997). The grackle has an extremely varied diet, which includes insects, crayfish, frogs, other small aquatic life, mice, nestling birds, eggs, sprouting and ripened grains, seeds, and fruits (Bull and Farrand, Jr. 1977, Peer and Bollinger 1997). During the migration periods, common grackles can occur in mixed species flocks of blackbirds. Common grackles are social birds, nesting in colonies of up to 200 pairs and forming flocks with other blackbirds, which may exceed 1 million birds (Peer and Bollinger 1997).

In North Carolina, common grackles occur across the State and throughout the year (Peer and Bollinger 1997). Large numbers of nesting grackles can occur in open woodlands, swamps, marshes, pine forests, hammocks, and suburban areas. The Partners in Flight Science Committee (2013) estimated the breeding population in the State at two million grackles. The number of grackles observed along BBS routes surveyed in the State has shown a downward trend between 1966 and 2015 estimated at -2.22% annually (Sauer et al. 2017). Between 2005 and 2015, the number of grackles observed during the BBS has also shown a downward trend in the State estimated at -3.57% annually (Sauer et al. 2017). During the migration periods and the winter months, migrating grackles from northern nesting areas increase the number of grackles in the State (Peer and Bollinger 1997). The number of common grackles observed in areas of the State surveyed during the CBC has shown a general increasing trend since 1966 (National Audubon Society 2010).

From FY 2011 through FY 2016, WS dispersed 914 common grackles and lethally removed 221 grackles to alleviate damage (see Table 4.32). Based on the previous number of requests to manage damages and threats associated with common grackles, and in an anticipation of an increased need to address future damages and threats in the State, up to 200 common grackles could be lethally removed by WS annually in North Carolina under the proposed action alternative. If WS lethally removed up to 200 common grackles annually, the take would represent 0.01% of the estimated two million common grackles breeding within the State.

Table 4.32 – Common grackles addressed by WS in North Carolina, FY 2011 - FY 2016

Fiscal Year	Take	Dispersed
2011	94	448
2012	23	85
2013	11	34
2014	6	60
2015	34	152
2016	53	135
TOTAL	**221**	**914**

From 2011 through 2016, other entities reported removing 55 common grackles, which is an average removal of nine common grackles per year. If the annual take by other entities reached nine grackles annually and if WS' take reached 200 common grackles, the combined take of WS and other entities would be 209 grackles. The take of 209 common grackles would represent 0.01% of the estimated breeding population in the State.

Like other blackbird species, most activities associated with common grackles occur when large concentrations of grackles are present in the winter. However, the number of common grackles that winter in the State is unknown and likely fluctuates throughout the year and from year to year. The numbers of common grackles present in the State likely increases as migratory grackles begin arriving in the State during the fall and winter.

ADDITIONAL TARGET SPECIES

WS has addressed limited numbers of additional target bird species previously or WS anticipates addressing a limited number of additional bird species under the proposed action alternative. WS would primarily address those species to alleviate aircraft strike risks at airports in the State. Requests for assistance associated with those species would often occur infrequently or would involve only a few individuals. WS anticipates addressing those requests for assistance using primarily non-lethal dispersal methods. Under the proposed action alternative, WS could receive requests for assistance to use lethal methods to remove some of those bird species when non-lethal methods were ineffective or were determined to be inappropriate using the WS Decision model. An example could include birds that pose an immediate strike threat at an airport where attempts to disperse the birds were ineffective. The target bird species that WS could address in limited numbers, after receiving a request for assistance associated with those species, would include those bird species identified in Appendix B[23]. Impacts associated with implementing Alternative 1 on the populations of those species is also addressed in Appendix B.

WILDLIFE DISEASE SURVEILLANCE AND MONITORING

The ability to efficiently conduct surveillance for and detect diseases is dependent upon rapid detection of the pathogen if it is introduced. Effective implementation of a surveillance system would facilitate planning and execution at regional and state levels, and coordination of surveillance data for risk assessment. It would also facilitate partnerships between public and private interests, including efforts by federal, state, and local governments as well as non-governmental organizations, universities, and other interest groups[24]. Current information on disease distribution and knowledge of the mixing of birds in migratory flyways has been used to develop a prioritized sampling approach based on the major North American flyways. Surveillance data from all of those areas would be incorporated into national risk assessments, preparedness and response planning to reduce the adverse impacts of a disease outbreak in wild birds, poultry, or humans.

To provide the most useful information and a uniform structure for surveillance, five strategies for collecting samples in birds have been proposed. Those strategies include:

Investigation of illness/death in birds: A systematic investigation of illness and death in wild birds may be conducted to determine the cause of the illness or the cause of death in birds. This strategy offers the best and earliest probability of detection if a disease is introduced by migratory birds into the United States. Illness and death involving wildlife are often detected by or reported to natural resource agencies and entities. This strategy capitalizes on existing situations of birds without additional birds being handled or killed.

Surveillance in live wild birds: This strategy involves sampling live-captured, apparently healthy birds to detect the presence of a disease. Bird species that represent the highest risk of being exposed to or infected with the disease because of their migratory movement patterns or birds that may be in contact with species from areas with reported outbreaks would be targeted. Where possible, this sampling effort would be coordinated with local projects that already plan on capturing and handling the desired bird species. Coordinating sampling with ongoing projects currently being conducted by state and federal agencies, universities, and others maximizes use of resources and minimizes the need for additional bird capture and handling.

Surveillance in hunter-harvested birds: Check stations for waterfowl hunting or other harvestable bird species would provide an opportunity to sample dead birds to determine the presence of a disease and supplement data collected during surveillance of live wild birds. Sampling of hunter-killed birds would focus on hunted species that are most likely to be exposed to a disease and have relatively direct migratory pathways from those areas to the United States.

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[23]Appendix B contains a list of the common and scientific names of those bird species that WS could address infrequently and/or in low numbers.

[24]Data collected by organizations/agencies conducting research and monitoring will provide a broad species and geographic surveillance effort.

Sentinel species: Waterfowl, gamefowl, and poultry flocks reared in backyard facilities may prove to be valuable for early detection and used for surveillance of diseases. Sentinel waterfowl may also be placed in wetland environments where they are potentially exposed to and infected with disease agents as they commingle with wild birds.

Environmental sampling: Many avian diseases are spread through the intestinal tract of waterfowl and can be detected in both feces and the water in which the birds swim, defecate, and feed. This is the principal means of introduction to naïve birds and potentially to poultry, livestock, and humans. Analysis of water and fecal material from habitats can help to identify specific types of diseases and the pathogenicity of those organisms. Environmental sampling is a reasonably cost effective, technologically achievable method to assess risks to humans, livestock, and other wildlife.

Under the disease sampling strategies listed above that could be implemented to detect or monitor avian diseases in the United States, WS' implementation of those sampling strategies would not adversely affect avian populations in the State. The sampling (*e.g.*, drawing blooding, feather sample, fecal sample) and the subsequent release of live-captured birds would not result in adverse effects since those birds are released unharmed on site. In addition, sampling of sick, dying, or hunter-harvested birds would not result in the additive lethal take of birds that would not have already occurred in the absence of a disease sampling program; therefore, the sampling of birds for diseases would not adversely affect the populations of any of the birds addressed in this EA, nor would sampling of birds result in any take that would not have already occurred in the absence of disease sampling (*e.g.*, hunter harvest).

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

Under a technical assistance only alternative, WS would recommend an integrated methods approach similar to the proposed action alternative (Alternative 1); however, WS would not provide direct operational assistance under this alternative. Methods and techniques recommended would be based on WS' Decision Model using information provided from the requester or from a site visit. In some instances, wildlife-related information provided to the requester by WS could result in tolerance or acceptance of the situation. In other instances, damage management options would be discussed and recommended.

When damage management options were discussed, WS could recommend and demonstrate for use both non-lethal and lethal methods legally available for use to alleviate bird damage. Those persons receiving technical assistance from WS could implement those methods recommended by WS, could employ other methods not recommended by WS, could seek assistance from other entities, or take no further action. However, those persons requesting assistance would likely be those people that would implement methods.

Despite no direct involvement by WS in resolving damage and threats associated with birds in the State, those persons experiencing damage caused by birds could continue to alleviate damage by employing those methods legally available. Appendix C contains a discussion of the methods available for use in managing damage and threats associated with birds. With the exception of mesurol, alpha chloralose, and DRC-1339, all methods listed in Appendix C would be available under this alternative, although not all methods would be available for direct implementation by all persons because several chemical methods would only be available to those persons with pesticide applicators licenses[25]. Mesurol, alpha chloralose, and DRC-1339 are only available for use by WS and therefore would be unavailable for use under this alternative. However, Starlicide™ Complete could be commercially available as a restricted-use pesticide

[25]Pesticide applicators licenses can be obtained by people who meet North Carolina Department of Agriculture and Consumer Services requirements and successfully pass testing requirements

for managing damage associated with starlings, red-winged blackbirds, common grackles, and brown-headed cowbirds at livestock and poultry operations, which contains the same active ingredient as DRC-1339. Management actions taken by non-federal entities would be considered the *environmental status quo*.

Under this alternative, those persons experiencing threats or damage associated with birds in the State could lethally take birds. In order for the property owner or manager to use lethal methods, they must apply for their own depredation permit to take birds from the USFWS and the NCWRC, when required. Lethal removal of birds could continue to occur without a permit, during hunting seasons for some species (*e.g.*, waterfowl), under depredation/control orders for certain species (*e.g.*, blackbirds), or through the issuance of depredation permits by the USFWS and/or the NCWRC. The USFWS and the NCWRC can issue permits for those species of birds protected under the MBTA, while the NCWRC may issue permits for wild turkeys and other resident bird species.

Technical assistance could also be provided by WS as part of the application process for issuing a depredation permit by the USFWS under this alternative, when deemed appropriate. WS could evaluate the damage and complete a Migratory Bird Damage Report for the requester, which would include information on the extent of the damages, the number of birds present, and a recommendation for the number of birds that should be taken to best alleviate the damages. Following the USFWS review of a completed application for a depredation permit from a property owner or manager and the Migratory Bird Damage Report, a depredation permit could be issued to authorize the lethal take of a specified number of each bird species.

Therefore, under this alternative, the number of birds lethally taken would likely be similar to the other alternatives. Take could be similar since take could occur through the issuance of a depredation permit, take could occur under depredation/control orders, take of non-native bird species could occur without the need for a permit, and take would continue to occur during the harvest season for certain species.

This alternative would place the immediate burden of resolving damage on the people requesting assistance. Those persons experiencing damage or were concerned with threats posed by birds could seek assistance from other governmental agencies, private entities, or conduct damage management on their own. Those persons experiencing damage or threats could take action using those methods legally available to alleviate or prevent bird damage as permitted by federal, State, and local laws and regulations or those persons could take no action. Therefore, any potential effects on bird populations in the State would not occur directly from a program implementing technical assistance only. WS' recommendation of lethal methods, including hunting, under this alternative would not limit the ability of those people interested to harvest birds during the regulated season since the USFWS and/or the NCWRC determine the number of birds that may be taken during the hunting season, under depredation permits, under depredation orders, and under control orders.

With the oversight of the USFWS and the NCWRC, it is unlikely that bird populations would be adversely affected by implementation of this alternative. Under this alternative, WS would not be directly involved with damage management actions and direct operational assistance could be provided by other entities, such as the NCWRC, the USFWS, private entities, and/or municipal authorities. If direct operational assistance was not available from WS or other entities, it is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal take, which could lead to real but unknown effects on other wildlife populations. People have resorted to the illegal use of chemicals and methods to alleviate wildlife damage issues (*e.g.*, see White et al. 1989, USFWS 2001, FDA 2003).

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, WS would not conduct technical or direct operational assistance to reduce threats to human health and safety, or alleviate damage to agricultural resources, property, and natural resources. WS would not be involved with any aspect of bird damage management in the State. All requests for assistance received by WS to resolve damage caused by birds would be referred to the USFWS, the NCWRC, the NCDACS, and/or private entities.

Despite no involvement by WS in resolving damage and threats associated with birds in the State, those people experiencing damage caused by birds could continue to alleviate damage by employing both non-lethal and lethal methods. Similar to Alternative 2, with the exception of mesurol, alpha chloralose, and DRC-1339, all methods listed in Appendix C would be available under this alternative, although not all methods would be available for direct implementation by all persons because several chemical methods would only be available to those people with pesticide applicators licenses. Mesurol, alpha chloralose, and DRC-1339 would only be available for use by WS and therefore would be unavailable for use under this alternative. However, a product containing the same active ingredient as DRC-1339, Starlicide™ Complete, could become commercially available as a restricted-use pesticide for managing damage associated with starlings, red-winged blackbirds, common grackles, and brown-headed cowbirds at livestock and poultry operations.

Lethal take of birds could continue to occur without the need for a permit, during hunting seasons, under depredation/control orders, or through the issuance of depredation permits by the USFWS and/or the NCWRC, when required. The USFWS and/or the NCWRC can issue permits for those species of birds protected under the MBTA, while the NCWRC may issue permits for resident bird species, such as wild turkeys. WS would have no impact on the ability to harvest birds under this alternative. Management actions taken by non-federal entities would be considered the *environmental status quo*.

Under this alternative, property owners/managers may have difficulty obtaining permits to use lethal methods. As detailed above in Alternative 1, the USFWS requires that permittees contact WS to obtain a recommendation (*i.e.*, technical assistance) on how to address bird damage as part of the permitting process. When completing a Migratory Bird Damage Report for a requester, WS would evaluate the situation and then issue a recommendation describing the damage, species involved, number of individual birds involved, previous actions taken to address the problem, and recommendations on how to address the problem. Under this alternative, WS would not assist the requester in preparing the Migratory Bird Damage Report for submission to the USFWS. The USFWS does not have the mandate or the resources to conduct damage management activities. Therefore, State agencies with responsibilities for migratory birds would likely have to collect the information needed to complete the Migratory Bird Damage Report. If the NCWRC, the NCDACS, or another entity provided the information to the USFWS, they could review the application and make a determination as described in Alternative 1.

In some cases, the number of birds lethally removed under this alternative would likely be similar to the other alternatives. Take would be similar since lethal removal could continue to occur without the need for a permit, during hunting seasons, under depredation/control orders, or through the issuance of depredation permits by the USFWS. WS' involvement would not be additive to the lethal removal that could occur since the people requesting WS' assistance could conduct bird damage management activities without WS' involvement.

This alternative would place the immediate burden of operational damage management work on the resource owner, other governmental agencies, and/or private businesses. Those people experiencing damage or threats could take action using those methods legally available to resolve or prevent bird damage as permitted by federal, state, and local laws and regulations, or those persons could take no action.

As previously stated, WS would not be involved with any aspect of addressing damage or threats of damage caused by birds under this alternative. Management actions could be undertaken by a property owner or manager, provided by private entities, provided by volunteer services of private individuals or organizations, or provided by other entities, such as the USFWS and the NCWRC. If direct operational assistance and technical assistance were not provided by WS or another entity, it is possible that frustration caused by the inability to reduce damage and threats, along with ignorance on how best to reduce damage and threats, could lead to the inappropriate use of legal methods and the use of illegal methods. This may occur if those people or organizations providing technical assistance have less technical knowledge and experience managing wildlife damage than WS. Illegal, unsafe, and environmentally unfriendly actions could lead to real but unknown effects. In the past, people have resorted to the illegal use of chemicals and methods to alleviate wildlife damage issues (*e.g.*, see White et al. 1989, USFWS 2001, FDA 2003).

Issue 2 - Effects on Non-target Wildlife Species Populations, Including T&E Species

As discussed previously, a concern is often raised about the potential impacts to non-target species, including T&E species, from the use of methods to resolve damage caused by birds. The potential effects on the populations of non-target wildlife species, including T&E species, are analyzed below.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

The proposed action/no action alternative would continue the current implementation of an adaptive integrated methods approach utilizing non-lethal and lethal techniques, as deemed appropriate using the WS Decision Model, to reduce damage and threats associated with birds in North Carolina. WS' personnel use a thought process for evaluating and responding to requests for assistance detailed in the WS Decision Model (see WS Directive 2.201) and described by Slate et al. (1992). As part of that thought process, WS' employees would consider the methods available and their potential to disperse, capture, or kill non-targets based on the use pattern of the method.

Personnel from WS would be experienced and trained in wildlife identification to identify damage or recognize damage threats. In addition, WS' employees would be knowledgeable in the use patterns of methods to select the most appropriate methods to address target animals and exclude non-target species. To reduce the likelihood of capturing non-target wildlife, WS would employ the most selective methods for the target species, would employ the use of attractants that were as specific to target species as possible, and determine placement of methods to avoid exposure to non-targets. SOPs to prevent and reduce any potential adverse effects on non-targets are discussed in Chapter 3 of this EA. Despite the best efforts to minimize non-target take during program activities, the potential for adverse effects to non-targets exists when applying both non-lethal and lethal methods to manage damage or reduce threats to safety.

Non-lethal methods have the potential to cause adverse effects to non-targets primarily through exclusion, harassment, dispersal, and could include inadvertently live capturing non-target animals. Any exclusionary device erected to prevent access of target species also potentially excludes species that are not the primary reason the exclusion was erected; therefore, non-target species excluded from areas may potentially be adversely impacted if the area excluded were large enough. The use of auditory and visual dispersal methods used to reduce damage or threats caused by birds would also likely disperse non-targets in the immediate area the methods were employed. Therefore, non-targets could be dispersed from an area while employing non-lethal harassment and dispersal techniques. However, like target species, the potential impacts on non-target species would likely be temporary with target and non-target species often returning after the cessation of dispersal methods. Non-lethal dispersal and harassment methods would not be employed over large geographical areas or applied at such intensity that essential resources (*e.g*., food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal harassment and dispersal methods would generally be regarded as having minimal impacts on overall populations of wildlife since individuals of those species would be unharmed. The use of non-lethal harassment and dispersal methods would not have adverse impacts on non-target populations in the State under any of the alternatives.

Other non-lethal methods available for use under this alternative include live traps, nets, nest destruction, translocation, and repellents. Live traps (*e.g*., cage traps, walk-in traps, decoy traps) and nets (*e.g*., cannon nets, mist nets, bow nets, dipping nets) restrain birds once captured and would be considered live-capture methods. Live traps and nets have the potential to capture non-target wildlife. Trap and net placement in areas where target species were active and the use of target-specific attractants would likely minimize the capture of non-targets. If live traps and nets were attended to appropriately, any non-targets captured could be released on site unharmed.

Nets could include the use of net guns, net launchers, cannon/rocket nets, drop nets, bow nets, dipping nets, and mist nets. Nets would virtually be selective for target individuals since application would occur by attending personnel, with handling of wildlife occurring after deployment of the net or nets would be checked frequently to address any live-captured wildlife. Therefore, any non-targets captured using nets could be immediately released on site. Any potential non-targets captured using non-lethal methods would be handled in such a manner as to ensure the survivability of the animal if released. Even though live-capture does occur from those methods, the potential for death of a target or non-target animal while being restrained or released does exist, primarily from being struck by the net gun/launcher weights, or cannon/rocket assemblies during deployment. The likelihood of non-targets being struck is extremely low and is based on being present when the net is activated and in a position to be struck. Nets would be positioned to envelop wildlife upon deployment and to minimize striking hazards. Baiting of the areas to attract target species often occurs when using nets. Therefore, sites could be abandoned if non-target use of the area was high.

Destruction of eggs and nests would not adversely affect non-target species because identification of eggs and the nest would occur prior to efforts to destroy the nest. Non-lethal methods that use auditory and visual stimuli to reduce or prevent damage could be employed to elicit fright responses in target bird species. When employing those methods to disperse or harass target species, any non-targets near those methods when employed would also likely be dispersed from the area. Similarly, any exclusionary device constructed to prevent access by target species would also exclude access to non-target species. The persistent use of non-lethal methods would likely result in the dispersal or abandonment of those areas by both target and non-target species where non-lethal methods were employed. Therefore, any use of non-lethal methods would have similar results on both non-target and target species. Although non-lethal methods do not result in lethal take of non-targets, the use of non-lethal methods could restrict or prevent access of non-targets to beneficial resources. Overall, potential impacts to non-targets from the use of non-lethal methods would not adversely affect populations since those methods would often be temporary.

Only those repellents registered with the EPA pursuant to the FIFRA and registered with the NCDACS for use in the State would be recommended and used by WS under this alternative. Therefore, the use and recommendation of repellents would not have negative effects on non-target species when used according to label requirements. Many taste repellents for birds are derived from natural ingredients that pose a very low risk to non-targets when exposed to or when ingested.

Two chemicals commonly registered with the EPA as bird taste repellents are methyl anthranilate and anthraquinone. Methyl anthranilate naturally occurs in grapes. Methyl anthranilate has been used to flavor food, candy, and soft drinks. Anthraquinone naturally occurs in plants, like aloe. Anthraquinone has also been used to make dye. Both chemicals claim to be unpalatable to many bird species. Several products are registered for use to reduce bird damage containing either methyl anthranilate or anthraquinone. Formulations containing those chemicals are liquids that are applied directly to susceptible resources. Methyl anthranilate applied to alleviate goose damage was effective for about four days depending on environmental conditions, which was a similar duration experienced when applying anthraquinone as geese continued to feed on treated areas (Cummings et al. 1995, Dolbeer et al. 1998). Dolbeer et al. (1998) found that geese tended to loaf on anthraquinone treated turf at a lower abundance, but the quantity of feces on treated and untreated turf was the same; thus, the risk of damage was unabated. Mesurol is applied directly inside eggs that are of a similar appearance to those being predated on by crows. Therefore, risks to non-targets would be restricted to those wildlife species that would select for the egg baits. Additional label requirements limiting the number of treated eggs per acre and detailing the removal and disposal process for unconsumed or unused treated eggs would further limit the risk to non-target species. Adherence to the label requirements of mesurol would ensure threats to non-targets would be minimal. Avitrol is a flock dispersing method available to manage damage caused by house sparrows, blackbirds, crows, starlings, and pigeons. When used in accordance with the label requirements, the use of Avitrol would also not adversely affect non-targets based on restrictions on baiting locations (Schafer et al. 1974).

The immobilizing drug alpha chloralose could be available to target waterfowl, geese, and pigeons. Immobilizing drugs could be applied through hand baiting that would target specific individuals or groups of target species. Therefore, immobilizing drugs would only be applied after identification of the target occurred prior to application. Pre-baiting and acclimation of the target species would occur prior to the application of alpha chloralose, which would allow for the identification of non-targets that may visit the site prior to application of the bait. All unconsumed bait would be retrieved after the application session had been completed. Since sedation occurs after consumption of the bait, personnel would be present on site at all times to retrieve target species. This constant presence by WS' personnel would allow for continual monitoring of the bait to ensure non-targets were not present. Based on the use pattern of alpha chloralose by WS, no adverse effects to non-targets would be expected from the use of alpha chloralose.

Since products containing the active ingredient nicarbazin could be commercially available and purchased by people with a certified applicators license, the use of the product could occur under any of the alternatives discussed in the EA; therefore, the effects of the use would be similar across all the alternatives if the product were used according to label instructions. Under the proposed action, WS could use or recommend products containing nicarbazin as part of an integrated approach to managing damage associated with geese, domestic waterfowl, and pigeons if products were registered for use in North Carolina. A product containing the active ingredient nicarbazin is currently registered in the State to manage local pigeon populations. Products containing nicarbazin are not currently registered in the State for use to manage local goose and domestic waterfowl populations. WS' use of nicarbazin under the proposed action would not be additive since the use of the product could occur from other sources, such as private pest management companies or those people experiencing damage could become a certified applicator and apply the bait themselves when the appropriate depredation permits were received[26].

[26]A depredation permit would only be required when managing localized Canada goose populations. A depredation permit would not be required to manage pigeon or domestic waterfowl populations.

Exposure of non-target wildlife to nicarbazin could occur from direct ingestion of the bait by non-target wildlife or from secondary hazards associated with wildlife consuming birds that have eaten treated bait. Several label restrictions of products containing nicarbazin are intended to reduce risks to non-target wildlife from direct consumption of treated bait (EPA 2005). The labels require an acclimation period that habituates target birds to feeding in one location at a certain time. During baiting periods, the applicator must be present on site until all bait has been consumed. Non-target risks can be further minimized by requirements on where treated baits can be placed. All unconsumed bait must also be retrieved daily, which further reduces threats of non-targets consuming treated bait.

In addition, nicarbazin is only effective in reducing the hatch of eggs when blood levels of 4,4'-dinitrocarbanilide (DNC) are sufficiently elevated in a bird species. When consumed by birds, nicarbazin is broken down into the two base components of DNC and 2-hydroxy-4,6-dimethylpyrimidine (HDP), which are then rapidly excreted. To maintain the high blood levels required to reduce egg hatch, birds must consume nicarbazin daily at a sufficient dosage that appears to be variable depending on the bird species (Yoder et al. 2005, Avery et al. 2006). For example, to reduce egg hatch in Canada Geese, geese must consume nicarbazin at 2,500 ppm compared to 5,000 ppm required to reduce egg hatch in pigeons (Avery et al. 2006, Avery et al. 2008*b*). In pigeons, consuming nicarbazin at a rate that would reduce egg hatch in Canada Geese did not reduce the hatchability of eggs in pigeons (Avery et al. 2006). With the rapid excretion of the two components of nicarbazin (DNC and HDP) in birds, non-targets birds would have to consume nicarbazin daily at sufficient doses to reduce the rate of egg hatching.

Secondary hazards also exist from wildlife consuming geese, domestic waterfowl, or pigeons that have ingested nicarbazin. As mentioned previously, once consumed, nicarbazin is rapidly broken down into the two base components of DNC and HDP. DNC is the component of nicarbazin that limits egg hatchability while HDP only aids in absorption of DNC into the bloodstream. DNC is not readily absorbed into the bloodstream and requires the presence of HDP to aid in absorption of appropriate levels of DNC. Therefore, to pose a secondary hazard to wildlife, ingestion of both DNC and HDP from the carcass would have to occur and HDP would have to be consumed at a level to allow for absorption of the DNC into the bloodstream. In addition, an appropriate level of DNC and HDP would have to be consumed from a carcass daily to produce any negative reproductive effects to other wildlife since current evidence indicates a single dose does not limit reproduction. To be effective, nicarbazin (both DNC and HDP) must be consumed daily during the duration of the reproductive season to limit the hatchability of eggs. Therefore, to experience the reproductive effects of nicarbazin, geese, domestic waterfowl, or pigeons that had consumed nicarbazin would have to be consumed by a non-target species daily and a high enough level of DNC and HDP would have to be available in the carcass and consumed for reproduction to be affected. Based on the risks and likelihood of wildlife consuming a treated carcass daily and receiving the appropriate levels of DNC and HDP daily to negatively impact reproduction, secondary hazards to wildlife from the use of nicarbazin are extremely low (EPA 2005).

Although some risks to other non-target species besides bird species does occur from the use of products containing nicarbazin, those risks would likely be minimal given the restrictions on where and how bait could be applied. Although limited toxicological information for nicarbazin exists for wildlife species besides certain bird species, available toxicology data indicates nicarbazin is relatively non-toxic to other wildlife species (World Health Organization 1998, EPA 2005, California Department of Pesticide Regulation 2007). Given the use restriction of nicarbazin products and the limited locations where bait could be applied, the risks of exposure to non-targets would be extremely low.

Impacts to non-targets from the use of non-lethal methods would be similar to the use of non-lethal methods under any of the alternatives. Non-targets would generally be unharmed from the use of non-lethal methods under any of the alternatives since no lethal take would occur. Non-lethal methods would be available under all the alternatives analyzed. WS' involvement in the use of or recommendation of non-lethal methods would ensure non-target impacts are considered under WS' Decision Model. Impacts to non-targets under this alternative from the use of and/or the recommendation of non-lethal methods are likely to be low.

WS would also employ and/or recommend lethal methods under the proposed action alternative to alleviate damage. Lethal methods available for use to manage damage caused by birds under this alternative would include shooting, lethal traps, egg destruction, and DRC-1339. In addition, birds could also be euthanized once live-captured by other methods. Available methods and the application of those methods to alleviate bird damage are further discussed in Appendix C. In addition, birds could still be lethally removed during the regulated harvest season, through depredation/control orders, and through the issuance of depredation permits under this alternative.

The use of firearms would essentially be selective for target species since birds would be identified prior to application; therefore, no adverse effects to non-targets would be anticipated from use of this method. The euthanasia of birds by WS' personnel would be conducted in accordance with WS Directive 2.505. Chemical methods used for euthanasia would be limited to carbon dioxide administered in an enclosed chamber after birds were live-captured. Since live-capture of birds using other methods would occur prior to the administering of carbon dioxide, no adverse effects to non-targets would occur under this alternative. WS' recommendation that birds be harvested during the regulated season by private entities to alleviate damage would not increase risks to non-targets. Shooting would essentially be selective for target species and the unintentional lethal removal of non-targets would not likely increase based on WS' recommendation of the method. Additionally, when appropriate, WS would use suppressed firearms to minimize noise and the associated dispersal effect that could occur from the discharge of a firearm.

As mentioned previously, the avicide DRC-1339 is only available for use by WS and would therefore only be available under the proposed action alternative. However, a product containing the same active ingredient, 3-chloro-p-toluidine hydrochloride ($C_7H_9Cl_2N$), as DRC-1339, called Starlicide™ Complete, could become commercially available as a restricted-use pesticide and would be available under any of the alternatives. A common concern with the use of DRC-1339 is the potential non-target risks. All label requirements of DRC-1339 would be followed to minimize non-target hazards. As required by the label, all potential bait sites would be pre-baited and monitored for non-target use as outlined in the pre-treatment observations section of the label. If non-targets were observed feeding on the pre-bait, the plots would be abandoned and no baiting would occur at those locations. Treated bait would be mixed with untreated bait per label requirements when applied to bait sites to minimize the likelihood of non-targets finding and consuming bait that had been treated. The bait type selected can also limit the likelihood that non-target species would consume treated bait since some bait types would not be preferred by non-target species.

Once sites were baited, sites would be monitored daily to observe for non-target feeding activity. If non-targets were observed feeding on bait, those sites would be abandoned. By acclimating target bird species to a feeding schedule, baiting could occur at specific times to ensure bait would be quickly consumed by target bird species, especially when large flocks of target species were present. The acclimation period would allow treated bait to be present only when birds were conditioned to be present at the site. An acclimation period would also increase the likelihood that treated bait would be consumed by the target species, which would make it unavailable to non-targets. In addition, when present in large numbers, many bird species tend to exclude non-targets from a feeding area due to their aggressive behavior and by the large number of conspecifics present at the location. Therefore, risks to non-target species from consuming treated bait would only occur when treated bait was present at a bait location. WS would retrieve all dead birds, to the extent possible, following treatment with DRC-1339 to minimize secondary hazards associated with scavengers feeding on bird carcasses.

DRC-1339 Primary Hazard Profile **-** DRC-1339 was selected for reducing bird damage because of its high toxicity to blackbirds (DeCino et al. 1966, West et al. 1967, Schafer 1972) and low toxicity to most mammals, sparrows, and finches (Schafer and Cunningham 1966, Apostolou 1969, Schafer 1972, Schafer et al. 1977, Matteson 1978, Cunningham et al. 1979, Cummings et al. 1992, Sterner et al. 1992). The likelihood of a non-target bird obtaining a lethal dose would be dependent on the frequency of encountering the bait, length of feeding, the bait dilution rate, the bird's propensity to select against the treated bait, and the susceptibility of the non-target species to the toxicant. Birds that ingest DRC-1339 probably die because of irreversible necrosis of the kidney and subsequent inability to excrete uric acid (*i.e*., uremic poisoning) (DeCino et al. 1966, Felsenstein et al. 1974, Knittle et al. 1990). Birds ingesting a lethal dose of DRC-1339 usually die in one to three days.

The median acute lethal dose (LD_{50})[27] values for starlings, blackbirds, and magpies (Corvidae) range from one to five mg/kg (Eisemann et al. 2003). For American crows, the median acute lethal dose has been estimated at 1.33 mg/kg (DeCino et al. 1966). The acute oral toxicity (LD_{50}) of DRC-1339 has been estimated for over 55 species of birds (Eisemann et al. 2003). DRC-1339 is toxic to mourning doves, pigeons, quail (*Coturnix coturnix*), chickens, and ducks (*Anas* spp.) at ≥5.6 mg/kg (DeCino et al. 1966). In cage trials, Cummings et al. (1992) found that 2% DRC-1339 treated rice did not kill savannah sparrows (*Passerculus sandwichensis*). Gallinaceous birds and waterfowl may be more resistant to DRC-1339 than blackbirds, and their large size may reduce the chances of ingesting a lethal dose (DeCino et al. 1966). Avian reproduction does not appear to be affected from ingestion of DRC-1339 treated baits until levels are ingested where toxicity is expressed (USDA 2001).

There have been concerns expressed about the study designs used to derive acute lethal doses of DRC-1339 for some bird species (Gamble et al. 2003). The appropriateness of study designs used to determine acute toxicity to pesticides has many views (Lipnick et al. 1995). The use of small sample sizes was the preferred method of screening for toxicity beginning as early as 1948 to minimize the number of animals involved (Dixon and Mood 1948). In 1982, the EPA established standardized methods for testing for acute toxicity that favored larger sample sizes (EPA 1982). More recently, regulatory agencies have again begun to debate the appropriate level of sample sizes in determining acute toxicity based on a growing public concern for the number of animals used for scientific purposes.

Based on those concerns, the Ecological Committee on FIFRA Risk Assessment was established by the EPA to provide guidance on ecological risk assessment methods (EPA 1999). The committee report recommended to the EPA that only one definitive LD_{50} be used in toxicity screening either on the mallard or northern bobwhite and recommended further testing be conducted using the up-and-down method (EPA 1999). Many of the screening methods used for DRC-1339 prior to the establishment of EPA guidelines in 1982 used the up-and-down method of screening (Eisemann et al. 2003).

A review of the literature shows that LD_{50} research using smaller sample sizes conducted prior to EPA established guidelines are good indicators of LD_{50} derived from more rigorous designs (Bruce 1985, Bruce 1987, Lipnick et al. 1995). Therefore, acute and chronic toxicity data gathered prior to EPA guidance remain valid and to ignore the data would be inappropriate and wasteful of animal life (Eisemann et al. 2003).

DRC-1339 Secondary Hazards **-** Secondary poisoning has not been observed with DRC-1339 treated baits. During research studies, carcasses of birds that died from DRC-1339 were fed to raptors and scavenger mammals for 30 to 200 days with no symptoms of secondary poisoning observed (Cunningham et al. 1979). This can be attributed to relatively low toxicity to species that might scavenge on blackbirds

[27]An LD_{50} is the dosage in milligrams of material per kilogram of body weight required to cause death in 50% of a test population of a species.

killed by DRC-1339 and its tendency to be almost completely metabolized in the target birds, which leaves little residue to be ingested by scavengers.

DRC-1339 is rapidly metabolized and excreted; therefore, the avicide does not bioaccumulate, which probably accounts for its low secondary hazard profile (Schafer 1991). For example, cats, owls, and magpies would be at risk only after exclusively eating DRC-1339 poisoned starlings for 30 continuous days (Cunningham et al. 1979). According to the EPA (1995), laboratory studies with raptors indicated no adverse effects when certain raptor species were fed starlings poisoned with 1% DRC-1339 treated baits. Two American kestrels survived eating 11 and 60 poisoned starlings over 24 and 141 days, respectively. Two Cooper's hawks ate 191 and 222 starlings with no observable adverse effects. Three northern harriers ate 100, 191, and 222 starlings over 75 to 104 days and survived with no apparent detrimental effects. The LD_{50} values established for other avian predators and scavengers such as crows, ravens, and owls indicate these species are acutely more sensitive to DRC-1339 than hawks and kestrels (EPA 1995). The risk to mammalian predators from feeding on birds killed with DRC-1339 appears to be low (Johnston et al. 1999).

The risks associated with non-target animal exposure to DRC-1339 baits have been evaluated in rice fields in Louisiana (Glahn et al. 1990, Cummings et al. 1992, Glahn and Wilson 1992), poultry and cattle feedlots in several western states (Besser 1964, Ford 1967, Royall et al. 1967), ripening sunflower fields in North Dakota (Linz et al. 2000), and around blackbird staging areas in east-central South Dakota (Knutsen 1998, Linz et al. 1999, Smith 1999). Smith (1999) used field personnel and dogs to search for dead non-target animals around sites baited with DRC-1339. Smith (1999) did not find carcasses of non-targets that exhibited histological signs consistent with DRC-1339 poisoning. Other studies also failed to detect any non-target birds that had succumbed to DRC-1339. However, DRC-1339 is a slow-acting avicide and thus, some birds could move to areas not searched by the study participants before dying.

***DRC-1339 Environmental Degradation* -** DRC-1339 is unstable in the environment; therefore, DRC-1339 degrades rapidly when exposed to sunlight, heat, or ultra violet radiation and has a short half-life (EPA 1995). DRC-1339 is highly soluble in water but does not hydrolyze and degradation occurs rapidly in water. The chemical tightly binds to soil and has low mobility. The half-life is about 25 hours, which means it is nearly 100% broken down within a week, and identified metabolites (*i.e*., degradation chemicals) have low toxicity.

Additional concerns have been raised regarding the risks to non-target wildlife associated with crows caching bait treated with DRC-1339. Crows are known to cache surplus food usually by making a small hole in the soil using the bill, by pushing the food item under the substrate, or covering items with debris (Verbeek and Caffrey 2002). Distances traveled from where the food items were gathered to where the item is cached varies, but some studies suggest crows can travel from 100 meters (Kilham 1989) up to 2 kilometers (Cristol 2001, Cristol 2005). Caching activities appear to occur throughout the year, but may increase when food supplies are low. Therefore, the potential for treated baits to be carried from a bait site to surrounding areas exists as part of the food cache behavior exhibited by crows.

Several factors must be overcome for non-target risks to occur from bait cached by a crow. Those factors being: 1) the non-target wildlife species would have to locate the cached bait; 2) the bait-type used to target crows would have to be palatable or selected for by the non-target wildlife; 3) the non-target wildlife species consuming the treated bait would have to consume a lethal dose from a single bait; and 4) if a lethal dose is not achieved by eating a single treated cached bait, the non-target wildlife would have to ingest several treated baits (either from cached bait or from the bait site) to obtain a lethal dose, which could vary by the species.

DRC-1339 is typically very unstable in the environment and degrades quickly when exposed to sunlight, heat, and ultraviolet radiation. The half-life of DRC-1339 in biologically active soil was estimated at 25 hours with the identified metabolites having a low toxicity (EPA 1995). DRC-1339 is also highly soluble in water, does not hydrolyze, and photodegrades quickly in water with a half-life estimated at 6.3 hours in summer, 9.2 hours in spring sunlight, and 41 hours during winter (EPA 1995). DRC-1339 binds tightly with soil; thus, the avicide is considered to have low mobility (EPA 1995). Given the best environmental fate information available and the unlikelihood of a non-target locating enough treated bait(s) sufficient to produce lethal effects, the risks to non-targets from crows caching treated bait would be low. Treated bait would be mixed with untreated bait before baiting an area. Mixing treated bait with untreated bait would minimize non-target hazards and reduce the likelihood of the target species developing bait aversion. Since treated bait is diluted, often times up to 1 treated bait for every 25 untreated baits, the likelihood of a crow selecting treated bait and then caching the bait is further reduced.

While WS would take precautions to safeguard against taking non-targets during operational use of methods and techniques for resolving damage and reducing threats caused by birds, the use of such methods can result in the incidental take of unintended species. Those occurrences would be rare and should not affect the overall populations of any species under the proposed action. WS' take of non-target species during activities to reduce damage or threats to human safety associated with birds in North Carolina would be expected to be extremely low to non-existent. From FY 2011 through FY 2016, the only take of non-target animals by WS occurred in FY 2015 when two common grackles were unintentionally killed in a trap intended for other bird species. WS would monitor the take of non-target species to ensure program activities or methodologies used in bird damage management do not adversely affect non-targets. Methods available to alleviate and prevent bird damage or threats when employed by trained, knowledgeable personnel are selective for target species. WS would annually report to the USFWS and/or the NCWRC any non-target take to ensure take by WS is considered as part of management objectives established. The potential impacts to non-targets would be similar to the other alternatives and are considered minimal to non-existent.

The proposed bird damage management could benefit many other wildlife species that were adversely affected by predation or competition for resources. For example, crows are generally very aggressive nesting area colonizers and they will force other species from those nesting areas. American crows and fish crows often feed on the eggs, nestlings, and fledglings of other bird species. Fish crows are known to feed heavily on colonial waterbird eggs (McGowan 2001). This alternative has the greatest possibility of successfully reducing bird damage and conflicts to wildlife species since all available methods could possibly be implemented or recommended by WS.

T&E SPECIES EFFECTS

Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or mitigation measures. SOPs to avoid T&E effects are described in Chapter 3 of this EA.

Federally Listed Species – WS reviewed the current list of species designated as threatened or endangered in North Carolina as determined by the USFWS and the National Marine Fisheries Services during the development of this EA. Appendix D contains the list of species currently listed in the State along with common and scientific names.

No take of threatened or endangered species by WS has occurred previously in the State during the implementation of activities and the use of methods to manage the damage that birds cause. Based on a review of those T&E species listed in the State during the development of the EA, WS determined that activities conducted pursuant to the proposed action would have no effect on most species listed as threatened or endangered in the State by the USFWS and the National Marine Fisheries Services and would have no effect on any critical habitats designated within the State. For several species listed within the State, WS determined that the proposed activities "*may affect*" those species but those effects would be solely beneficial, insignificant, or discountable, which would warrant a "*not likely to adversely affect*" determination. Based on those determinations, WS initiated informal consultation with the USFWS for those species that a "*may affect*, *not likely to adversely affect*" determination was made. The USFWS concurred with WS' determination that activities conducted pursuant to the proposed action would not likely adversely affect those species (A. Ratzlaff, USFWS, pers. comm. 2017, J. Hammond, USFWS, pers. comm. 2017).

During the public involvement period for this EA, the USFWS listed the yellow lance (*Elliptio lanceolata*) as a threatened species within the state. The yellow lance is a freshwater mussel that is often found buried in clean, course to medium sand within moderate flowing water in riverine or larger creek environments. The Yellow Lance is associated with the Tar-Pamlico and Neuse River basins in North Carolina. The yellow Lance occurs or is thought to occur in Edgecombe, Franklin, Granville, Halifax, Johnston, Nash, Pitt, Vance, Wake, Warren, Wayne, and Wilson Counties within the state. The primary threats to the yellow lance are habitat degradation associated with water quality, water quantity, instream habitat, and habitat connectivity associated with human development, agricultural practices, forest management, barriers, and invasive species (United States Fish and Wildlife Service 2018). Activities to manage bird damage would not result in major ground disturbances, siltation, pollution, or stream alterations. Based on the use patterns of methods, implementation of Alternative 1 would have no effect on the status of the yellow lance.

Based on the use pattern of the methods and the locations where WS could implement damage management activities, the implementation of Alternative 1 would have no effect on those threatened or endangered species in North Carolina under the jurisdiction of the National Marine Fisheries Service, including any designated crtical habitat. WS would continue to consult with the USFWS and/or the National Marine Fisheries Service to evaluate activities to resolve bird damage to ensure the protection of threatened or endangered species and to comply with the ESA.

State Listed Species – WS has reviewed the current list of protected state non-game species in North Carolina (see Appendix E). Based on the review of those species, WS has determined that the proposed activities would have no effect on those species.

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

Under a technical assistance alternative, WS would have no direct impact on non-target species, including T&E species. Methods recommended or provided through loaning of equipment could be employed by those people requesting assistance. Recommendations would be based on WS' Decision Model using information provided by the person requesting assistance or through site visits. Recommendations would include methods or techniques to minimize non-target impacts associated with the methods being recommended or loaned. Methods recommended could include non-lethal and lethal methods as deemed appropriate by WS' Decision Model and as permitted by laws and regulations. The only methods that would not be available under a technical assistance only alternative would include DRC-1339, alpha chloralose, and mesurol, which would only be available for use by WS' employees.

The potential impacts to non-targets under this alternative would be variable and based on several factors. If methods were employed, as recommended by WS, the potential impacts to non-targets would likely be similar to the proposed action. If recommended methods and techniques are not followed or if other methods are employed that were not recommended, the potential impacts on non-target species, including T&E species is likely higher compared to the proposed action.

The potential impacts of harassment and exclusion methods to non-target species would be similar to those described under the proposed action. Harassment and exclusion methods are easily obtainable and simple to employ. Since identification of targets would occur when employing shooting as a method and if people were familiar with the identifying characteristics of the target bird species, the potential impacts to non-target species would likely be low under this alternative.

Those people experiencing damage from birds may implement methods and techniques based on the recommendations of WS. The potential for impacts would be based on the knowledge and skill of those persons implementing recommended methods. Potential impacts from providing only technical assistance could be greater than those described in the proposed action if those people experiencing damage do not implement methods or techniques correctly. Methods or techniques recommended by WS that were implemented incorrectly could lead to an increase in non-target take.

If requesters were provided technical assistance but do not implement any of the recommended actions and take other actions, the potential impacts to non-targets could be higher compared to the proposed action. If those people requesting assistance implement recommended methods appropriately and as instructed or demonstrated, the potential impacts to non-targets would be similar to the proposed action. Methods or techniques that were not implemented as recommended or were used inappropriately would likely increase potential impacts to non-targets. Therefore, the potential impacts to non-targets, including T&E species would be variable under a technical assistance only alternative.

It is possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal killing of birds, which could lead to unknown effects on local non-target species populations, including some T&E species. When those people experiencing damage caused by wildlife reach a level where assistance does not adequately reduce damage or where no assistance is available, people have resorted to using chemical toxicants that are illegal for use on the intended target species (*e.g.*, see White et al. 1989, USFWS 2001, FDA 2003). The use of illegal toxicants by those persons frustrated with the lack of assistance or assistance that inadequately reduces damage to an acceptable level can often result in the indiscriminate take of wildlife species.

Those persons requesting assistance would likely be those people who would use lethal methods since a damage threshold had been met for that individual requester that triggered seeking assistance to reduce damage. The potential impacts on non-targets by those persons experiencing damage would be highly variable. People whose bird damage problems were not effectively alleviated by non-lethal methods could resort to other means of legal or illegal lethal control. This could result in less experienced persons implementing control methods and could lead to greater take of non-target wildlife than the proposed action.

The ability to reduce negative impacts caused by birds to wildlife species and their habitats, including T&E species, would be variable based upon the skills and abilities of the person implementing damage management actions. It would be expected that this alternative would have a greater chance of reducing damage than Alternative 3 since WS would be available to provide information and advice.

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, WS would not be directly involved with damage management activities in the State. Therefore, no direct impacts to non-targets or T&E species would occur by WS under this alternative. Birds could continue to be taken under depredation permits issued by the USFWS and the NCWRC, take could continue to occur during the regulated harvest season, non-native bird species could continue to be taken without the need for a permit, and birds could still be taken under their respective depredation/control orders. Risks to non-targets and T&E species would continue to occur from those people who implement damage management activities on their own or through recommendations by the other federal, state, and private entities. Although some risks would occur from those people that implement bird damage management in the absence of any involvement by WS, those risks would likely be low, and would be similar to those under the other alternatives.

The ability to reduce damage and threats of damage caused by birds would be variable based upon the skills and abilities of the person implementing damage management actions under this alternative. The risks to non-targets and T&E species would be similar across the alternatives since most of those methods described in Appendix C would be available across the alternatives. If those methods available were applied as intended, risks to non-targets would be minimal to non-existent. If methods available were applied incorrectly or applied without knowledge of animal behavior, risks to non-target wildlife would be higher under this alternative. If frustration from the lack of available assistance caused those persons experiencing bird damage to use methods that were not legally available for use, risks to non-targets would be higher under this alternative. People have resorted to the use of illegal methods to alleviate wildlife damage that have resulted in the lethal take of non-target wildlife (*e.g.*, see White et al. 1989, USFWS 2001, FDA 2003).

Issue 3 - Effects of Damage Management Methods on Human Health and Safety

A common concern is the potential adverse effects that available methods could have on human health and safety. The threats to human safety of methods available under the alternatives are evaluated below by each of the alternatives.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

The cooperator requesting assistance would be made aware through a MOU, work initiation document, or a similar document that those methods agreed upon could potentially be used on property owned or managed by the cooperator. Therefore, the cooperator would be made aware of the use of those methods on property they own or manage prior to the initiation of any project, which would assist with identifying any risks to human safety associated with the use of those methods.

Under the proposed action, those methods discussed in Appendix C, would be integrated to resolve and prevent damage associated with birds in the State. WS would use the Decision Model to determine the appropriate method or methods that would effectively resolve the request for assistance. Those methods would be continually evaluated for effectiveness and if necessary, additional methods could be employed. Non-lethal and lethal methods could be used under the proposed action. WS would continue to provide technical assistance and/or direct operational assistance to those persons seeking assistance with managing damage or threats from birds. Risks to human safety from technical assistance conducted by WS would be similar to those risks addressed under the other alternatives. The use of non-lethal methods as part of an integrated approach to managing damage that could be employed as part of direct operational assistance by WS would be similar to those risks addressed in the other alternatives.

Although hazards to human safety from non-lethal methods exist, those methods would generally be regarded as safe when used by trained individuals who were experienced in their use. Although some risk of fire and bodily harm would exist from the use of pyrotechnics, lasers, and propane cannons, when used appropriately and in consideration of those risks, those methods can be used with a high degree of safety.

Lethal methods available under the proposed action would include the use of firearms, egg destruction, DRC-1339, live-capture followed by euthanasia, and the recommendation that birds be harvested during the regulated hunting season established for those species by the USFWS and the NCWRC. Those lethal methods available under the proposed action alternative or similar products would also be available under the other alternatives. Although the avicide DRC-1339 would be restricted to use by WS only, a similar product containing the same active ingredient as DRC-1339 could be made available for use as a restricted use pesticide by other entities. However, at the time this EA was developed, a commercially available product containing the same active ingredient as DRC-1339 for use to manage damage associated with blackbirds and starlings at livestock and poultry operations was not registered for use in the State.

WS' employees who conduct activities would be knowledgeable in the use of methods, wildlife species responsible for causing damage or threats, and WS' directives. That knowledge would be incorporated into the decision-making process inherent with the WS' Decision Model that would be applied when addressing threats and damage caused by birds. Prior to and during the utilization of methods, WS' employees would consider risks to human safety based on location and method. Risks to human safety from the use of methods would likely be greater in urban areas when compared to rural areas that were less densely populated. Consideration would also be given to the location where damage management activities would be conducted based on property ownership. If locations where methods would be employed occurred on private property in rural areas where access to the property was controlled and monitored, the risks to human safety from the use of methods would likely be less. If damage management activities occurred at or near public use areas, then risks of the public encountering damage management methods and the corresponding risk to human safety would increase. Activities would generally be conducted when human activity was minimal (*e.g*., early mornings, at night) or in areas where human activities was minimal (*e.g*., in areas closed to the public).

The use of live-capture traps has also been identified as a potential issue. Traps would typically be set in situations where human activity was minimal to ensure public safety. Traps rarely cause serious injury and would only be triggered through direct activation of the device. Live-capture traps available for birds are typically walk-in style traps, such as box/cage traps, nest traps, or decoy traps, where birds enter but are unable to exit. Other types of live traps include Bal-Chatri traps that utilize small monofilament nooses to ensnare the talons of raptors, pole traps, padded foothold traps, Dho-gaza traps, and mist nets. Human safety concerns associated with live traps used to capture birds require direct contact to cause bodily harm. If live-traps were left undisturbed, risks to human safety would be minimal.

Other live-capture devices, such as net guns, net launchers, bow nets, and mist nets, pose minor safety hazards to the public since activation of the device occurs by trained personnel after target species are observed in the capture area of the net. Lasers also pose minimal risks to the public since application occurs directly to target species by trained personnel, which limits the exposure of the public to misuse of the method.

Many of the non-chemical methods available would only be activated when triggered by attending personnel (*e.g*., cannon nets, firearms, pyrotechnics, lasers), are passive live-capture methods (*e.g*., walk-in style live-traps, mist nets), or are passive harassment methods (*e.g.,* effigies, exclusion techniques, anti-perching devices, electronic distress calls). The primary safety risk of most non-chemical methods occurs directly to the applicator or those people assisting the applicator. However, risks to others do exist when employing non-chemical methods, such as when using firearms, cannon nets, or pyrotechnics. Most of the non-chemical methods available to address bird damage in North Carolina would be available for use under any of the alternatives and could be employed by any entity, when permitted.

Certain safety issues can arise related to misusing firearms and the potential human hazards associated with firearm use when employed to reduce damage and threats. To help ensure safe use and awareness, WS' employees who use firearms to conduct official duties are required to attend an approved firearm safety-training course and to remain certified for firearm use, WS' employees must attend a re-certification safety-training course in accordance with WS Directive 2.615. WS' employees who carry and use firearms as a condition of employment, are required to sign a form certifying that they have not been convicted of a misdemeanor crime of domestic violence. A thorough safety assessment would be conducted before firearms were deemed appropriate to alleviate or reduce damage and threats to human safety when conducting activities. WS would work closely with cooperators requesting assistance to ensure all safety issues were considered before the use of firearms was deemed appropriate. All methods, including firearms, must be agreed upon with the cooperator to ensure the safe use of methods.

All WS' personnel who handle and administer chemical methods would be properly trained in the use of those methods. Training and adherence to agency directives would ensure the safety of employees applying chemical methods. Birds euthanized by WS or lethally removed using chemical methods would be disposed of in accordance with WS Directive 2.515. All euthanasia would occur in the absence of the public to minimize risks. SOPs are further described in Chapter 3 of this EA.

The recommendation of repellents or the use of those repellents registered for use to disperse birds in the State could occur under the proposed action as part of an integrated approach to managing bird damage. Those chemical repellents that would be available to recommend for use or directly used by WS under this alternative would also be available under any of the alternatives. Therefore, risks to human safety from the recommendation of repellents or the direct use of repellents would be similar across all the alternatives. Risks to human safety associated with the use or recommendation of repellents were addressed under the technical assistance only alternative (Alternative 2) and would be similar across all the alternatives. WS' involvement, either through recommending the use of repellents or the direct use of repellents, would ensure that label requirements of those repellents are discussed with those persons requesting assistance when recommended through technical assistance or would be specifically adhered to by WS' personnel when using those chemical methods. Therefore, the risks to human safety associated with the recommendation of or direct use of repellents could be lessened through WS' participation.

Mesurol contains the active ingredient methiocarb. Mesurol is registered by the EPA for use to condition crows not to feed on the eggs of T&E species, but is currently not registered for this purpose in North Carolina. However, mesurol will be evaluated in this assessment as a repellent that could be employed under the proposed action if the product becomes available. Mesurol is mixed with water and once mixed, placed inside raw eggs that are similar in size and appearance to the eggs of the species being protected. Treated eggs are placed in the area where the protected species are known to nest at least three weeks prior to the onset of egg laying to condition crows to avoid feeding on eggs. Methiocarb is a carbamate pesticide that acts as a cholinesterase inhibitor. Crows ingesting treated eggs become sick (*e.g*., regurgitate, become lethargic), but typically recover. Human safety risks associated with the use of mesurol occur primarily to the mixer and handler during preparation. WS' personnel would follow all label requirements, including the personal protective equipment required to handle and mix bait. When used according to label requirements, the risks to human safety from the use of mesurol would be minimal.

Risks to human safety from the use of avicides could occur through direct exposure of the chemical or exposure to the chemical from birds that have been lethally taken. The only avicide currently registered for use in North Carolina is DRC-1339 (3-chloro-p-toluidine hydrochloride) that could be used for bird damage management. DRC-1339 is currently registered with the EPA to manage damage associated with several bird species and can be formulated on a variety of bait types depending on the label. At the time this EA was developed, the only formulations of DRC-1339 registered for use in the State were Compound DRC-1339 Concentrate for blackbird species and starlings at feedlots (EPA Reg. # 56228-10), Compound DRC-1339 Concentrate for pigeons (EPA Reg. # 56228-28), and Compound DRC-1339 Concentrate for staging areas (EPA Reg. # 56228-30.

Technical DRC-1339 (powder) must be mixed with water and in some cases, a binding agent (required by the label for specific bait types). Once the technical DRC-1339, water, and binding agent, if required, are mixed, the liquid is poured over the bait and mixed until the liquid is absorbed and evenly distributed. The treated bait is then allowed to air dry. The mixing, drying, and storage of DRC-1339 treated bait occurs in controlled areas that are not accessible by the public. Therefore, risks to public safety from the preparation of DRC-1339 are minimal. Some risks do occur to the handlers during the mixing process from inhalation and direct exposure on the skin and eyes. Adherence to label requirements during the mixing and handling of DRC-1339 treated bait for use of personal protective equipment ensures the safety of WS' personnel handling and mixing treated bait. Therefore, risks to handlers and mixers that adhere to the personal protective equipment requirements of the label are low. Before application at bait locations, treated bait is mixed with untreated bait at ratios required by the product label to minimize non-target hazards and to avoid bait aversion by target species.

Locations where treated bait may be placed are determined based on product label requirements (*e.g.*, distance from water, specific location restrictions), the target bird species use of the site (determined through prebaiting and an acclimation period), on non-target use of the area (areas with non-target activity would not be used or would be abandoned), and based on human safety (*e.g.*, in areas restricted or inaccessible by the public or where warning signs have been placed). Once appropriate locations were determined, treated baits would be placed in feeding stations or would be broadcast using mechanical methods (ground-based equipment or hand spreaders) or by manual broadcast (distributed by hand) per label requirements. Once baited using the diluted mixture (treated bait and untreated bait), when required by the label, locations would be monitored for non-target activity and to ensure the safety of the public. After each baiting session, all uneaten bait would be retrieved. Through prebaiting, target birds can be acclimated to feed at certain locations at certain times. By acclimating birds to a feeding schedule, baiting could occur at specific times to ensure bait placed would be quickly consumed by target bird species, especially when large flocks of target species were present. The acclimation period would allow treated bait to be placed at a location only when target birds were conditioned to be present at the site, which provides a higher likelihood that treated bait would be consumed by the target species making it unavailable for potential exposure to humans. To be exposed to the bait, someone would have to approach a bait site and handle treated bait. If the bait had been consumed by the target species or if the bait was removed by WS, then treated bait would no longer be available and human exposure to the bait could not occur. Therefore, direct exposure to treated bait during the baiting process would only occur if someone approached a bait site that contained bait and if treated bait was present, would have to handle treated bait.

Several factors would minimize any risk to public health from the use of DRC-1339. For example, the use of DRC-1339 is prohibited within 50 feet of standing water and cannot be applied directly to food or feed crops (contrary to some misconceptions, DRC-1339 is not applied to feed materials that livestock can feed upon). DRC-1339 is also highly unstable and degrades rapidly when exposed to sunlight, heat, or ultraviolet radiation and the half-life of DRC-1339 is about 25 hours. In general, DRC-1339 on treated bait material would almost completely be broken down within a week if target birds did not consume the bait or if WS did not retrieve uneaten bait. The avicide DRC-1339 is more than 90% metabolized in target birds within the first few hours after they consume the bait. Therefore, little material is left in bird carcasses that may be found or retrieved by people. For exposure to occur in people from a carcass, a person would need to ingest the internal organs of birds that died from ingesting DRC-1339 bait. Application rates of bait treated with DRC-1339 are extremely low (EPA 1995). Furthermore, the EPA has concluded that, based on mutagenicity (*i.e.*, the tendency to cause gene mutations in cells) studies, the avicide DRC-1339 is not a mutagen or a carcinogen (*i.e.*, cancer-causing agent) (EPA 1995).

An additional concern associated with the use of the avicide DRC-1339 is the potential exposure of people to crows harvested during the regulated hunting season that have ingested DRC-1339 treated bait. The hunting season for crows in the State during the development of this assessment occurred year round (open season) (NCWRC 2016). Under the proposed action, baiting using DRC-1339 to reduce crow damage could occur in the State during the period of time when hunters could harvest crows. Although baiting could occur in rural areas of the State during those periods, most requests for assistance to manage crow damage during the period of time when hunters can harvest crows in the State would occur in urban areas associated with urban crow roosts. Crows using urban communal roost locations often travel long distances to forage before returning to the roost location during the evening.

When managing damage associated with urban crow roosts, the use of DRC-1339 would likely occur at known forage areas (where crows from a roost location travel to) or could occur near the roost location where crows have been conditioned to feed using prebaiting. Crows, like other blackbirds, often stage (congregate) in an area prior to entering a roost location. The staging behavior often exhibited by blackbirds occurs consistently and prebaiting can induce this behavior to occur consistently at a particular location since blackbirds often feed prior to entering a roost location. Prebaiting can also induce feeding at a specific location as crows exit a roost location in the morning by providing a consistent food source. Baiting with DRC-1339 treated baits most often occurs during the winter when the availability of food is limited and prebaiting can condition crows to feed consistently at a location by providing a consistent source of food. Given the range in which the death of sensitive bird species occurs, crows that consume treated bait could fly long distances. Although not specifically known for crows, sensitive bird species that ingest a lethal dose of DRC-1339 treated bait generally die within 24 to 72 hours after ingestion (USDA 2001). Therefore, crows that ingest a lethal dose of DRC-1339 at the bait site could die in other areas besides the roost location or the bait site.

For a crow that ingested DRC-1339 treated bait to pose a potential risk to human safety to someone harvesting crows during the hunting season in the State, a hunter would have to harvest a crow that ingested DRC-1339 treated bait and subsequently consume certain portions of the crow. The mode of action of DRC-1339 requires ingestion by crows, so handling a crow harvested or found dead would not pose any primary risks to human safety.

Although not specifically known for crows, in other sensitive species, DRC-1339 is metabolized and/or excreted quickly once ingested. In starlings, nearly 90% of the DRC-1339 administered dosages well above the LD_{50} for starlings was metabolized or excreted within 30 minutes of dosage (Cunningham et al. 1979). In one study, more than 98% of a DRC-1339 dose delivered to starlings could be detected in the feces within 2.5 hours (Peoples and Apostolou 1967) with similar results found for other bird species (Eisemann et al. 2003). Once death occurs, DRC-1339 concentrations appear to be highest in the gastrointestinal tract of birds but some residue could be found in other tissues of carcasses (Giri et al. 1976, Cunningham et al. 1979, Johnston et al. 1999) with residues diminishing more slowly in the kidneys (Eisemann et al. 2003). However, most residue tests to detect DRC-1339 in tissues of birds have been completed using DRC-1339 dosages that far exceeded the known acute lethal oral dose for those species tested and far exceeds the level of DRC-1339 that would be ingested from treated bait. Johnston et al. (1999) found DRC-1339 residues in breast tissue of boat-tailed grackles (*Quiscalus major*) using acute doses ranging from 40 to 863 mg/kg. The acute lethal oral dose of DRC-1339 for boat-tailed grackles has been estimated to be ≤ 1 mg/kg, which is similar to the LD_{50} for crows (Eisemann et al. 2003). In those boat-tailed grackles consuming a trace of DRC-1339 up to 22 mg/kg, no DRC-1339 residues were found in the gastrointestinal track nor were residues found in breast tissue (Johnston et al. 1999).

In summary, nearly all of the DRC-1339 ingested by sensitive species is metabolized or excreted quickly, normally within a few hours. Residues of DRC-1339 have been found in the tissues of birds consuming

DRC-1339 at very high dosage rates that exceed current acute lethal dosages achieved under the label requirements of DRC-1339. Residues of DRC-1339 ingested by birds appear to be primarily located in the gastrointestinal tract of birds.

As stated previously, to pose risks to human safety, a hunter would have to harvest a crow that has ingested DRC-1339 and then, ingest tissue of the crow that contained residue. Very little information is available on the acute or chronic toxicity of DRC-1339 on people. However, based on the information available, risks to human safety would be extremely low based on several factors. First, a hunter would have to harvest a crow that had ingested DRC-1339. As stated previously, the use of DRC-1339 primarily occurs to address damage associated with urban roosts. Hunting and discharging a firearm is prohibited in most municipal areas. Therefore, a crow would have to ingest treated bait and then travel to an area (typically outside the city limit) where hunting was allowed. WS would not recommend hunting as a damage management tool in those general areas where DRC-1339 was actively being applied. Secondly, to pose a risk to human safety, parts of the crow would have to be consumed. Thirdly, the tissue consumed would have to contain chemical residues of DRC-1339. Current information indicates that the majority of the chemical is excreted from target bird species within a few hours of ingestion. The highest concentration of the chemical in target bird species occurs in the gastrointestinal tract of the bird, which is discarded and not consumed. Although residues have been detected in the tissues that might be consumed (*e.g*., breast meat) in some bird species that have consumed DRC-1339, residues appear to only be detectable when the bird has consumed a high dose of the chemical that far exceeds the LD_{50} for that species and would not be achievable under normal baiting procedures. Although no information is currently available on the number of people that might consume crows in North Carolina, the number is likely very few, if any, people are likely consuming crows harvested in North Carolina or elsewhere. Hunters primarily harvest crows for recreational purposes and people remove crows to alleviate damage in the State; therefore, people are not likely harvesting crows for subsistence.

Under the proposed action, the controlled and limited circumstances in which DRC-1339 would be used would prevent any exposure of the public to this chemical. Based on current information, the human health risks from the use of DRC-1339 would be virtually nonexistent under this alternative.

Reproductive inhibitors are formulated on bait and would be administered to target wildlife through consumption of treated bait. Therefore, the current concern, outside of transport and storage, would be the risks directly to the handler and support staff during the handling and distribution of the bait on the ground for consumption.

Threats to human safety from the use of nicarbazin would likely be minimal if labeled directions were followed. The use pattern of nicarbazin would also ensure threats to public safety were minimal. The label requires an acclimation period before placing treated bait, which assists with identifying risks, requires the presence of the applicator at the location until all bait was consumed, and requires any unconsumed bait to be retrieved. The EPA has characterized nicarbazin as a moderate eye irritant. The FDA has established a tolerance of nicarbazin residues of 4 parts per million allowed in uncooked chicken muscle, skin, liver, and kidney (see 21 CFR 556.445). The EPA characterized the risks of human exposure as low when used to reduce egg hatchability in Canada Geese. The EPA also concluded that if human consumption occurred, a prohibitively large amount of nicarbazin would have to be consumed to produce toxic effects (EPA 2005). Based on the use pattern of the nicarbazin and if label instructions were followed, risks to human safety would be low with the primary exposure occurring to those handling and applying the product. When WS and other entities follow the safety procedures required by the label, risks to handlers and applicators would be minimal.

The recommendation by WS that certain bird species (*e.g*., waterfowl) be harvested during the regulated hunting season, which is established by the NCWRC under frameworks determined by the USFWS, would not increase risks to human safety above those risks already inherent with hunting those species. Recommendations to allow hunting on property owned or managed by a cooperator to reduce local bird densities in order to alleviate damage or threats would not increase risks to human safety. Safety requirements established by the NCWRC for the regulated hunting season would further minimize risks associated with hunting. Although hunting accidents do occur, the recommendation of allowing hunting to reduce localized populations of birds would not increase those risks.

Alpha chloralose is an immobilizing agent available only for use by WS. The FDA has approved the use of alpha chloralose as an INAD (INAD #6602) to be used for the immobilization and capture of certain species of birds by trained WS' personnel. Alpha chloralose is administered to target individuals, either as a tablet or liquid solution contained within a bread ball or as a powder formulated on whole kernel corn. Application of either form occurs by hand with applicators present on site for monitoring. Application of the tablet or liquid solution form in bread baits occurs by hand and targets individual or small groups of waterfowl. Alpha chloralose formulated on whole corn is placed on the ground in designated areas where target waterfowl are pre-conditioned to feed using a pre-bait. All unconsumed baits are retrieved. Since applicators are present at all times during application of alpha chloralose, the risks to human safety are low. All WS' employees using alpha chloralose would be required to complete a training course on the proper use and handling of alpha chloralose. All WS' employees who use alpha chloralose would wear the appropriate personal protective equipment required to ensure the safety of employees.

Of additional concern with the use of immobilizing drugs and reproductive inhibitors would be the potential for human consumption of meat from waterfowl that have been immobilized using alpha chloralose or have consumed nicarbazin. Since hunters could harvest waterfowl during a regulated harvest season and consume harvested waterfowl, the use of immobilizing drugs and potentially reproductive inhibitors would also be a concern. Prebaiting procedures can condition waterfowl to feed during a period in the day when consumption of treated bait ensures waterfowl do not disperse from the immediate area where the bait is applied. The intended use of immobilizing drugs is to live-capture waterfowl. Primarily, waterfowl in urban environments where hunting and the harvest of waterfowl does not occur or is unlikely to occur (*e.g.*, due to city ordinances preventing the discharge of a firearm within city limits) would be targeted with immobilizing drugs or reproductive inhibitors. However, it could be possible for target waterfowl to leave the immediate area where baiting was occurring after consuming bait and enter areas where hunting could occur. To mitigate this risk, withdrawal times are often established. A withdrawal time is the period established between when the animal consumed treated bait to when it is safe to consume the meat of the animal by humans. Withdrawal periods are not well defined in free-ranging wildlife species for all drugs. In compliance with FDA use restrictions, the use of alpha chloralose would be prohibited for 30 days prior to and during the hunting season on waterfowl and other game birds that could be hunted. In the event that WS was requested to immobilize waterfowl or use nicarbazin during a period when harvest of waterfowl was occurring or during a period of time where a withdrawal period could overlap with the start of a harvest season, WS would not use immobilizing drugs or nicarbazin. In those cases, other methods would be employed.

The recommendation by WS that certain bird species (*e.g.*, waterfowl) be harvested during the regulated hunting season, which would be established by the NCWRC under frameworks determined by the USFWS, would not increase risks to human safety above those risks already inherent with hunting those species. Recommendations of allowing hunting on property owned or managed by a cooperator to reduce bird populations, which could then reduce damage or threats would not increase risks to human safety. Safety requirements established by the NCWRC for the regulated hunting season would further minimize risks associated with hunting. Although hunting accidents do occur, the recommendation of allowing hunting to reduce localized populations of birds would not increase those risks.

WS could also use paintball guns to disperse target bird species. Paintballs do not actually contain paint, but are marking capsules that consist of a gelatin shell filled with a non-toxic glycol and water-based coloring that rapidly dissipates and is not harmful to the environment. Although the ingredients may vary slightly depending on the manufacturer, paintball ingredients may include polyethylene glycol, gelatin, glycerine (glycerol), sorbitol, water, ground pigskin, dipropylene glycol, mineral oil, and dye as the colorant (Donaldson 2003). Paintballs are considered non-toxic to people and do not pose an environmental hazard, as described on product labeling and Material Safety Data Sheets. However, consumption may cause toxicosis in dogs, which is potentially fatal without supportive veterinary treatment (Donaldson 2003). Little is known about the mechanism of action and lethal dose for dogs that consume paintballs, but it is suspected that there is an osmotic diuretic effect resulting in an abnormal electrolyte and fluid balance (Donaldson 2003). Most affected dogs recovered within 24 hours (Donaldson 2003).

No adverse effects to human safety have occurred from WS' use of methods to alleviate bird damage in the State from FY 2011 through FY 2016. The risks to human safety from the use of non-lethal and lethal methods, when used appropriately and by trained personnel, would be considered low. Based on the use patterns of methods available to address damage caused by birds, this alternative would comply with Executive Order 12898 and Executive Order 13045.

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

Under this alternative, WS would be restricted to making recommendations of methods and the demonstration of methods only to resolve damage. WS would only provide technical assistance to those people requesting assistance with bird damage and threats. The only methods that would not be available under this alternative would be mesurol, alpha chloralose, and DRC-1339. Although hazards to human safety from non-lethal methods exist, those methods are generally regarded as safe when used by trained individuals who are experienced in their use. Although some risk of fire and bodily harm exists from the use of pyrotechnics and propane cannons, when used appropriately and in consideration of those risks, they can be used with a high degree of safety.

The use of chemical methods that are considered non-lethal would also be available under this alternative. Chemical methods available would include repellents. There are few chemical repellents registered for use to manage birds in the State. Most repellents require ingestion of the chemical to achieve the desired effects on target species. Repellents that require ingestion are intended to discourage foraging on vulnerable resources and to disperse birds from areas where the repellents are applied. The active ingredients of repellents that are commonly registered for use to disperse birds include methyl anthranilate, polybutene, and anthraquinone. Currently, no repellents are registered for use to disperse birds in the State that contain the active ingredient anthraquinone. Methyl anthranilate (grape derivative) and anthraquinone (plant extract) are naturally occurring chemicals. Repellents, when used according to label directions, are generally regarded as safe especially when the ingredients are considered naturally occurring. Some risk of exposure to the chemical occurs to the applicator and to others from the potential for drift as the product is applied. Some repellents also have restrictions on whether application can occur on edible plants, with some restricting harvest for a designated period after application. All restriction on harvest and required personal protective equipment would be included on the label and if followed properly, would minimize risks to human safety associated with the use of those products.

The recommendation by WS that birds be harvested during the regulated hunting season, which is established by the NCWRC, would not increase risks to human safety above those risks already inherent with hunting birds. Recommendations to allow hunting on property owned or managed by a cooperator to reduce local bird densities, which could then reduce bird damage or threats would not increase risks to human safety. Safety requirements established by the NCWRC for the regulated hunting season would further minimize risks associated with hunting. Although hunting accidents do occur, the recommendation of allowing hunting to reduce localized bird populations would not increase those risks.

The recommendation of shooting with firearms as a method of direct lethal take could occur under this alternative. Safety issues can arise related to misusing firearms and the potential human hazards associated with firearms use when employed to reduce damage and threats. When used appropriately and with consideration for human safety, risks associated with firearms are minimal. If firearms were employed inappropriately or without regard to human safety, serious injuries or loss of life could occur. Under this alternative, recommendations of the use of firearms by WS would include human safety considerations. Since the use of firearms to alleviate bird damage would be available under any of the alternatives and the use of firearms by those persons experiencing bird damage could occur whether WS was consulted or contacted, the risks to human safety from the use of firearms would be similar among all the alternatives.

If non-chemical methods were employed according to recommendations and as demonstrated by WS, the potential risks to human safety would be similar to the proposed action. If methods were employed without guidance from WS or applied inappropriately, the risks to human safety could increase. The extent of the increased risk would be unknown and variable. Non-chemical methods inherently pose minimal risks to human safety given the design and the extent of the use of those methods.

The cooperator requesting assistance would also be made aware of threats to human safety associated with the use of those methods. SOPs for methods are discussed in Chapter 3 of this EA. Risks to human safety from activities and methods recommended under this alternative would be similar to the other alternatives since the same methods would be available. If misused or applied inappropriately, any of the methods available to alleviate bird damage could threaten human safety. However, when used appropriately, methods available to alleviate damage would not threaten human safety.

Alternative 3 – No Bird Damage Management Conducted by WS

Under the no involvement by WS alternative, WS would not be involved with any aspect of managing damage associated with birds in the State, including technical assistance. Due to the lack of involvement in managing damage caused by birds, no impacts to human safety would occur directly from WS. This alternative would not prevent those entities experiencing threats or damage from birds from conducting damage management activities in the absence of WS' assistance. Many of the methods discussed in Appendix C would be available to those persons experiencing damage or threats and could be used to lethally remove birds if permitted by the USFWS and/or the NCWRC. The direct burden of implementing permitted methods would be placed on those experiencing damage.

Non-chemical methods available to alleviate or prevent damage associated with birds generally do not pose risks to human safety. Since most non-chemical methods available for bird damage management involve the live-capture or harassment of birds, those methods would generally be regarded as posing minimal risks to human safety. Habitat modification and harassment methods would also generally be regarded as posing minimal risks to human safety. Although, some risks to safety would likely occur from the use of pyrotechnics, propane cannons, and exclusion devices, those risks would be minimal when those methods were used appropriately and in consideration of human safety. The only methods that would be available under this alternative that would involve the direct lethal take of birds would be shooting, egg destruction, and live-capture followed by euthanasia. Under this alternative, shooting, egg destruction, and live-capture followed by euthanasia would be available to those persons experiencing damage or threats of damage when required and permitted by the USFWS and/or the NCWRC. Firearms, when handled appropriately and with consideration for safety, pose minimal risks to human safety.

Similar to the technical assistance only alternative, DRC-1339, alpha-chloralose, and mesurol would not be available under this alternative to those people experiencing damage or threats from birds. Chemical methods that would be available to the public would include repellents and if a person obtained the appropriate restricted use pesticide license, a product with the same active ingredient as DRC-1339, if registered in the State, could be applied. Since most methods available to resolve or prevent bird damage or threats are available to anyone, the threats to human safety from the use of those methods are similar between the alternatives. However, methods employed by those people not experienced in the use of methods or are not trained in their proper use, could increase threats to human safety. Overall, the methods available to the public, when applied correctly and appropriately, pose minimal risks to human safety.

Issue 4 - Effects on the Aesthetic Values of Birds

People often enjoy viewing, watching, and knowing birds exist as part of the natural environment and gain aesthetic enjoyment in such activities. Those methods available to alleviate damage are intended to disperse and/or remove birds. Non-lethal methods are intended to exclude or make an area less attractive, which disperses birds to other areas. Similarly, lethal methods are intended to remove those birds identified as causing damage or posing a threat of damage. The effects on the aesthetic value of birds as it relates to the alternatives are discussed below.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

Under the proposed action, methods would be employed that would result in the dispersal, exclusion, or removal of individuals or small groups of birds to resolve damage and threats. In some instances where birds were dispersed or removed, the ability of interested persons to observe and enjoy those birds would likely temporarily decline.

Even the use of exclusionary devices could lead to the dispersal of wildlife if the resource being damaged was acting as an attractant. Thus, once the attractant was removed or made unavailable, the birds would likely disperse to other areas where resources were more vulnerable.

The use of lethal methods could result in temporary declines in local populations resulting from the removal of birds to address or prevent damage and threats. The goal under the proposed action would be to respond to requests for assistance and to manage those birds responsible for the resulting damage. Therefore, the ability to view and enjoy birds would remain if a reasonable effort were made to locate birds outside the area in which damage management activities occurred. Those birds removed by WS would be those birds that could be removed by the person experiencing damage in the absence of assistance by WS.

Activities would only be conducted on properties where a request for assistance was received and activities would only be conducted after an agreement for such services had been agreed upon by the requester. Some aesthetic value would be gained by the removal of birds and the return of a more natural environment, including the return of native wildlife and plant species that may be suppressed or displaced by high bird densities.

Since those birds removed by WS under this alternative could be removed by other entities, WS' involvement in removing those birds would not likely be additive to the number of birds that could be taken in the absence of WS' involvement. Birds could be removed by other entities with a depredation permit issued by the USFWS and/or the NCWRC, under depredation/control orders, without the need for a permit (non-native species), or during the regulated hunting seasons.

WS' take of birds from FY 2011 through FY 2016 has been of low magnitude when compared to the population estimates, trending data, and other available information. WS' activities would not likely be additive to the birds that would be taken in the absence of WS' involvement. Although birds removed by WS would no longer be present for viewing or enjoying, those birds would likely be taken by the property owner or manager if WS were not involved in the action. Given the limited take proposed by WS under this alternative, when compared to the known sources of mortality of birds and their population information, damage management activities conducted by WS pursuant to the proposed action would not adversely affect the aesthetic value of birds. The impact on the aesthetic value of birds and the ability of the public to view and enjoy birds under the proposed action would be similar to the other alternatives and would likely be low.

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

If those people seeking assistance from WS were those persons likely to conduct bird damage management activities in the absence of WS' involvement, then technical assistance provided by WS would not adversely affect the aesthetic value of birds in the State similar to Alternative 1. Birds could be lethally taken under this alternative by those entities experiencing bird damage or threats, which could result in localized reductions in the presence of birds at the location where damage was occurring. The presence of birds where damage was occurring could be reduced where damage management activities were conducted under any of the alternatives. Even the recommendation of non-lethal methods would likely result in the dispersal of birds from the area if those non-lethal methods recommended by WS were employed by those people receiving technical assistance. Therefore, technical assistance provided by WS would not prevent the aesthetic enjoyment of birds since any activities conducted to alleviate bird damage could occur in the absence of WS' participation in the action, either directly or indirectly.

Under this alternative, the effects on the aesthetic values of birds would be similar to those addressed in the proposed action. When people seek assistance with managing damage from WS or another entity, the damage level has often reached an unacceptable threshold for that particular person. Therefore, in the case of bird damage, the social acceptance level of those birds has reached a level where assistance has been requested and those persons would likely apply methods or seek those entities that would apply those methods based on recommendations provided by WS or by other entities. Based on those recommendations, methods would likely be employed by the requester that would result in the dispersal and/or removal of birds responsible for damage or threatening safety. If those birds causing damage were dispersed or removed by those people experiencing damage based on recommendations by WS or other entities, the potential effects on the aesthetic value of those birds would be similar to the proposed action alternative.

The impacts on aesthetics from a technical assistance program would only be lower than the proposed action if those individuals experiencing damage were not as diligent in employing those methods as WS would be if conducting an operational program. If those people experiencing damage abandoned the use of those methods, then birds would likely remain in the area and available for viewing and enjoyment by those people interested in doing so. Similar to the other alternatives, the geographical area in which damage management activities occurs would not be such that birds would be dispersed or removed from such large areas that opportunities to view and enjoy birds would be severely limited.

Alternative 3 – No Bird Damage Management Conducted by WS

Under the no bird damage management by WS alternative, the actions of WS would have no impact on the aesthetic value of birds in the State. Those people experiencing damage or threats from birds would be responsible for researching, obtaining, and using all methods as permitted by federal, state, and local laws and regulations. The degree to which damage management activities would occur in the absence of assistance by any agency is unknown, but likely lower compared to damage management activities that would occur where some level of assistance was provided. Birds could still be dispersed or removed under this alternative by those persons experiencing damage or threats of damage. The potential impacts on the aesthetic values of birds could be similar to the proposed action if similar levels of damage management activities are conducted by those people experiencing damage or threats or is provided by other entities. If no action was taken or if activities were not permitted by the USFWS and/or the NCWRC, then no impact on the aesthetic value of birds would occur under this alternative.

Birds could continue to be dispersed and lethally taken by other entities under this alternative. Lethal take would continue to occur when permitted by the USFWS and the NCWRC through the issuance of depredation permits. Take could also occur during the regulated harvest season for certain species, pursuant to depredation/control orders, pursuant to depredation permits, and in the case of some species, take could occur any time without the need for a depredation permit.

Since other entities could continue to take birds under this alternative despite WS' lack of involvement, the ability to view and enjoy birds would likely be similar to the other alternatives. The lack of WS' involvement would not lead to a reduction in the number of birds dispersed or taken since WS has no authority to regulate take or the harassment of birds in the State. The USFWS and the NCWRC with management authority over birds, would continue to adjust all take levels based on population objectives for those bird species in the State. Therefore, the number of birds lethally taken annually through hunting, depredation permits, and under the depredation/control orders would be regulated and adjusted by the USFWS and/or the NCWRC.

Those people experiencing damage or threats would continue to use those methods they feel appropriate to alleviate bird damage or threats, including lethal take. Therefore, WS' involvement in bird damage management would not be additive to the birds that could be lethally removed in the State. The impacts to the aesthetic value of birds would be similar to the other alternatives.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

Humaneness and animal welfare concerns associated with methods available for use to manage bird damage have been identified as an issue. As described previously, most of those methods available for use to manage bird damage would be available under any of the alternatives, when permitted by the USFWS and/or the NCWRC, when required. The humaneness and animal welfare concerns of methods available for use in North Carolina, as the use of those methods relates to the alternatives, is discussed below.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

Under the proposed action, WS would integrate methods using WS' Decision Model as part of technical assistance and direct operational assistance. Methods available under the proposed action could include non-lethal and lethal methods integrated into direct operational assistance conducted by WS. Under this alternative, WS would use non-lethal methods that were generally regarded as humane. Non-lethal methods would include resource management methods (*e.g.*, crop selection, limited habitat modification, modification of human behavior), exclusion devices, frightening devices, reproductive inhibitors, immobilizing drugs, nest destruction, cage traps, nets, and repellents.

As discussed previously, humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal. People may perceive the humaneness of an action differently. The challenge in coping with this issue is how to achieve the least amount of animal suffering.

Some people believe any use of lethal methods to alleviate damage associated with wildlife is inhumane because the resulting fate is the death of the animal. Other people believe that certain lethal methods can lead to a humane death. Others believe most non-lethal methods of capturing wildlife to be humane because the animal is generally unharmed and alive. Still others believe that any disruption in the behavior of wildlife is inhumane. With the multitude of attitudes on the meaning of humaneness and the varying perspectives on the most effective way to address damage and threats in a humane manner, agencies are challenged with conducting activities and employing methods that are perceived to be humane while assisting those persons requesting assistance to manage damage and threats associated with wildlife. The goal of WS would be to use methods as humanely as possible to address requests for assistance to reduce damage and threats to human safety. WS would continue to evaluate methods and activities to minimize the pain and suffering of animals addressed when attempting to alleviate requests for assistance.

Some methods have been stereotyped as "*humane*" or "*inhumane*". However, many "*humane*" methods can be inhumane if not used appropriately. For instance, many members of the public would consider a cage trap to be a "*humane*" method. Yet, without proper care, live-captured wildlife in a cage trap can be treated inhumanely if not attended to appropriately. Some concern arises from the use of live-capture methods causing stress on the animal, but if used appropriately, the stress is minimal and only temporary. Overall, many people consider the use of non-lethal management methods as humane when used appropriately.

Although some concerns of humaneness and animal welfare could occur from the use of cage traps, nets, immobilizing drugs, reproductive inhibitors, and repellents, those methods, when used appropriately and by trained personnel, would not result in the inhumane treatment of wildlife. Concerns from the use of those non-lethal methods could occur from injuries to animals while restrained, from the stress of the animal while being restrained, or during the application of the method. Pain and physical restraint can cause stress in animals and the inability of animals to effectively deal with those stressors can lead to distress. Suffering occurs when action is not taken to alleviate conditions that cause pain or distress in animals.

If birds were to be live-captured by WS, WS' personnel would be present on-site during capture events or WS' employees would check methods at least once every 24 hours to ensure WS' employees addressed birds captured quickly to prevent injury. Although stress could occur to an animal restrained in a live-capture device, timely attention to live-captured wildlife would alleviate suffering. Stress would likely be temporary.

Under the proposed action, lethal methods could also be employed to alleviate or prevent bird damage and threats, when requested. Lethal methods would include shooting, DRC-1339, the recommendation that birds be harvested during the regulated hunting seasons, and euthanasia after birds were live-captured. WS' use of euthanasia methods under the proposed action would follow those methods required by WS' directives (see WS Directive 2.430, WS Directive 2.505).

The euthanasia methods being considered for use under the proposed action for live-captured birds would be cervical dislocation and carbon dioxide. The AVMA guidelines on euthanasia list cervical dislocation, carbon dioxide, and gunshot as conditionally acceptable, methods of euthanasia for free-ranging birds that can lead to a humane death (AVMA 2013). The use of cervical dislocation, carbon dioxide, or gunshot for euthanasia would occur after the animal had been live-captured and away from public view. Although the AVMA guidelines list cervical dislocation and gunshot as conditionally acceptable methods of euthanasia for free-ranging wildlife, there is greater potential those methods may not consistently produce a humane death (AVMA 2013). WS' personnel that employ methods to euthanize live-captured birds would be trained in the proper use of those methods to ensure a timely and quick death.

Although the mode of action associated with DRC-1339 is not well understood, it appears to cause death primarily by nephrotoxicity (*i.e.*, toxic effect on the kidneys) in susceptible species and by central nervous system depression in non-susceptible species (DeCino et al. 1966, Westberg 1969, Schafer 1984). DRC-1339 causes irreversible necrosis of the kidney and the affected bird is subsequently unable to excrete uric acid with death occurring from uremic poisoning and congestion of major organs (DeCino et al. 1966, Knittle et al. 1990). The external appearances and behavior of starlings that ingest DRC-1339 slightly above the LD_{50} for starlings appear normal for 20 to 30 hours, but water consumption doubles after 4 to 8 hours and decreases thereafter. Food consumption remains fairly constant until about 4 hours before death, at which time starlings refuse food and water and become listless and inactive. The birds perch with feathers fluffed as in cold weather and appear to doze, but are still responsive to external stimuli. As death nears, breathing rate increases slightly and becomes more difficult. Eventually, the birds no longer respond to external stimuli and become comatose. Death follows shortly thereafter without convulsions or spasms (DeCino et al. 1966). Birds ingesting a lethal dose of DRC-1339 become listless and lethargic, and a quiet death normally occurs in 24 to 72 hours following ingestion. This method appears to result in a less stressful death than probably occur by most natural causes, which are primarily disease, starvation, and predation. In non-sensitive birds and mammals, central nervous system depression and the attendant cardiac or pulmonary arrest is the cause of death (Felsenstein et al. 1974). DRC-1339 is the only lethal method that would not be available to other entities under the other alternatives. DRC-1339 to manage damage caused by certain species of birds would only be available for use by WS' personnel. A similar product containing the same active ingredient could commercially become available as a restricted use pesticide for use to manage damage associated with blackbirds and starlings; however, the product is not currently registered for use in North Carolina.

The chemical repellent under the trade name Avitrol acts as a dispersing agent when birds ingest treated bait, which causes them to become hyperactive (see discussion in Appendix C). Their distress calls generally alarm the other birds and cause them to leave the site. Only a small number of birds need to be affected to cause alarm in the rest of the flock. The affected birds generally die. In most cases where Avitrol is used, only a small percentage of the birds are affected and killed by the chemical with the rest being dispersed. In experiments to determine suffering, stress, or pain in affected animals, Rowsell et al. (1979) tested Avitrol on pigeons and observed subjects for clinical, pathological, or neural changes indicative of pain or distress but none were observed. Conclusions of the study were that the chemical met the criteria for a humane pesticide.

The use of nicarbazin would generally be considered as a humane method of managing local populations of domestic waterfowl and pigeons. Nicarbazin reduces the hatchability of eggs laid by waterfowl and appears to have no adverse effects on waterfowl. Consuming bait daily did not appear to adversely affect those chicks that hatched from parents fed nicarbazin (Avery et al. 2006, Avery et al. 2008*b*). Nicarbazin has been characterized as a veterinary drug since 1955 by the FDA for use in broiler chickens to treat outbreaks of coccidiosis with no apparent ill effects to chickens. Based on current information and research, the use of nicarbazin would generally be considered humane.

Alpha chloralose could be used by WS as a sedative to live-capture geese and other waterfowl. Although overdosing waterfowl with alpha chloralose can cause death, WS would employ alpha chloralose as a non-lethal method only. When using alpha chloralose, WS' personnel would be present on site to retrieve birds that become sedated. Some concern occurs that waterfowl may drown if sedation occurs while they are loafing on water. WS would ensure that a boat and/or a canoe were available for quick retrieval of birds that become sedated while in the water.

Research and development by WS has improved the selectivity and humaneness of management techniques. Research is continuing to bring new findings and products into practical use. Until new findings and products are found practical, a certain amount of animal suffering could occur when some methods are used in situations where non-lethal damage management methods are not practical or effective. Personnel from WS are experienced and professional in their use of management methods. Consequently, management methods are implemented in the most humane manner possible under the constraints of current technology. Those methods discussed in Appendix C to alleviate bird damage and/or threats in the State, except for DRC-1339, alpha chloralose, and mesurol, could be used under any of the alternatives by those people experiencing damage regardless of WS' direct involvement. Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives. Those persons who view a particular method as humane or inhumane would likely continue to view those methods as humane or inhumane under any of the alternatives. SOPs that would be incorporated into WS' activities to ensure methods are used by WS as humanely as possible are listed in Chapter 3.

Therefore, the goal would be to address requests for assistance using methods in the most humane way possible that minimizes the stress and pain to the animal. Overall, the use of resource management methods, harassment methods, and exclusion devices are regarded as humane when used appropriately. Although some concern arises from the use of live-capture methods, the stress of animals is likely temporary.

People have also expressed concerns over the potential separation of goose families from management actions. Generally, adult geese form pair bonds that they maintain until one of the pair dies; however, geese will form new pairs bonds even when their previous mate is still alive (MacInnes et al. 1974, Mowbray et al. 2002). Goose family units generally migrate together during the fall migration period and spend much of the fall and winter together (Raveling 1968, Raveling 1969, Mowbray et al. 2002). The separation of family units could occur during damage management activities targeting geese. This could occur through translocation, harassment (*e.g.,* pyrotechnics, dogs), and lethal control methods.

Although resident Canada geese can have high adult and juvenile survival rates, especially in urban areas with a reduced number of predators, Canada goose family units often experience change. For example, annual harvest of Canada geese appears to strongly influence annual survival rates of geese (Mowbray et al. 2002). People harvested 35,812 Canada geese in the State during the 2014 hunting season and 19,257 geese during the 2015 hunting season. During the 2014 hunting season, people harvested 5,600 Canada geese in the State during the special September hunting season that specifically targets resident Canada geese in the State. Similarly, people harvested 5,300 resident Canada geese during the 2015 September hunting season for resident Canada geese (Raftovich et al. 2016). In addition, the period between when geese hatch and when they fledge tends to be a period of high mortality in Canada geese (Mowbray et al. 2002). Adults that lose a mate can form new pair bonds and will breed with new mates (Raveling 1988, Mowbray et al. 2002). Although WS' activities could separate geese, adult geese do form new pair bonds and continue to breed with new mates. Although juvenile geese generally migrate with their parents during the fall migration period and spend much of the fall and winter together, juveniles would likely survive if they separate from a parent or both parents.

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

The issue of humaneness of methods under this alternative is likely to be perceived as similar to humaneness issues discussed under the proposed action. This perceived similarity is derived from WS' recommendation of methods that some consider inhumane. WS would not directly be involved with damage management activities under this alternative. However, the recommendation of the use of methods would likely result in the requester employing those methods. Therefore, by recommending methods and thus a requester employing those methods, the issue of humaneness would be similar to the proposed action.

WS would instruct and demonstrate the proper use and placement of methodologies to increase effectiveness in capturing target bird species and to ensure methods are used in such a way as to minimize pain and suffering. However, the efficacy of methods employed by a cooperator would be based on the skill and knowledge of the person using the methods to resolve the threat to safety or damage situation despite WS' demonstration. Therefore, a lack of understanding of the behavior of birds or improperly identifying the damage caused by birds along with inadequate knowledge and skill in using methodologies to resolve the damage or threat could lead to incidents with a greater probability of being perceived as inhumane. In those situations, the pain and suffering are likely to be regarded as greater than those discussed under Alternative 1.

Those people requesting assistance would be directly responsible for the use and placement of methods and if monitoring or checking of those methods does not occur in a timely manner, captured wildlife could experience suffering and if not addressed timely, could experience distress. The amount of time an animal is restrained under the proposed action would be shorter compared to a technical assistance alternative if those requesters implementing methods were not as diligent or timely in checking methods. Similar to Alternative 3, it can be difficult to evaluate the behavior of individual people and determining what may occur under given circumstances. Therefore, only the availability of WS' assistance can be evaluated under this alternative since determining human behavior can be difficult. If those persons seeking assistance from WS apply methods recommended by WS through technical assistance as intended and as described by WS, then those methods would be applied as humanely as possible to minimize pain and distress. If those persons provided technical assistance by WS apply methods not recommended by WS or do not employ methods as intended or without regard for humaneness, then the issue of method humaneness would be of greater concern since pain and distress of birds would likely be higher.

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, WS would not be involved with any aspect of bird damage management in North Carolina. Those people experiencing damage or threats associated with birds could use those methods legally available and permitted by the USFWS, the NCWRC, and federal, state, and local regulations. Those methods would likely be considered inhumane by those persons who would consider methods proposed under any alternative as inhumane. The issue of humaneness would likely be directly linked to the methods legally available to the public since methods are often labeled as inhumane by segments of society no matter the entity employing those methods. A method considered inhumane, would still be perceived as inhumane regardless of the person or entity applying the method. However, even methods generally regarded as being humane could be employed in inhumane ways. Methods could be employed inhumanely by those people inexperienced in the use of those methods or if those people were not as diligent in attending to those methods.

The efficacy and therefore, the humaneness of methods would be based on the skill and knowledge of the person employing those methods. A lack of understanding of the target species or methods used could lead to an increase in situations perceived as being inhumane to wildlife despite the method used. Despite the lack of involvement by WS under this alternative, those methods perceived as inhumane by certain individuals and groups would still be available to the public for use to alleviate damage and threats caused by birds. Therefore, those methods considered inhumane would continue to be available for use under this alternative. If those people experiencing bird damage apply those methods considered humane as intended and in consideration of the humane use of those methods, then the issue of method humaneness would be similar across the alternatives. If persons employ humane methods in ways that are inhumane, the issue of method humaneness could be greater under this alternative if those persons experiencing bird damage are not provided with information and demonstration on the proper use of those methods. However, the level at which people would apply humane methods inhumanely under this alternative based on a lack of assistance is difficult to determine and could just as likely be similar across the alternatives.

4.2 CUMULATIVE IMPACTS OF THE PROPOSED ACTION BY ISSUE

Cumulative impacts, as defined by CEQ (40 CFR 1508.7), are impacts to the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts may result from individually minor, but collectively significant, actions taking place over time.

Under Alternative 1 and Alternative 2, WS would address damage associated with birds either by providing technical assistance (Alternative 2) or by providing technical assistance and direct operational assistance (Alternative 1) in the State. WS would be the primary agency conducting direct operational bird damage management in the State under Alternative 1. However, other federal, state, and private entities could also be conducting bird damage management in the State. The take of native migratory bird species requires a depredation permit from the USFWS pursuant to the MBTA, which requires permit holders to report all take occurring under the permit. Take of Canada geese, Muscovy ducks, and blackbirds can occur under depredation/control orders without the need for a depredation permit. Free-ranging or feral domestic waterfowl, including mute swans, rock pigeons, European starlings, house sparrows, and Eurasian collared-doves can be lethally taken without the need for a depredation permit because they are considered non-native species. Several species of birds addressed in this assessment can be harvested during the annual regulated harvest season.

WS does not normally conduct direct damage management activities concurrently with such agencies or other entities in the same area, but may conduct damage management activities at adjacent sites within the same period. In addition, commercial pest control companies may conduct damage management activities in the same area. The potential cumulative impacts analyzed below could occur because of WS' damage management program activities over time or because of the aggregate effects of those activities combined with the activities of other agencies and private entities. Through ongoing coordination and collaboration between WS, the USFWS, and the NCWRC, activities of each agency and the take of birds would be available. Damage management activities in the State would be monitored to evaluate and analyze activities to ensure they are within the scope of analysis of this EA.

Issue 1 - Effects of Damage Management Activities on Target Bird Populations

Evaluation of activities relative to target species indicated that program activities would likely have no cumulative adverse effects on bird populations when targeting those species responsible for damage. WS' actions would be occurring simultaneously, over time, with other natural processes and human generated changes that are currently taking place. These activities include, but are not limited to:

- Natural mortality of birds
- Human-induced mortality through vehicle strikes, aircraft strikes, and illegal take
- Human-induced mortality of birds through private damage management activities
- Human-induced mortality through regulated harvest
- Human and naturally induced alterations of wildlife habitat

- Annual and perennial cycles in wildlife population densities

All those factors play a role in the dynamics of bird populations. In many circumstances, requests for assistance arise when some or all of those elements have contrived to elevate target species populations or place target species at a juncture to cause damage to resources. The actions taken to minimize or eliminate damage are constrained as to scope, duration, and intensity for the purpose of minimizing or avoiding impacts to the environment. WS uses the Decision Model to evaluate damage occurring, including other affected elements and the dynamics of the damaging species; to determine appropriate strategies to minimize effects on environmental elements; applies damage management actions; and subsequently monitors and adjusts/ceases damage management actions (Slate et al. 1992). This process allows WS to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative adverse impacts on target species.

With management authority over bird populations, the USFWS and/or the NCWRC could adjust take levels, including the take by WS, to ensure population objectives for bird species were achieved. Consultation and reporting of take by WS would ensure the USFWS and/or the NCWRC considered any activities conducted by WS. As stated previously, WS would not use those lethal methods available as population management tools over broad areas. WS would use lethal methods, including the use of DRC-1339, to reduce the number of birds present at a location where damage was occurring by targeting those birds causing damage or posing threats; therefore, the intent of lethal methods would be to manage those birds causing damage and not to manage entire bird populations.

WS' take of birds in North Carolina from FY 2011 through FY 2016 was of a low magnitude when compared to the total known take and when compared to available population information. The USFWS and the NCWRC considers all known take when determining population objectives for birds and could adjust the number of birds that could be taken during the regulated hunting season and the number of birds taken for damage management purposes to achieve the population objectives. Any take by WS would occur at the discretion of the USFWS and/or the NCWRC. Any bird population declines or increases induced through the regulation of take would be the collective objective for bird populations established by the USFWS and/or the NCWRC. Therefore, the cumulative take of birds annually or over time by WS would occur at the desire of the USFWS and/or the NCWRC as part of management objectives for birds in the State. No cumulative effects on target bird species would be expected from WS' damage management activities based on the following considerations:

Historical outcomes of WS' damage management activities on wildlife

Damage management activities would be conducted by WS only at the request of a cooperator to reduce damage that was occurring or to prevent damage from occurring and only after methods to be used were agreed upon by all parties involved. WS would monitor activities to ensure any potential impacts are identified and addressed. WS would work closely with state and federal resource agencies to ensure damage management activities would not adversely affect bird populations and that WS' activities were considered as part of management goals established by those agencies. Historically, WS' activities to manage birds in North Carolina have not reached a magnitude that would cause adverse impacts to bird populations in the State.

SOPs built into the WS program

SOPs are designed to reduce the potential negative effects of WS' actions on birds, and are tailored to respond to changes in wildlife populations, which could result from unforeseen environmental changes. This would include those changes occurring from sources other than WS. Alterations in programs are defined through SOPs and implementation is insured through monitoring, in accordance with the WS' Decision Model (Slate et al. 1992).

Issue 2 - Effects on Non-target Wildlife Species Populations, Including T&E Species

Potential effects on non-target species from conducting bird damage management arise from the use of non-lethal and lethal methods to alleviate or prevent those damages. The use of non-lethal methods during activities to reduce or prevent damage caused by birds has the potential to exclude, disperse, or capture non-target wildlife. However, the effects of non-lethal methods are often temporary and often do not involve the lethal take of non-target wildlife species. When using exclusion devices and/or repellents, both target and non-target wildlife can be prevented from accessing the resource being damaged. Since exclusion does not involve lethal take, cumulative impacts on non-target species from the use of exclusionary methods would not occur, but would likely disperse those individuals to other areas. Exclusionary methods often require constant maintenance or application to ensure effectiveness. Therefore, the use of exclusionary devices would be somewhat limited to small, high-value areas and not used to the extent that non-targets are excluded from large areas that would cumulatively impact populations from the inability to access a resource, such as potential food sources or nesting sites. The use of visual and auditory harassment and dispersal methods would generally be temporary with non-target species returning after the cessation of those activities. Dispersal and harassment do not involve the lethal take of non-target species and similar to exclusionary methods are not used to the extent or at a constant level that would prevent non-targets from accessing critical resources that would threaten survival of a population.

The use of lethal methods or those methods used to live-capture target species followed by euthanasia also have the potential to affect non-target wildlife through the lethal take or capture of non-target species. Capture methods used are often methods that are set to confine or restrain target wildlife after being triggered by a target individual. Capture methods are employed in such a manner as to minimize the threat to non-target species by placement in those areas frequently used by target wildlife, using baits or lures that are as species specific as possible, and modification of individual methods to exclude non-targets from capture. Most methods described in Appendix C are methods that would be employed to confine or restrain target bird species that would be subsequently euthanized using humane methods. With all live-capture devices, non-target wildlife captured can be released on site if determined to be able to survive following release. SOPs are intended to ensure take of non-target wildlife is minimal during the use of methods to capture target wildlife.

The use of firearms and euthanasia methods are essentially selective for target species since identification of an individual is made prior to the application of the method. Euthanasia methods are applied through direct application to target wildlife. Therefore, the use of those methods would not affect non-target species.

Chemical methods available for use under the proposed action would be taste repellents, nicarbazin, mesurol, alpha chloralose, and DRC-1339, which are described in Appendix C. Except for repellents that would be applied directly to the affected resource, all chemical methods would be employed using baits that would be highly attractive to target species and would be used in areas where exposure to non-targets would be minimal. The use of those methods requires an acclimation period and monitoring of potential bait sites for non-target activity. All chemicals would be used according to the product label, which would ensure that proper use would minimize non-target threats. WS' adherence to directives and SOPs governing the use of chemicals also ensures non-target hazards would be minimal.

All chemical methods would be tracked and recorded to ensure proper accounting of used and unused chemicals occurs. All chemicals would be stored and transported according with WS' Directives and relevant federal, state, and local regulations. The amount of chemicals used or stored by WS would be minimal to ensure human safety. Based on this information, WS' use of chemical methods, as part of the proposed action, would not have cumulative effects on non-targets.

All label requirements of DRC-1339 would be followed to minimize non-target hazards. As required by the label, all potential bait sites are pre-baited and monitored for non-target use as outlined in the pre-treatment observations section of the label. If non-targets were observed feeding on the pre-bait, the plots would be abandoned and no baiting would occur at those locations. Once sites were baited, sites would be monitored daily to observe for non-target feeding activity. If non-targets were observed feeding on bait, those sites would be abandoned. WS would retrieve all dead birds to the extent possible following treatment with DRC-1339 to minimize secondary hazards associated with scavengers feeding on bird carcasses.

Only those repellents registered for use in the State by the EPA and the NCDACS would be used or recommended by WS as part of an integrated approach to managing damage and threats associated with birds. The recommendation and/or use of repellents would also follow all label instructions approved by the EPA. Repellents would be registered in accordance with the FIFRA through a review process administered by the EPA. The FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. Repellents available for use to disperse birds from areas of application must be registered with the EPA according to the FIFRA. Although some hazards exist from the use of repellents, hazards occur primarily to the handler and the applicator. When repellents that were registered for use by the EPA in accordance to the FIFRA were applied according to label requirements, no adverse effects to non-targets would be expected.

The active ingredient in numerous commercial repellents is methyl anthranilate, which is a derivative of grapes and sometimes used as a flavoring in food and as a fragrance in cosmetics. Other repellents available contain the active ingredient polybutene, which, when applied, creates a sticky surface intended to prevent perching. Other bird repellents commonly registered contain the active ingredient anthraquinone, which is a naturally occurring plant extract. Characteristics of those chemicals and potential use patterns indicate that WS use of those products in North Carolina would have no significant cumulative impacts related to environmental fate when WS uses those products according to label requirements.

The use of immobilizing chemicals, reproductive inhibitors, and euthanasia methods are essentially selective for target species since identification of an individual is made prior to the application of the method. Immobilizing chemicals and reproductive inhibitors would be applied using hand baiting, which targets individuals or groups of target bird species that have been acclimated to feeding on the bait in a certain location. With immobilizing drugs and reproductive inhibitors, all unconsumed bait must be retrieved after each application, which further limits non-target exposure. With immobilizing chemicals, the applicator would be present on-site at all times to retrieve sedated birds, which allows for constant monitoring for non-targets in the area of application. Euthanasia methods require the target bird species to be restrained before application, which allows any non-targets to be released if captured. Therefore, the use of immobilizing chemicals, reproductive inhibitors, or euthanasia methods would not affect non-target species.

The methods described in Appendix C have a high level of selectivity and can be employed using SOPs to ensure minimal effects to non-target species. From FY 2011 through FY 2016, two common grackles were killed unintentionally in FY 2015 during activities targeting other bird species. No other take of non-target species as occurred from FY 2011 through FY 2016. Based on the methods available to resolve bird damage and/or threats, WS does not anticipate the number of non-targets taken to reach a magnitude where declines in those species' populations would occur. Therefore, take of non-targets under the proposed action would not cumulatively affect non-target species.

Based on a review of those threatened or endangered species listed in the State during the development of the EA, WS determined that activities conducted pursuant to the proposed action would have no effect on most species listed as threatened or endangered in the State by the USFWS and the National Marine Fisheries Services and would have no effect on any critical habitats designated within the State. For several species listed as threatened or endangered within the State, WS determined that the proposed activities "*may affect*" those species but those effects would be solely beneficial, insignificant, or discountable, which would warrant a "*not likely to adversely affect*" determination. Based on those determinations, WS initiated informal consultation with the USFWS for those species that a "*may affect, not likely to adversely affect*" determination was made. The USFWS concurred with WS' determination that activities conducted pursuant to the proposed action would not likely adversely affect those species. Cumulative impacts would be minimal on non-targets from any of the alternatives discussed.

Issue 3 - Effects of Damage Management Methods on Human Health and Safety

All non-chemical methods described in Appendix C are used within a limited time frame, are not residual, and do not possess properties capable of inducing cumulative adverse impacts on human health and safety. All non-chemical methods would be used after careful consideration of the safety of those people employing methods and to the public. Capture methods would be employed where human activity was minimal to ensure the safety of the public, whenever possible. Capture methods also require direct contact to trigger, ensuring that those methods, when left undisturbed would have no effect on human safety. All methods would be agreed upon by the requesting entities, which would be made aware of the safety issues of those methods when entering into a MOU, work initiation document, or another comparable document between WS and the cooperating entity. SOPs would also ensure the safety of the public from those methods used to capture or take wildlife. Firearms used to alleviate or prevent damage, though hazards do exist, are employed to ensure the safety of employees and the public.

Personnel employing non-chemical methods would continue to be trained to be proficient in the use of those methods to ensure the safety of the applicator and the public. Based on the use patterns of non-chemical methods, those methods would not cumulatively affect human safety.

Repellents to disperse birds from areas of application are available. All repellents must be registered with the EPA according to the FIFRA and registered for use in the State with the NCDACS. Many of the repellents currently available for use have active ingredients that are naturally occurring and are generally regarded as safe. Although some hazards exist from the use of repellents, hazards occur primarily to the handler and the applicator. When repellents were applied according to label requirements, no adverse effects to human safety would be expected.

Chemical methods available for use under the proposed action are repellents, reproductive inhibitors, immobilizing drugs, and euthanasia chemicals described in Appendix C. Repellents are commercially available to the public and can be applied over large areas to discourage birds from feeding in an area. The active ingredients of those repellents available for birds are methyl anthranilate and anthraquinone. Methyl anthranilate, which has been classified by the FDA as a product that is "*generally recognized as safe*", is a naturally occurring chemical found in grapes, and is synthetically produced for use as a grape food flavoring and for perfume (see 21 CFR 182.60). The EPA exempts methyl anthranilate from the requirement of establishing a tolerance for agricultural applications (see 40 CFR 180.1143). The final ruling published by the EPA on the exemption from the requirement of a tolerance for methyl anthranilate concludes with reasonable certainty that no harm would occur from cumulative exposure to the chemical by the public, including infants and children, when applied according to the label and according to good agricultural practices (see 67 FR 51083-51088). Based on the use patterns of methyl anthranilate and the conclusions of the FDA and the EPA on the toxicity of the chemical, WS' use of methyl anthranilate and the recommendation of the use of the chemical would not have cumulative impacts.

Additional repellents could contain the active ingredient anthraquinone. Overall, the EPA considers the toxicological risk from exposure to anthraquinone to be negligible (EPA 1998). The EPA also considers the primary cumulative exposure is most likely to occur to handlers and/or applicators from dermal, oral, and inhalation exposure but consider the exposure risks, when appropriate measures are taken, to be negligible (EPA 1998). Therefore, the EPA concluded that cumulative effects were not expected from any common routes of toxicity (EPA 1998). Based on the known use patterns and the conclusions of the EPA, no cumulative effects are expected from WS' use of anthraquinone or the recommendation of the use of anthraquinone.

DRC-1339 could be used by WS to manage damage or threats associated with birds in North Carolina. DRC-1339 has been evaluated for possible residual effects, which might occur from buildup of the chemical in soil, water, or other environmental sites. DRC-1339 is applied to bait and placed in areas only after pre-baiting has occurred and only in those areas where non-target species are not present or would not be exposed to treated baits. Baits treated with DRC-1339 would be placed on platforms or other hard surfaces where they would seldom be exposed to soil, surface water, and/or ground water. All uneaten bait would be recovered and disposed of according to EPA label requirements.

DRC-1339 exhibits a low persistence in soil or water, and bioaccumulation of the chemical is unlikely (EPA 1995). Additionally, the relatively small quantity of DRC-1339 that could potentially be used in bird damage management programs in North Carolina, the chemical's instability, which results in degradation of the product, and application protocols used in WS' programs further reduces the likelihood of any environmental accumulation. The use of DRC-1339 under the proposed action would not be expected to increase to a level that effects would occur from the cumulative use of the chemical. Based on potential use patterns, the chemical and physical characteristics of DRC-1339, and factors related to the environmental fate, no cumulative impacts are expected from the lethal chemical components used or recommended by the WS program in North Carolina.

WS would only use the immobilizing drug alpha chloralose to capture waterfowl. To capture waterfowl, WS would insert alpha chloralose tablets into a dough ball made out of bread or WS would mix the powder form onto whole kernel corn or into bread baits. After an acclimation period where waterfowl are habituated to feeding on a certain bait, being fed at a certain time, and at a certain location, treated baits are substituted for the pre-bait. As required by WS' use of alpha chloralose under the INAD, all unconsumed bait must be retrieved. Since target wildlife are habituated to feed at a certain location and a certain time on a similar pre-bait, a general estimate of the needed bait can be determined and bait is readily consumed by target species which limits the amount of time bait is exposed. Application of alpha chloralose is limited in duration given that baiting ceases once the target birds are removed. Through acclimation, the majority of target birds can be conditioned to feed at a certain time and location, which allows for the majority of target birds to be removed after an initial application of alpha chloralose treated baits. Some follow-up baiting could occur to remove any remaining waterfowl that were not captured during the initial baiting efforts. In compliance with FDA use restrictions, the use of alpha chloralose is prohibited for 30 days prior to and during the hunting season on waterfowl and other game birds that could be hunted. Given the use patterns of alpha chloralose described, no cumulative impacts from the use of alpha chloralose to capture waterfowl are expected.

WS' personnel would be required to attend training courses on the proper use of alpha chloralose and employees using alpha chloralose must be certified in the application of alpha chloralose. Training would ensure proper care and handling occurred, ensure that proper doses were administered, and ensure human safety.

Direct application of chemical methods to target species would ensure that there are no cumulative impacts to human safety. All chemical methods would be tracked and recorded to ensure proper accounting of used and unused chemicals occurs. All chemicals would be stored and transported according to FDA regulations, including the directives of the cooperating agencies. The amount of chemicals used or stored by WS and cooperating agencies would be minimal to ensure human safety. Based on this information, the use of chemical methods as part of the proposed action by WS and cooperating agencies would not have cumulative impacts on human safety.

The only euthanasia chemical proposed for use by WS is carbon dioxide, which is an approved method of euthanasia for birds by the AVMA. Carbon dioxide is naturally occurring in the environment ranking as the fourth most abundant gas in the atmosphere. However, in high concentrations, carbon dioxide causes hypoxia due to the depression of vital centers. Carbon dioxide is considered a moderately rapid form of euthanasia (AVMA 2013). Carbon dioxide is commercially available as a compressed bottled gas. Carbon dioxide is a colorless, odorless, non-flammable gas used for a variety of purposes, such as in carbonated beverages, dry ice, and fire extinguishers. Although some hazards exist from the inhalation of high concentrations of carbon dioxide during application for euthanasia purposes, when used appropriately, the risks of exposure are minimal. Since carbon dioxide is a common gas found in the environment, the use of and/or recommending the use of carbon dioxide for euthanasia purposes will not have cumulative impacts.

WS has received no reports or documented any adverse effects to human safety from damage management activities conducted in North Carolina from FY 2011 through FY 2016. No cumulative effects from the use of those methods discussed in Appendix C would be expected given the use patterns of those methods for resolving bird damage in the State. For these reasons, WS concludes that the use of methods would not create an environmental health or safety risk to children from implementing the proposed action. It is not anticipated that the proposed action or the other alternatives would result in any adverse or disproportionate environmental impacts to minorities or persons and populations of low-income people.

Issue 4 - Effects on the Aesthetic Values of Birds

The activities of WS would result in the removal of birds from those areas where damage or threats were occurring. Therefore, the aesthetic value of birds in those areas where damage management activities were being conducted would be reduced. However, for some people, the aesthetic value of a more natural environment would be gained by reducing bird densities, including the return of native plant species that may be suppressed or killed by accumulations of fecal droppings by high bird densities found under roost areas.

Some people experience a decrease in the aesthetic enjoyment of wildlife because they feel that overabundant species are objectionable and interfere with their enjoyment of wildlife in general. Continued increases in numbers of individuals or the continued presence of birds may lead to further degradation of some people’s enjoyment of any wildlife or the natural environment. The actions of WS could positively affect the aesthetic enjoyment of wildlife for those people that are being adversely affected by the target species identified in this EA.

Bird population objectives are established and enforced by the USFWS and/or the NCWRC through the regulating of take after consideration of other known mortality factors. Therefore, WS has no direct impact on the status of the bird population since all take by WS occurs at the discretion of the USFWS and/or the NCWRC. Since those people seeking assistance could remove birds from areas where damage was occurring with or without a permit from the USFWS and/or the NCWRC, WS' involvement would have no effect on the aesthetic value of birds in the area where damage was occurring. When damage caused by birds has occurred, any removal of birds by the property or resource owner would likely occur whether WS was involved with taking the birds or not.

Therefore, the activities of WS would not be expected to have any cumulative adverse effects on this element of the human environment if occurring at the request of a property owner and/or manager.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

WS continues to seek new methods and ways to improve current technology to improve the humaneness of methods used to manage damage caused by wildlife. Cooperation with individuals and organizations involved in animal welfare continues to be an agency priority for the purpose of evaluating strategies and defining research aimed at developing humane methods.

All methods not requiring direct supervision during employment (*e.g.*, live traps) would be checked and monitored to ensure any wildlife confined or restrained are addressed in a timely manner to minimize distress of the animal. All euthanasia methods used for live-captured birds would be applied according to AVMA guidelines for free-ranging wildlife. Shooting would occur in limited situations and personnel would be trained in the proper use of firearms to minimize pain and suffering of birds taken by this method.

WS would employ methods as humanely as possible by applying measures to minimize pain and that allow wildlife captured to be addressed in a timely manner to minimize distress. Through the establishment of SOPs that guide WS in the use of methods to address damage and threats associated with birds in the State, the cumulative impacts on the issue of method humaneness are minimal. All methods would be evaluated to ensure SOPs were adequate to ensure those methods continue to be used to minimize suffering and that wildlife captured are addressed in a timely manner to minimize distress.

CHAPTER 5: RESPONSES TO PUBLIC COMMENTS

WS made the EA available to the public for review and comment by a legal notice published in *The News and Observer* newspaper from March 16, 2018 through March 18, 2018. WS also made the EA available to the public for review and comment on the APHIS website on March 8, 2018 and on the federal e-rulemaking portal at the regulations.gov website beginning on March 6, 2018. WS also sent a notice of availability directly to agencies, organizations, and individuals with probable interest in managing bird damage in the state. The public involvement process ended on April 20, 2018.

5.1 SUMMARY OF PUBLIC COMMENTS AND WS' RESPONSES TO THE COMMENTS

During the public comment period, WS received five comment responses related to the draft EA. Section 5.1 summarizes the comment responses WS received and provides WS' responses to the comments.

Comment – Birds cause damage because they have nowhere to go as people keep removing more wildlife habitat; WS needs to preserve natural areas where animals can go; WS should reduce the damage that people do in North Carolina

Response: Section 1.6 discusses the primary statutory authorities for the WS program. The WS program is the lead federal authority in managing damage to agricultural resources, natural resources, property, and threats to human safety associated with animals. The WS program in North Carolina does not have the statutory authority to regulate human behavior and human population growth. Similarly, WS does not have the authority to preserve natural areas in North Carolina. Therefore, managing the behavior of people, managing human population growth, and preserving natural areas are outside the scope of the EA.

Comment – Farmers should find hunters to chase birds from their farms

Response: If WS implemented Alternative 1 or Alternative 2, WS could recommend the use of legal hunting practices to those people requesting assistance when WS' personnel determine hunting to be appropriate using the WS Decision Model. However, many bird species do not have hunting seasons and for those species that people can hunt, hunting can only legally occur during open hunting seasons. Therefore, recommending hunting as the only approach to managing all bird damage would not meet the need for action.

Comment – Non-lethal methods are effective at reducing bird damage

Response: Appendix B in the EA discusses many non-lethal methods that WS' personnel could recommend or employ to resolve damage under the applicable alternatives. When responding to a request for assistance and evaluating available methods using the WS Decision Model, WS' personnel would give preference to non-lethal methods when practical and effective (see WS Directive 2.101).

Comment – WS should not allow overhunting of bird species

Response: Section 1.6 discusses the primary statutory authorities for the WS program. The WS program is the lead federal authority in managing damage to agricultural resources, natural resources, property, and threats to human safety associated with animals. The WS program in North Carolina does not have the statutory authority to regulate hunting in North Carolina. Therefore, regulating hunting is outside the scope of the EA.

Comment – WS should assess areas for problems with wildlife before any man-made structures are built

Response: Section 1.6 discusses the primary statutory authorities for the WS program. The WS program is the lead federal authority in managing damage to agricultural resources, natural resources, property, and threats to human safety associated with animals. The WS program in North Carolina does not have the statutory authority to regulate human behavior, including when or where man-made structures are built. Therefore, managing the behavior of people and assessing problems with wildlife before people build structures are outside the scope of the EA.

Comment – Interfering with bird populations will cause increases in insect populations, which will have an impact on crops

Response: During the development of the EA, an issued identified by WS was the potential effects that could occur to the populations of target bird species from the alternative approaches that WS developed to meet the need for action (see Issue 1 in Section 3.4). The environmental consequences of implementing the alternative approaches on the populations of target bird species occurred in Section 4.1. If WS implements Alternative 1, WS could integrate the use of methods into a damage management strategy to reduce damage and threats of damage, which could include the use of lethal methods. WS would only conduct activities to manage bird damage at the request of a cooperator and would only use those methods the cooperator agrees to allow WS to use on property they own and/or manage. In addition, the lethal take of many of the target bird species addressed in the EA can only occur after the USFWS and/or the NCWRC have authorized the take to occur and take can only occur at the levels authorized.

As stated previously, WS would not use those lethal methods available as population management tools over broad areas. WS would use lethal methods to reduce the number of birds present at a location where damage was occurring by targeting those birds causing damage or posing threats; therefore, the intent of lethal methods would be to manage those birds causing damage and not to manage entire bird populations. As discussed in Section 4.1, WS' activities to manage birds in North Carolina would not reach a magnitude that would cause adverse impacts to bird populations in the State. Therefore, the magnitude of lethal removal, including cumulative removal, is not likely to reach a level that would indirectly cause insect populations to increase.

Comment – WS wants to kill all wildlife

Response: The WS Decision Model would be the implementing mechanism for a damage management program under applicable alternatives that WS' personnel would adapt to an individual damage situation. When WS receives a request for direct operational assistance, WS would conduct site visits to assess the damage or threats, would identify the cause of the damage, and would apply the Decision Model described by Slate et al. (1992) and WS Directive 2.201 to determine the appropriate methods to resolve or prevent damage. Discussion of the Decision Model and WS' use of the Model occurs in Section 3.1 of the EA. In addition, WS would give preference to non-lethal methods when practical and effective (see WS Directive 2.101). Appendix B in the EA discusses many non-lethal methods that WS' personnel could recommend or employ to resolve damage under the applicable alternatives. The WS program does not attempt to eradicate any species of native wildlife in the State. WS operates in accordance with federal and state laws and regulations enacted to ensure species viability.

Comment – WS should receive no taxpayer funding; WS should shutdown

Response: WS identified an alternative approach that would require cooperators completely fund activities (see Section 3.2). However, WS did not consider the alternative in detail for the reasons provided in Section 3.2. In those cases where WS receives federal and/or state funding to conduct activities, federal, state, and/or local officials have made the decision to provide funding for damage management activities and have allocated funds for such activities. Additionally, damage management activities are an appropriate sphere of activity for government programs because managing wildlife is a government responsibility.

CHAPTER 6: LIST OF PREPARERS, REVIEWERS, AND PERSONS CONSULTED

6.1 LIST OF PREPARERS

Barbara Schellinger, Wildlife Biologist	USDA-APHIS-Wildlife Services
Ryan Wimberly, Environmental Management Coordinator	USDA-APHIS-Wildlife Services
Keith Wehner, State Director	USDA-APHIS-Wildlife Services
Todd Menke, Assistant State Director	USDA-APHIS-Wildlife Services

6.2 LIST OF PERSONS CONSULTED AND REVIEWERS

Scott Anderson, Wildlife Biologist	North Carolina Wildlife Resources Commission
Allen Boynton, Wildlife Diversity Coordinator	North Carolina Wildlife Resources Commission
John Carpenter, Coastal Regional Bird Biologist	North Carolina Wildlife Resources Commission
Joe Fuller, Migratory Game Bird Coordinator	North Carolina Wildlife Resources Commission
Gabriela Garrison, Eastern Pied. Habitat Coordinator	North Carolina Wildlife Resources Commission
John Hammond, USFWS Biologist	USFWS Raleigh Ecological Services

Doug Howell, Waterfowl Biologist	North Carolina Wildlife Resources Commission
Chris Kreh, Upland Game Bird Biologist	North Carolina Wildlife Resources Commission
Chris McGrath, Wildlife Diversity Coordinator	North Carolina Wildlife Resources Commission
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Michelle Outlaw, Permits Administrator Program	USFWS Region 4 Migratory Bird Permit
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APPENDIX A
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APPENDIX B
ADDITIONAL BIRD SPECIES THAT WS COULD ADDRESS

In addition to the bird species identified in Chapter 1, WS could also receive requests for assistance to manage damage and threats of damage associated with several other bird species but those requests would occur infrequently or the requests would involve only a few individual birds. Damages and threats of damages associated with those species would occur primarily at airports where those species pose a threat of aircraft strikes. WS anticipates addressing those requests for assistance using primarily non-lethal dispersal methods. Under the proposed action alternative, WS could receive requests for assistance to use lethal methods to remove those species when non-lethal methods were ineffective or were determined to be inappropriate using the WS Decision model. An example could include birds that pose an immediate strike threat at an airport where attempts to disperse the birds were ineffective.

Those species that WS could address in low numbers and/or infrequently when those species cause damage or pose a threat of damage include brants (*Branta bernicla*), mute swans (*Cygnus olor*), tundra swans (*Cygnus columbianus*), wood ducks (*Aix sponsa*), gadwalls (*Anas strepera*), American wigeons (*Anas americana*), American black ducks (*Anas rubripes*), blue-winged teals (*Anas discors*), Northern shovelers (*Anas clypeata*), Northern pintails (*Anas acuta*), green-winged teals (*Anas crecca*), canvasbacks (*Aythya valisineria*), redheads (*Aythya americana*), ring-necked ducks (*Aythya collaris*), greater scaup (*Aythya marila*), lesser scaup (*Aythya affinis*), buffleheads (*Bucephala albeola*), hooded mergansers (*Lophodytes cucullatus*), common mergansers (*Mergus merganser*), red-breasted mergansers (*Mergus serrator*), ruddy ducks (*Oxyura jamaicensis*), Northern bobwhites (*Colinus virginianus*), ring-necked pheasants (*Phasianus colchicus*), ruffed grouse (*Bonasa umbellus*), pied-billed grebes (*Podilymbus podiceps*), horned grebes (*Podiceps auritus*), Eurasian collared-doves (*Streptopelia decaocto*), common nighthawks (*Chordeiles minor*), chimney swifts (*Chaetura pelagica*), clapper rails (*Rallus crepitans*), Sandhill cranes (*Antigone canadensis*), black-necked stilts (*Himantopus mexicanus*), American oystercatchers (*Haematopus palliatus*), black-bellied plovers (*Pluvialis squatarola*), Wilson's plovers (*Charadrius wilsonia*), semipalmated plovers (*Charadrius semipalmatus*), Hudsonian godwits (*Limosa haemastica*), ruddy turnstones (*Arenaria interpres*), sanderlings (*Calidris alba*), least sandpipers (*Calidris minutilla*), buff-breasted sandpipers (*Calidris subruficollis*), pectoral sandpipers (*Calidris melanotos*), semipalmated sandpipers (*Calidris pusilla*), Western sandpipers (*Calidris mauri*), Wilson's snipe (*Gallinago delicata*), American woodcocks (*Scolopax minor*), spotted sandpipers (*Actitis macularius*), solitary sandpipers (*Tringa solitaria*), greater yellowlegs (*Tringa melanoleuca*), lesser yellowlegs (*Tringa flavipes*), lesser black-backed gulls (*Larus fuscus*), Caspian terns (*Hydroprogne caspia*), common terns (*Sterna hirundo*), Forster's terns (*Sterna forsteri*), royal terns (*Thalasseus maximus*), sandwich terns (*Thalasseus sandvicensis*), common loons (*Gavia immer*), anhingas (*Anhinga anhinga*), American bitterns (*Botaurus lentiginosus*), great egrets (*Ardea alba*), snowy egrets (*Egretta thula*), little blue herons (*Egretta caerulea*), tricolored herons (*Egretta tricolor*), cattle egrets (*Bubulcus ibis*), green herons (*Butorides virescens*), black-crowned night-herons (*Nycticorax nycticorax*), yellow-crowned night-herons (*Nyctanassa violacea*), white ibis (*Eudocimus albus*), glossy ibis (*Plegadis falcinellus*), Mississippi kites (*Ictinia mississippiensis*), Northern harriers (*Circus cyaneus*), sharp-shinned hawks (*Accipiter striatus*), Cooper's hawks (*Accipiter cooperii*), red-shouldered hawks (*Buteo lineatus*), broad-winged hawks (*Buteo platypterus*), red-tailed hawks (*Buteo jamaicensis*), great horned owls (*Bubo virginianus*), barred owls (*Strix varia*), barn owls (*Tyto alba*), short-eared owls (*Asio flammeus*), eastern screech owls (*Megascops asio*), belted kingfishers (*Megaceryle alcyon*), downy woodpeckers (*Picoides pubescens*), hairy woodpeckers (*Picoides villosus*), pileated woodpeckers (*Dryocopus pileatus*), red-headed woodpeckers (*Melanerpes erythrocephalus*), red-bellied woodpeckers (*Melanerpes carolinus*), Northern flickers (*Colaptes auratus*), American kestrels (*Falco sparverius*), merlin (*Falco columbarius*), peregrine falcons (*Falco peregrinus*), loggerhead shrikes (*Lanius ludovicianus*), blue jays (*Cyanocitta cristata*), horned larks (*Eremophila alpestris*), purple martins (*Progne subis*), tree swallows (*Tachycineta bicolor*), Northern rough-winged swallows (*Stelgidopteryx serripennis*), bank swallows (*Riparia riparia*), cliff swallows (*Petrochelidon pyrrhonota*), wood thrushes (*Hylocichla mustelina*), American robins (*Turdus migratorius*), gray catbirds (*Dumetella carolinensis*), brown thrashers (*Toxostoma rufum*), cedar waxwings (*Bombycilla cedrorum*), American goldfinches (*Spinus tristis*), purple finches (*Haemorhous purpureus*), field sparrows (*Spizella pusilla*), song sparrows (*Melospiza melodia*), chipping sparrows (*Spizella passerina*), Savannah sparrows (*Passerculus sandwichensis*), white-throated sparrows (*Zonotrichia albicollis*), white-crowned sparrow (*Zonotrichia leucophrys*), yellow-rumped warbler (*Setophaga coronata*), swallow-tailed kite (*Elanoides forficatus*), dark-eyed juncos (*Junco hyemalis*), Eastern phoebes (*Sayornis phoebe*), American pipits (*Anthus rubescens*), northern cardinals (*Cardinalis cardinalis*), bobolinks (*Dolichonyx oryzivorus*), rusty blackbirds (*Euphagus carolinus*), boat-tailed grackles (*Quiscalus major*), snow geese (*Anser caerulescens*), and least terns (*Sternula antillarum*).

Many of these bird species can cause damage to or pose threats to a variety of resources. The bird species associated with requests for assistance that WS could receive and the resource types those bird species can damage in North Carolina occur in Table B-1.

Table B-1. Additional bird species addressed in the EA and resources affected by those bird species[1].

	Resources					Resources			
Species	**A**	**N**	**P**	**H**	**Species**	**A**	**N**	**P**	**H**
Brant		X	X	X	**Tricolored Heron**	X	X	X	X
Mute Swan			X	X	**Cattle Egret**	X	X	X	X
Tundra Swan			X	X	**Green Heron**	X	X	X	X
Wood Duck			X	X	**Black-crowned Night-Heron**			X	X
Gadwall			X	X	**Yellow-crowned Night-Heron**			X	X
American Wigeon			X	X	**White Ibis**			X	X
American Black Duck			X	X	**Glossy Ibis**			X	X
Northern Shoveler			X	X	**Mississippi Kite**	X	X	X	X
Northern Pintail			X	X	**Northern Harrier**	X	X	X	X
Green-winged Teal	X		X	X	**Sharp-shinned Hawk**	X	X	X	X
Canvasback			X	X	**Cooper's Hawk**	X	X	X	X
Redhead			X	X	**Red-shouldered Hawk**	X	X	X	X
Ring-necked Duck			X	X	**Broad-winged Hawk**	X	X	X	X
Greater Scaup			X	X	**Red-tailed Hawk**	X	X	X	X
Lesser Scaup			X	X	**Great Horned Owl**	X	X	X	X
Bufflehead			X	X	**Barred Owl**	X	X	X	X
Hooded Merganser			X	X	**Barn Owl**	X	X	X	X
Common Merganser			X	X	**Short-eared Owl**		X	X	X
Red-breasted Merganser			X	X	**Eastern screech Owl**		X	X	X
Ruddy Duck			X	X	**Belted Kingfisher**			X	X
Northern Bobwhite			X	X	**Downy Woodpecker**			X	X
Ring-necked Pheasant			X	X	**Hairy Woodpecker**			X	X
Ruffed Grouse			X	X	**Pileated Woodpecker**			X	X
Pied-billed Grebe			X	X	**Red-headed Woodpecker**			X	X
Horned Grebe			X	X	**Red-bellied Woodpecker**			X	X
Eurasian Collared-Dove		X	X	X	**Northern Flicker**			X	X
Common Nighthawk			X	X	**American Kestrel**	X	X	X	X
Chimney Swift			X	X	**Merlin**			X	X
Blue-winged Teal	X		X	X	**Peregrine Falcon**	X	X	X	X
Clapper Rail			X	X	**Loggerhead Shrike**	X	X	X	X

Species	Resources				Species	Resources			
	A	N	P	H		A	N	P	H
Sandhill Crane			X	X	**Blue Jay**			X	X
Black-necked Stilt			X	X	**Horned Lark**			X	X
American Oystercatcher			X	X	**Purple Martin**			X	X
Black-bellied Plover			X	X	**Tree Swallow**			X	X
Wilson's Plover			X	X	**Northern Rough-winged Swallow**			X	X
Semipalmated Plover			X	X	**Bank Swallow**			X	X
Hudsonian Godwit			X	X	**Cliff Swallow**			X	X
Ruddy Turnstone			X	X	**Wood Thrush**			X	X
Sanderling			X	X	**American Robin**			X	X
Least Sandpiper			X	X	**Gray Catbird**			X	X
Buff-breasted Sandpiper			X	X	**Brown Thrasher**			X	X
Pectoral Sandpiper			X	X	**Cedar Waxwing**			X	X
Semipalmated Sandpiper			X	X	**American Goldfinch**			X	X
Western Sandpiper			X	X	**Purple Finch**			X	X
Wilson's Snipe			X	X	**Field Sparrow**			X	X
American Woodcock			X	X	**Song Sparrow**			X	X
Spotted Sandpiper			X	X	**Chipping Sparrow**			X	X
Solitary Sandpiper			X	X	**Savannah Sparrow**			X	X
Greater Yellowlegs			X	X	**White-throated Sparrow**			X	X
Lesser Yellowlegs			X	X	**White-crowned Sparrow**			X	X
Lesser Black-backed Gull			X	X	**Yellow-rumped Warbler**			X	X
Caspian Tern		X	X	X	**Swallow-tailed Kite**	X	X	X	X
Common Tern		X	X	X	**Dark-eyed Junco**			X	X
Forster's Tern		X	X	X	**Eastern Phoebe**			X	X
Royal Tern		X	X	X	**American Pipit**			X	X
Sandwich Tern		X	X	X	**Northern Cardinal**			X	X
Common Loon			X	X	**Bobolink**			X	X
Anhinga			X	X	**Rusty Blackbird**	X	X	X	X
American Bittern			X	X	**Boat-tailed Grackle**	X	X	X	X
Great Egret	X	X	X	X	**Snow Goose**	X	X	X	X
Snowy Egret	X	X	X	X	**Least Tern**			X	X
Little Blue Heron	X	X	X	X					

[1]A=Agriculture, N =Natural Resources, P=Property, H=Human Safety

Based on previous requests for assistance and the take levels necessary to alleviate those requests for assistance, WS would not lethally remove more than 20 individuals and 10 nests annually of any of those species identified in Table B-1, except for those waterfowl and game species identified in Table B-1 that have annual hunting seasons. If any requests for assistance regarding least terns, common terns, rusty blackbirds, American oystercatchers, or sanderlings are received, WS would only perform non-lethal harassment and no lethal removal would take place. In addition, the NCWRC considers the American oystercatcher, least tern, and common tern as species of special concern in the State.

Individuals can harvest snow geese, brant, bufflehead, wood ducks, American wigeons, American black ducks, blue-winged teal, Northern shovelers, Northern pintail, green-winged teal, canvasbacks, greater scaup, lesser scaup, ruddy ducks, gadwalls, redheads, ring-necked ducks, clapper rail, American woodcock, tundra swan, Wilson's snipe, hooded mergansers, common mergansers, red-breasted mergansers, Eurasian collared-doves, ruffed grouse, ring-necked pheasant, and Northern bobwhite. For those waterfowl and game species, WS could lethally remove up to 100 individuals of those species annually in the State since those species often occur during the migration periods in large numbers and the limited take of 100 individuals would be a minor component of the annual harvest of those species.

Most requests for assistance associated with waterfowl species occur near airports where waterfowl and other waterbirds may aggregate in large numbers in wet areas or on large bodies of water in close proximity to active runways, posing a strike risk and threat to human safety. Assistance may also be requested by fish hatcheries in the State that are receiving damage from fish-eating birds, such as mergansers, or from urban parks with large resident waterfowl populations that may be accumulating feces in public areas or behaving aggressively toward visitors. In addition, waterfowl may sometimes be used as bioindicators to assess environmental quality and, thus, individuals of these species are frequently sampled for environmental toxins, viruses, and/or bacterial organisms. For these reasons, WS could potentially take up to 100 individuals of each harvestable species annually. When compared to the annual take levels of these species, WS' take of up to 100 individuals a year would have little impact on the population or hunter harvest.

In addition, to alleviate damage or discourage nesting in areas where damages were occurring, WS could destroy up to 20 nests annually of those species in Table B-1 that nest in the State, including eggs in those nests. Many bird species have the ability to identify areas with regular human disturbance and low reproductive success and they will relocate to nest elsewhere when confronted with repeated nest failure. Although there may be reduced fecundity for the individuals affected by destroying eggs and removing nests, this activity has no long-term effect on breeding adult birds. Nest and egg removal would not be used by WS as a population management method. This method would be used by WS to inhibit nesting in an area experiencing damage due to nesting activity and would only be employed at a localized level. As with the lethal removal of birds, the destruction of eggs in nests can only occur when authorized by the USFWS and/or the NCWRC; therefore, the number of eggs destroyed by WS annually would occur at the discretion of the USFWS and/or the NCWRC.

WS does not expect the annual take of those species identified in Table B-1 to occur at any level that would adversely affect populations of those species. Take would be limited to those individuals deemed causing damage or posing a threat. The MBTA protects most of those bird species from take unless the USFWS permits the take pursuant to the Act. In addition, the NCWRC may also require a permit to lethally take those bird species. If the USFWS and/or the NCWRC did not issue a permit, no take would occur by WS. In addition, take could only occur at those levels stipulated in a permit. Therefore, the take of those bird species would occur in accordance with applicable state and federal laws and regulations authorizing take of migratory birds and their nests and eggs, including the USFWS and/or the NCWRC permitting processes. The USFWS and/or the NCWRC as the agencies with management responsibility for migratory birds, could impose restrictions on depredation take as needed to assure cumulative take does not adversely affect the continued viability of populations. This would assure that cumulative effects on those bird populations would not have a significant adverse effect on the quality of the human environment. In addition, WS would report annually to the USFWS any take of the bird species listed in Table B-1 in accordance with a federal permit.

APPENDIX C
METHODS AVAILABLE TO MANAGE BIRD DAMAGE

The most effective approach to resolving wildlife damage problems would be to integrate the use of several methods, either simultaneously or sequentially. An adaptive plan would integrate and apply practical methods of prevention and reduce damage by birds while minimizing harmful effects of damage reduction measures on people, other species, and the environment. An adaptive plan may incorporate resource management, physical exclusion and deterrents, and population management, or any combination of these, depending on the characteristics of specific damage problems.

In selecting damage management techniques for specific damage situations, consideration would be given to the responsible species and the magnitude, geographic extent, duration and frequency, and likelihood of bird damage. Consideration would also be given to the status of target and potential non-target species, local environmental conditions and impacts, social and legal aspects, and relative costs of damage reduction options. The cost of damage reduction may sometimes be a secondary concern because of the overriding environmental, legal, and animal welfare considerations. Those factors would be evaluated in formulating damage management strategies that incorporate the application of one or more techniques.

A variety of methods would potentially be available to the WS program in North Carolina relative to the management or reduction of damage from birds. Various federal, state, and local statutes and regulations and WS directives would govern WS' use of damage management methods. WS would develop and recommend or implement strategies based on resource management, physical exclusion, and wildlife management approaches. Within each approach there may be available a number of specific methods or techniques. The following methods could be recommended or used by the WS program in North Carolina. Many of the methods described would also be available to other entities in the absence of any involvement by WS.

NON-LETHAL WILDLIFE DAMAGE MANAGEMENT METHODS

Non-lethal methods consist primarily of tools or devices used to disperse or capture a particular animal or a local population of wildlife to alleviate damage and conflicts. Most of the non-lethal methods available to WS would also be available to other entities within the State and could be employed by those entities to alleviate bird damage.

Habitat alteration can be the planting of vegetation unpalatable to wildlife or altering the physical habitat (Conover and Kania 1991, Conover 1992). Conover (1991) found that even hungry Canada Geese refused to eat some ground covers such as common periwinkle (*Vinca minor*), English ivy (*Hedera helix*) and Japanese pachysandra (*Pachysandra terminalis*). Planting less preferred plants or grasses to discourage geese from a specific area could work more effectively if good alternative feeding sites are nearby (Conover 1985). However, the manipulation of turf grass varieties in urban/suburban, heavy use situations such as parks, athletic fields, and golf courses is often not feasible. Varieties of turf grass that grow well and can withstand regular mowing and regular/heavy human use include Kentucky blue grass, red fescue, perennial bent grass, perennial rye grass, and white clover. All of these grasses are appealing to most waterfowl. The turf grass varieties that are not appealing to geese, such as tall fescue, orchard grass, and timothy, do not withstand regular mowing and/or regular/heavy human use.

Fences, hedges, shrubs, boulders, and other structures can be placed at shorelines to impede waterfowl movements. Restricting a bird's ability to move between water and land would deter them from an area, especially during molts (Gosser et al. 1997). However, people are often reluctant to make appropriate landscape modifications to discourage waterfowl activity (Breault and McKelvey 1991, Conover and Kania 1991). Unfortunately, both people and geese appear to find lawn areas near water attractive

(Addison and Amernic 1983), and conflicts between people and geese would likely continue wherever this interface occurs.

Habitat modification can be an integral part of bird damage management. Wildlife production and/or presence are often directly related to the type, quality, and quantity of suitable habitat. Therefore, habitat can be managed to reduce or eliminate the production or attraction of certain bird species or to repel certain birds. In most cases, the resource or property owner would be responsible for implementing habitat modifications, and WS would only provide advice on the type of modifications that would provide the best chance of achieving the desired effect. Habitat management would most often be a primary component of damage management strategies at or near airports to reduce bird aircraft strike problems by eliminating bird nesting, roosting, loafing, or feeding sites. Generally, many bird problems on airport properties can be minimized through management of vegetation and water from areas adjacent to aircraft runways. For example, habitat management would often be necessary to minimize damage caused by crows, blackbirds, and starlings that form large roosts during late autumn and winter. Bird activity can be greatly reduced at roost sites by removing all the trees, selectively thinning trees, or pruning trees. Habitat modification would be available to all entities.

Supplemental feeding and lure crops are food resources planted or provided to attract wildlife away from more valuable resources (*e.g.*, crops). Food is provided so that the animals causing damage would consume it rather than the resource being protected. In feeding programs, target wildlife would be offered an alternative food source with a higher appeal with the intention of luring them from feeding on affected resources. This method can be ineffective if other food sources are available. For example, lure crops would largely be ineffective for geese since food resources (*e.g.*, turf) are readily available. For lure crops to be effective, the ability to keep birds from surrounding fields would be necessary, and the number of alternative feeding sites must be minimal (Fairaizl and Pfeifer 1988). Additionally, lure crops reduce damage for only a short time (Fairaizl and Pfeifer 1988) and damage by birds is generally continuous. The resource owner would be limited in implementing this method contingent upon ownership of or ability to manage the property. Supplemental feeding and the planting of lure crops would be available to other entities within the State.

Modifying human behavior would be methods recommended by WS when providing technical assistance. Recommendations would include modifying the behavior of people that may be attracting or contributing to the damage being caused by birds. For example, artificial feeding of waterfowl by people can attract and sustain more birds in an area than could normally be supported by natural food supplies. This unnatural food source can result in an increase in damage caused by waterfowl. Recommendations may include altering planting dates so that crops are less vulnerable to damage when birds may be present. Modifying human behavior could include recommending people plant crops that are less attractive or less vulnerable to damage. At feedlots or dairies, cultural methods generally involve modifications to the level of care or attention given to livestock, which may vary depending on the age and size of the livestock. Animal husbandry practices include but are not limited to techniques, such as night feeding, indoor feeding, removal of spilled grain or standing water, and use of bird proof feeders (Johnson and Glahn 1994). Those recommendations made by WS would be available for implementation by other entities.

Alterations to aircraft flight patterns or schedules could be recommended in cases where the presence of birds at or near airports results in threats to human safety and when such problems cannot be resolved by other means. However, altering operations at airports to decrease the potential for bird strike hazards would generally not be feasible unless an emergency exists. Otherwise, the expense of interrupted flights and the limitations of existing facilities generally make this practice prohibitive.

Removal of domestic waterfowl could be recommended or implemented by WS and other entities to alleviate damage. Flocks of urban/suburban domestic waterfowl are known to act as decoys and attract other migrating waterfowl (Crisley et al. 1968, Woronecki 1992). Avery (1994) reported that birds learn to locate food sources by watching the behavior of other birds. The removal of domestic waterfowl from water bodies removes birds that act as decoys in attracting other waterfowl. Domestic waterfowl could also carry diseases, which can threaten wild populations. Property or resource owners may be reluctant to remove some or all decoy birds because of the enjoyment of their presence.

Electric fencing could be recommended or implemented by WS and others to alleviate damage caused by waterfowl. The application of electrified fencing would generally be limited to rural settings, due to the possibility/likelihood of interaction with people and pets. Limits of this application arise where there are multiple landowners, the size of the area, and its proximity to bodies of water used by waterfowl. Perceptions from Minnesota on the effectiveness of electric fences were high (Cooper and Keefe 1997). While electric fencing may be effective in repelling waterfowl in some urban settings, its use is often prohibited in many municipalities for human safety reasons. Problems that typically reduce the effectiveness of electric fences include vegetation on fence, flight capable birds, fencing knocked down by other animals (*e.g*., white-tailed deer and dogs), and poor power. Electric fencing would generally be available to all entities.

Barrier fencing could also be recommended or implemented by WS and others. The construction or placement of physical barriers has limited application for birds and would primarily be recommended or employed to alleviate waterfowl damage. Barriers can be temporary or permanent structures. Lawn furniture/ornaments, vehicles, boats, snow fencing, plastic hazard fencing, metal wire fencing, and multiple strand fencing have all been used to limit the movement of Canada Geese. The application of this method would be limited to areas that could be completely enclosed and do not allow waterfowl to land inside enclosures. Similar to most abatement techniques, this method has been most effective when dealing with small numbers of breeding geese and their flightless young along wetlands and/or waterways. Unfortunately, there have been situations where barrier fencing designed to inhibit goose nesting has entrapped young and resulted in starvation (Cooper 1998). The preference for geese to walk or swim, rather than fly, during this time period contributes to the success of barrier fences. Birds that are capable of full or partial flight render this method useless, except for enclosed areas small enough to prevent landing. Exclusion adequate to stop bird movements can also restrict movements of livestock, people, and other wildlife (Fuller-Perrine and Tobin 1993). Barrier fencing would generally be available to all entities.

Surface coverings could be recommended or employed by WS and others to discourage birds from using areas, primarily waterfowl. For example, plastic balls approximately five inches in diameter can be used to cover the surface of a pond and prevent access by waterfowl. A "*ball blanket*" renders a pond unusable for boating, swimming, fishing, and other recreational activities. This method can be very expensive depending on the area covered.

Overhead wire grids consist of wire (*e.g*., fishing line) grid that is stretched over a resource to prevent access by birds. The birds apparently fear colliding with the wires and thus avoid flying into areas where the method has been employed. Johnson (1994) found that wire grids could deter crow use of specific areas where they are causing a nuisance. Waterfowl may be excluded from ponds using overhead wire grids (Fairaizl 1992, Lowney 1993) and are most applicable on ponds of two acres or less. Exclusion may be impractical in most settings (*e.g*., commercial agriculture); however, wire grids could be practical in small areas (*e.g*., personal gardens) or for high-value crops (*e.g*., grapes) (Johnson 1994). A few people would find exclusionary devices such as wire grids unsightly, trashy, and a lowering of the aesthetic value of the neighborhood when used over personal gardens. Wire grids generally render an area unusable by people. The cost of constructing and maintaining wire grids could be burdensome for some people.

Visual scaring techniques such as Mylar tape (highly reflective surface produces flashes of light that startles birds), eyespot balloons (the large eyes supposedly give birds a visual cue that a large predator is present), flags and/or effigies (scarecrows) sometimes are effective in reducing bird damage. Mylar tape has produced mixed results in its effectiveness to frighten birds (Dolbeer et al. 1986, Tobin et. al. 1988). Reflective tape has been used successfully to repel some birds from crops when spaced at three to five meter intervals (Bruggers et al. 1986, Dolbeer et al. 1986). Mylar flagging has been reported effective at reducing migrant Canada goose damage to crops (Heinrich and Craven 1990). Other studies have shown reflective tape ineffective (Bruggers et al. 1986, Dolbeer et al. 1986, Tobin et al. 1988, Conover and Dolbeer 1989). Birds quickly learn to ignore visual and other scaring devices if the birds' fear of the methods is not reinforced with shooting or other tactics. Visual scaring techniques can be impractical in many locations and has met with some concerns due to the negative aesthetic appearance presented on the properties where those methods are used.

Dogs can be effective at harassing waterfowl and keeping them off turf and beaches (Conover and Chasko 1985, Castelli and Sleggs 2000). Around water, this technique appears most effective when the body of water to be patrolled is less than two acres in size (Swift and Felegy 2009). Although dogs can be effective in keeping waterfowl off individual properties, they do not contribute to a solution for the larger problem of overabundant goose populations (Castelli and Sleggs 2000). Swift and Felegy (2009) reported that when harassment with dogs ceases, the number of geese returns to pre-treatment numbers. WS has recommended and encouraged the use of dogs where appropriate.

Scarecrows and effigies often depict predator animals (*e.g.*, alligators, owls), people, or mimic distressed target species (*e.g.*, dead geese, dead vultures) and they are intended to elicit a flight response from target birds, which disperses those birds from the area. Avery et al. (2002) and Seamans (2004) found that the use of vulture effigies were an effective non-lethal method to disperse roosting vultures. Avery et al. (2008*a*) found that effigies could be effective at dispersing crows. However, Conover and Chasko (1985) found an integrated approach (using swan and predator effigies, distress calls, and non-lethal chemical repellents) to be ineffective at scaring or repelling nuisance waterfowl. While Heinrich and Craven (1990) reported that using scarecrows reduced migrant Canada geese use of agricultural fields in rural areas, their effectiveness in scaring geese from urban/suburban areas was severely limited because geese were not afraid of humans as a result of nearly constant contact with people. In general, scarecrows would be most effective when they were moved frequently, alternated with other methods, and were well maintained. However, scarecrows tend to lose effectiveness over time and become less effective as populations increase (Smith et al. 1999). In general, those methods would be available to all entities.

Alarm or distress calls are electronic devices that mimic the sounds exhibited when target species are in distress, which is intended to cause a flight response and disperse target animals from the area. Alarm calls are given by birds when they detect predators while distress calls are given by birds when they are captured by a predator (Conover 2002). When other birds hear these calls, they know a predator is present or a bird has been captured (Conover 2002). Recordings of both calls have been broadcast in an attempt to scare birds from areas where they are unwanted. Recordings have been effective in scaring starlings from airports and vineyards, gulls from airports and landfills, finches from grain fields, herons from aquaculture facilities, and American crows from roosts (Conover 2002). Aguilera et al. (1991) found distress calls ineffective in causing migratory and resident geese to abandon a pond.

The effectiveness of alarm or distress calls can be reduced as birds become accustomed to the sounds and learn to ignore them. Because alarm or distress calls are given when a bird is being held by a predator or when a predator is present, birds should expect to see a predator when they hear these calls. If they do not, they may become accustomed to alarm or distress calls more quickly. In general, birds tend to habituate to hazing techniques (Zucchi and Bergman 1975, Summers 1985, Aubin 1990). For this reason, scarecrows or effigies should be paired with alarm or distress calls (Conover 2002), pyrotechnics (Mott and Timbrook 1988), or other methods to achieve maximum effectiveness. In some situations, the level of volume required for this method to be effective may disturb local residents or be prohibited by local noise ordinances. Although Mott and Timbrook (1988) reported distress calls were effective at repelling resident geese 100 meters from the distress unit, the birds would return shortly after the calls stopped. The repellency effect was enhanced when pyrotechnics were used with the distress calls. In some situations, the level of volume required for this method to be effective in urban/suburban areas would be prohibited by local noise ordinances. Heinrich and Craven (1990) found that an electronic device was ineffective at repelling migrant waterfowl.

Birds hazed from one area where they were causing damage frequently move to another area where they continue to cause damage (Brough 1969, Conover 1984, Summers 1985, Swift and Felegy 2009). Smith et al. (1999) noted that others have reported similar results, stating "*biologists are finding that some techniques (e.g., habitat modifications or scare devices) that were effective for low to moderate population levels tend to fail as flock sizes increase and waterfowl become more accustomed to human activity*". Whitford (2003) used a combination of noise harassment, dogs, nest displacement, and visual harassment to chase geese from an urban park during the nesting season. Birds responded by dispersing and continued harassment with alarm calls prevented recolonization of the site during the nesting season.

Lasers and lights are methods that have been evaluated for a number of species (Glahn et al. 2000*a*, Glahn et al. 2000*b*, Blackwell et al. 2002). For best results and to disperse numerous birds from a roost, a laser is most effectively used in periods of low light, such as after sunset and before sunrise. In the daytime, the laser can also be used during overcast conditions or in shaded areas to move individual and small numbers of birds, although the effective range of the laser is much diminished. Blackwell et al. (2002) tested lasers on several bird species and observed varied results among species. Lasers were ineffective at dispersing pigeons and mallard with birds habituating in approximately 5 minutes and 20 minutes, respectively (Blackwell et al. 2002).

Blackwell et al. (2002) tested lasers on several bird species and observed varied results among species. Lasers were ineffective at dispersing starlings and cowbirds (Blackwell et al. 2002). Lasers were found to be only moderately effective for harassing geese, with significant reduction in night roosting, but little to no reduction in diurnal activity at the site pre- and post-use (Sherman and Barras 2004). Similar to the use of lasers, application of spotlights to haze birds from night roosts has proven to be a moderately effective method. It is a method that can be incorporated with other methods in integrated management plans (VerCauteren et al. 2003).

Pyrotechnics (screamer shells, bird bombs, and 12-gauge cracker shells) have been used to repel many species of birds (Booth 1994). Aguilera et al. (1991) found 15 mm screamer shells effective at reducing resident and migrant Canada Geese use of areas in Colorado. However, Mott and Timbrook (1988) and Aguilera et al. (1991) doubted the efficacy of harassment and believed that moving the geese simply redistributed the problem to other locations. These devices are sometimes effective but usually only for a short period before birds become accustomed and learn to ignore them (Arhart 1972, Rossbach 1975, Shirota and Masake 1983, Schmidt and Johnson 1984, Mott 1985, Bomford 1990). Williams (1983) reported an approximate 50% reduction in blackbirds at two south Texas feedlots because of pyrotechnics and propane cannon use.

Fairaizl (1992) and Conomy et al. (1998) found the effectiveness of pyrotechnics highly variable among different flocks of waterfowl. Some flocks in urban areas required continuous harassment throughout the day with frequent discharges of pyrotechnics, but the waterfowl usually returned within hours. A minority of resident Canada Goose flocks in Virginia showed no response to pyrotechnics, while some flocks showed quick response to pyrotechnics during winter months, suggesting migrant geese made up some or all of the flock (Fairaizl 1992). Shultz et al. (1988) reported fidelity of resident Canada Geese to feeding and loafing areas is strong, even when heavy hunting pressure is ongoing. Mott and Timbrook (1988) concluded that the efficacy of harassment with pyrotechnics was partially dependent on availability of alternative loafing and feeding areas. Although one of the more effective methods of frightening geese away, more often than not pyrotechnics simply move geese to other areas. There are also safety and legal implications regarding their use. Discharge of pyrotechnics is inappropriate and prohibited in some urban/suburban areas. Pyrotechnic projectiles can start fires, ricochet off buildings, pose traffic hazards, trigger dogs to bark incessantly, and annoy and possibly injure people. Use of pyrotechnics in certain municipalities would be constrained by local firearm discharge and noise ordinances.

Paintballs and recreational paintball equipment may be used to supplement other harassment methods. Paintballs consist of a gelatin shell filled with a non-toxic glycol and water-based coloring that rapidly dissipates and is not harmful to the environment. A paintball marker (or gun) uses compressed CO_2 to propel paintballs an average of 280 feet per second, though they are not very accurate. The discharge of the paintball marker combined with the sound of paintballs hitting the ground or splashing in water may be effective in dispersing birds, especially when combined with other harassment techniques. Although paintballs break easily and velocity rapidly decreases with distance, firing at close range is discouraged to avoid harming birds. As with pyrotechnics, use of paintballs may be restricted in some areas by local ordinances.

Propane cannons produce a noise that is intended to represent a firearm discharge. Cannons are attached to a propane tank and regulated to discharge at certain intervals. Propane cannons are generally inappropriate for urban/suburban areas due to the repeated loud explosions, which many people would consider a serious and unacceptable nuisance and potential health threat (hearing damage). Although a propane cannon can be an effective dispersal tool for birds in agricultural settings, resident waterfowl in urban areas are more tolerant of noise and habituate to propane cannons relatively quickly.

High pressured water spray can serve two purposes: scaring birds from a roost or loafing area and cleaning feces and other particulates from an area. Spray from a high pressure sprayer would be persistent enough to irritate birds and cause them to leave an area, but would not be strong enough to cause physical damage. This method would be preferred when rousing crows or other gregarious bird species from a roost and may even be more acceptable than using loud noises or chemicals. Logistical issues with using this method arise due to the size of the equipment needed and access to water.

Avitrol is a chemical frightening agent (repellent) that can be effective in a single dose when mixed with untreated baits, normally in a 1:9 ratio. However, birds consuming treated baits are generally killed (Johnson and Glahn 1994). Prebaiting is usually necessary to achieve effective bait acceptance by the target species. This chemical has been registered for use on pigeons, crows, blackbirds, starlings, and house sparrows in various situations. Avitrol treated bait is placed in an area where the targeted birds are feeding. When a treated particle is consumed, the affected bird begins to broadcast distress vocalizations and display abnormal flying behavior; thereby, frightening the remaining birds away.

Avitrol is a restricted use pesticide that can only be sold to certified applicators and has been available in several bait formulations where only a small portion of the individual grains carries the chemical. It can be used during any time of the year, but is used most often during winter and spring. Any granivorous bird associated with the target species could be affected by Avitrol. Avitrol is water soluble, but laboratory studies demonstrated that Avitrol is strongly absorbed onto soil colloids and has moderately low mobility. Biodegradation is expected to be slow in soil and water, with a half-life ranging from three to 22 months. However, Avitrol may form covalent bonds with humic materials, which may serve to reduce its availability for intake by organisms from water. Avitrol does not accumulate in tissues, and is rapidly metabolized by many species (Schafer 1991).

Avitrol is acutely toxic to avian and mammalian species; however, blackbirds are more sensitive to the chemical and there is little evidence of chronic toxicity. Laboratory studies with predator and scavenger species have shown minimal potential for secondary poisoning and during field use; only magpies and crows appear to have been affected (Schafer 1991). However, a laboratory study by Schafer et al. (1974) showed that magpies exposed to 2 to 3.2 times the published LD_{50} in contaminated prey for 20 days were not adversely affected and three American Kestrels that were fed contaminated blackbirds for seven to 45 days were not adversely affected. Some hazards may occur to predatory species consuming unabsorbed chemical in the gastrointestinal tract of affected or dead birds (Schafer 1981, Holler and Schafer 1982).

Methyl anthranilate has been used as an artificial grape flavoring in foods and soft drinks for human consumption. Methyl anthranilate could be used or recommended by WS as a bird repellent and would be available for use by other entities. Methyl anthranilate has been shown to be a promising repellent for many bird species, including waterfowl (Dolbeer et al. 1993*b*). Cummings et al. (1995) found the effectiveness of methyl anthranilate declined significantly after 7 days. Belant et al. (1996) found methyl anthranilate ineffective as a bird grazing repellent, even when applied at triple the recommended label rate. Methyl anthranilate has also been investigated as a livestock feed additive (Mason et al. 1984, Mason et al. 1989). It is registered for applications to turf or to surface water areas used by unwanted birds. The material has been shown to be nontoxic to bees (LD_{50} > 25 micrograms/bee)[28], nontoxic to rats in an inhalation study (LC_{50} > 2.8 mg/L)[29], and of relatively low toxicity to fish and other invertebrates. Methyl anthranilate is naturally occurring in concord grapes and in the blossoms of several species of flowers (Dolbeer et al. 1992). It has been listed as "*Generally Recognized as Safe*" by the FDA (Dolbeer et al. 1992).

Water surface and turf applications of methyl anthranilate are generally considered expensive. A potentially more cost effective method of methyl anthranilate application is by use of a fog-producing machine (Vogt 1997). The fog drifts over the area to be treated and is irritating to the birds while being non-irritating to any humans that might be exposed. Fogging applications must generally be repeated three to five times after the initial treatment before the birds abandon a treatment site.

Mesurol was recently registered by WS to repel crows and ravens from bird nests of T&E species. It could be used by WS only as a bird repellent to deter predation by crows on eggs of T&E species. Dimmick and Nicolaus (1990) showed breeding pairs of crows could be conditioned with aversive chemicals to avoid eggs. However, Avery and Decker (1994) observed increased consumption of eggs treated with higher doses of mesurol by fish crows. Sullivan and Dinsmore (1990) reported bird nests greater than 700 meters from crow nests were relatively safe from crow predation, thus nests beyond 700 meters from active crow nests may not need to be treated.

WS would treat eggs similar in appearance as those eggs of the species needing protection. The active ingredient is injected into eggs, which are placed in artificial nests or upon elevated platforms. Upon ingestion, birds develop post-ingestional malaise (Mason 1989) and crows develop an aversion to consuming similar looking eggs (Dimmick and Nicolaus 1990). Repeated exposures may be necessary to develop and maintain aversion to threatened or endangered species eggs as the learning curve for crows can take from 23 days to 3 months (Dimmick and Nicolaus 1990, Avery and Decker 1994).

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[28]An LD_{50} is the dosage in milligrams of material per kilogram of body weight, or, in this case in micrograms per individual bee, required to cause death in 50% of a test population of a species.
[29]An LC_{50} is the dosage in milligrams of material per liter of air required to cause death in 50% of a test population of a species through inhalation.

Treated areas would be posted with warning signs at access points to exclude people from T&E species nesting areas. Treated eggs would not be placed in locations where T&E species may eat the treated eggs. Mesurol is highly toxic to birds and mammals and toxic to fish. It is also highly toxic to honey bees.

Particulate feed additives have been investigated for their bird-repellent characteristics. In pen trials, European Starlings rejected grain to which charcoal particles were adhered. If further research finds this method to be effective and economical in field application, it might become available as a bird repellent on livestock feed. Charcoal feed additives have been explored for use in reducing methane production in livestock and should have no adverse effects on livestock, on meat or milk production, or on human consumers of meat or dairy products.

Other chemical repellents have shown bird repellent capabilities. Anthraquinone is a naturally occurring chemical found in many plant species and in some invertebrates as a natural predator defense mechanism. Anthraquinone has shown effectiveness in protecting rice seed from Red-winged Blackbirds and Boat-tailed Grackles (Avery et al. 1997). It has also shown effectiveness as a foraging repellent against Canada Goose grazing on turf and as a seed repellent against Brown-headed Cowbirds (Dolbeer et al. 1998). Compounds extracted from common spices used in cooking and applied to perches in cage tests have been shown repellent characteristics against roosting European starlings (Clark 1997). Naphthalene (mothballs) was found to be ineffective in repelling European Starlings (Dolbeer et al. 1988).

Live traps generally allow target bird species to enter inside the trap but prevent them from exiting the trap. Bird live-captured in traps could be translocated or euthanized. Live traps include:

Bow nets are normally used for raptors but may also be used for European Starlings, shorebirds, and other species using visual bait and/or conspecific decoys. Bow nets are remotely triggered from a nearby observation site. Once the net is triggered, the net envelopes the target birds inside the net similar to a suitcase when closed.

Box/Cage traps come in a variety of styles to live-capture birds. A visual attractant or bait is generally placed inside the trap to attract target bird species. Target bird species enter the trap to through one-way doors to access the bait or attractant but are then unable to exit.

Decoy traps are similar in design to the Australian Crow Trap as reported by McCracken (1972) and Johnson and Glahn (1994) or typical pigeon traps. Live decoy birds of the same species that are being targeted are usually placed in the trap with sufficient food and water to assure their survival. Perches are configured in the trap to allow birds to roost above the ground and in a more natural position. Feeding behavior and calls of the decoy birds attract other birds, which enter the trap through one-way doors and are unable to exit. Active decoy traps are monitored daily, every other day, or as appropriate if food, water, and shelter are provided, to remove and euthanize excess birds and to replenish bait and water.

Drop nets could be suspended over a pre-baited site and manually or remotely triggered to drop on target animals or manually dropped on target birds from a high site such as a bridge or rooftop. Decoys may also be used to enhance the effectiveness of drop nets.

Cannon nets are normally used for larger birds, such as geese or pigeons and use mortar projectiles or compressed air to propel a net up and over birds that have been baited to a particular site.

Foothold traps could be employed to live-captures birds, primarily raptors. Johnson (1994) found that trapping with modified foothold traps could be effective in areas where a small resident crow population is present. No. 0 or 1 foothold traps with padded jaws were used to trap individual birds in areas habitually used by crows. Foothold traps could also be used atop poles to capture raptors. Pole traps are designed to live-capture raptors as they land atop a pole to perch. When landing atop the pole, raptors are captured in modified foothold traps. Traps are attached to a guide wire that runs from the trap down the pole to the ground. Once live-captured by the foothold trap, the trap and raptor slide down the guide wire to the ground for handling. Traps would be monitored a minimum of twice each day to ensure raptors captured were addressed timely.

Nest box traps are effective in capturing local breeding and post breeding European Starlings and other targeted secondary cavity nesting birds (DeHaven and Guarino 1969, Knittle and Guarino 1976) and operate similar to other live-capture traps. Nest box traps allow birds to enter but not exit.

Nest/Walk-in traps are similar to box or decoy traps. They are placed over an active nest or baited with food and allow the target bird to pass through a funnel, one-way, or drop down door that confines the target. Nest and walk-in traps are effective in capturing ground nesting birds, such as ducks, geese, and ground feeding birds such as rock pigeons and mourning doves.

Mist nets are more commonly used for capturing small-sized birds but can be used to capture larger birds, such as ducks and smaller raptors. It was introduced into the United States in the 1950s from Asia and the Mediterranean where it was used to capture birds for the market (Day et al. 1980). The mist net is a fine black silk or nylon net usually 3 to 10 feet wide and 25 to 35 feet long. Net mesh size determines the bird species that could be caught and overlapping pockets in the net cause birds to entangle themselves when they fly into the net. Decoys and electronic calls may also be used to enhance the effectiveness of mist nets.

Net guns/launchers are normally used for flocking birds such as waterfowl and European Starlings. They use a firearm blank or compressed air to propel a weighted net up and over birds, which have been baited to a particular site or birds that do not avoid people. Net guns are manually discharged while net launchers are remotely discharged from a nearby observation site.

Raptor traps are varied in form and function and include, but is not limited to, Bal-chatri, Dho Gaza traps, Phai hoop traps, and Swedish Goshawk traps. These traps could be used specifically to live-trap raptors.

Corral traps could be used to live-capture birds, primarily geese and other waterfowl. Corral traps can be effectively used to live capture Canada Geese during the annual molt when birds are unable to fly. Each year for a few weeks in the summer, geese are flightless as they are growing new flight feathers. Therefore, geese can be slowly guided into corral-traps.

Funnel traps could be used to live-capture waterfowl. Traps are set up in shallow water and baited. Funnel traps allow waterfowl to enter the trap but prevents the ducks from exiting. Traps would be checked regularly to address live-captured waterfowl. Captured ducks can be relocated or euthanized.

Alpha-chloralose is a central nervous system depressant used as an immobilizing agent to capture and remove pigeons, waterfowl and other birds. It is labor intensive and in some cases, may not be cost effective (Wright 1973, Feare et al. 1981). Alpha-chloralose is typically delivered in a well contained bait in small quantities with minimal hazards to pets and humans; single bread or corn baits are fed directly to the target birds. WS' personnel are present at the site of application during baiting to retrieve the immobilized birds. Unconsumed baits are removed from the site following each treatment. The solubility and mobility are believed to be moderate and environmental persistence is believed to be low. Bioaccumulation in plants and animal tissue is believed to be low. Alpha-chloralose is used in other countries as an avian and mammalian toxicant. The compound is slowly metabolized, with recovery occurring a few hours after administration (Schafer 1991). The dose used for immobilization is designed to be about two to 30 times lower than the LD_{50}. Mammalian data indicate higher LD_{50} values than birds. Toxicity to aquatic organisms is unknown (Woronecki et al. 1990) but the compound is not generally soluble in water and therefore should remain unavailable to aquatic organisms. Factors supporting the determination of this low potential included the lack of exposure to pets, non-target species and the public, and the low toxicity of the active ingredient. Other supporting rationale for this determination included relatively low total annual use and a limited number of potential exposure pathways. The agent is currently approved for use by WS as an Investigative New Animal Drug by the FDA rather than a pesticide.

Nest destruction is the removal of nesting materials during the construction phase of the nesting cycle or after removing eggs and/or nestlings. Nest destruction is generally only applied when dealing with a single bird or very few birds. This method is used to discourage birds from constructing nests in areas that may create nuisances for home and business owners. Heusmann and Bellville (1978) reported that nest removal was an effective but time-consuming method.

Live-capture and translocation could be accomplished using methods to live-capture some bird species for translocating and releasing those birds in other areas. WS could employ those methods in North Carolina when the target animal(s) can legally be translocated or can be captured and handled with relative safety by WS' personnel.

Smith (1996) reported that groups of juvenile geese relocated from urban to rural settings could effectively eliminate these geese from urban areas, retain them at the release site, include them in the sport harvest, and expose them to higher natural mortality. Smith (1996) also reported that multiple survival models indicated that survival estimates of relocated juveniles were half of those of urban captured and released birds. The relocation of resident geese from metropolitan communities can assist in the reduction of overabundant populations (Cooper and Keefe 1997), and translocating geese has generally been accepted by the public as a method of reducing goose populations to socially acceptable levels (Fairaizl 1992, Powell et al. 2004). In areas where interest in hunting is high, the potential exists for moving nuisance geese to areas more accessible by hunters. In addition, the removal of geese posing or likely to pose a hazard to air safety at airports has been demonstrated to reduce the population of local geese and decrease the number of flights through the airport operations airspace, resulting in increased air safety at the Minneapolis-St. Paul International Airport (Cooper 1991).

Live capture and handling of birds poses an additional level of human health and safety threat if target birds are aggressive, large, or extremely sensitive to the close proximity of humans. For that reason, WS may limit this method to specific situations and certain species. In addition, moving damage-causing individuals to other locations can typically result in damage at the new location, or the translocated individuals can move from the relocation site to areas where they are unwanted. In addition, translocation can facilitate the spread of diseases from one area to another. High population densities of some animals may make this a poor wildlife management strategy for those species. Translocation would be evaluated by WS on a case-by-case basis. Translocation would only occur with the prior authorization of the USFWS and/or the NCWRC.

Nicarbazin is an EPA registered reproductive inhibitor that can be used to reduce egg production and viability in Canada geese and rock pigeons. Nicarbazin is available to certified pesticide applicators and is not restricted to use by WS. Use of baits containing nicarbazin would allow the numbers of small to moderate sized groups of Canada geese and rock pigeons to be controlled by reducing the hatchability of eggs laid by treated birds without requiring the location of each individual nest to be determined (as is the case for egg oiling/addling/destruction).

Nicarbazin is thought to induce infertility in birds by two main mechanisms. Nicarbazin may disrupt the membrane surrounding the egg yolk, resulting in intermixing of egg yolk and white (albumin) components, and creating conditions in which the embryo cannot develop. Nicarbazin may also inhibit incorporation of cholesterol into the yolk, a step that is necessary for yolk formation; thereby, limiting energy for the developing embryo. If the yolk does not provide enough energy, the embryo will not completely form and the egg will never hatch. Nicarbazin bait must be consumed for several days to achieve blood levels that affect the hatchability of eggs that are forming. Nicarbazin is undetectable in the plasma of Canada Geese, Mallards, and chickens by four to six days after consumption of nicarbazin bait has stopped. The levels of active ingredient in the blood are reduced by half within one day after bait consumption stops. If the level of active ingredient falls by approximately one-half its peak levels, no effects on egg formation can be seen. This is reached after the second day without bait consumption. Consequently, the bait must be offered to the birds each day of the nesting period to effectively limit reproduction effectively.

LETHAL METHODS WILDLIFE DAMAGE MANAGEMENT METHODS

Shooting is more effective as a dispersal technique than as a way to reduce bird densities when large numbers of birds are present. Normally shooting is conducted with shotguns, rifles, or air rifles. Shooting is a very individual specific method and is typically used to remove a single offending bird. However, at times, a few birds could be shot from a flock to make the remainder of the birds more wary and to help reinforce non-lethal methods. Shooting can be relatively expensive because of the staff hours sometimes required. It is selective for target species and may be used in conjunction with the use of spotlights, decoys, and calling. Shooting with shotguns, air rifles, or rim and centerfire rifles is sometimes used to manage bird damage problems when lethal methods are determined to be appropriate. The birds are killed as quickly and humanely as possible. WS' firearm use and safety would comply with WS Directive 2.615.

Sport hunting is sometimes recommended by WS as a viable damage management method when the target species can be legally hunted. A valid hunting license and other licenses or permits may be required by the NCWRC and the USFWS for certain species. This method provides sport and food for hunters and requires no cost to the landowner. Sport hunting is occasionally recommended if it can be conducted safely.

Cervical dislocation is sometimes used to euthanize birds that are captured in live traps. The bird is stretched and the neck is hyper-extended and dorsally twisted to separate the first cervical vertebrae from the skull. The AVMA considers this technique as a conditionally acceptable method of euthanasia and states that cervical dislocation when properly executed may be a humane technique for euthanasia of poultry and other small birds (AVMA 2013). Cervical dislocation is a technique that may induce rapid unconsciousness, does not chemically contaminate tissue, and is rapidly accomplished (Beaver et al. 2001).

Carbon dioxide is sometimes used to euthanize birds that are captured in live traps. Live birds are placed in a container such as a plastic 5-gallon bucket or chamber and sealed shut. Carbon dioxide gas is released into the bucket or chamber and birds quickly die after inhaling the gas. This method is approved as a euthanizing agent by the AVMA (AVMA 2013). Carbon dioxide gas is a byproduct of animal respiration, is common in the atmosphere, and is required by plants for photosynthesis. It is used to carbonate beverages for human consumption and is released as a gas by dry ice. The use of carbon dioxide by WS for euthanasia purposes is exceedingly minor and inconsequential to the amounts used for other purposes by society.

Snap traps are modified rat snap traps used to remove individual European Starlings, and other cavity using birds. The trap treadle is baited with peanut butter or other food attractants and attached near the damage area. These traps pose no imminent danger to pets or the public, and are usually located in positions inaccessible to people and most non-avian animals. They are very selective because they are usually set in the defended territory of the target birds.

Egg addling/destruction are methods of suppressing reproduction in local nuisance bird populations by destroying egg embryos prior to hatching. Egg addling is conducted by vigorously shaking an egg numerous times, which causes detachment of the embryo from the egg sac. Egg destruction can be accomplished in several different ways, but the most commonly used methods are manually gathering eggs and breaking them, or by oiling or spraying the eggs with a liquid, which covers the entire egg and prevents the egg from obtaining oxygen (see egg oiling below).

Egg oiling is a method for suppressing reproduction of nuisance birds by spraying a small quantity of food grade vegetable oil or mineral oil on eggs in nests. The oil prevents exchange of gases and causes asphyxiation of developing embryos and has been found to be 96-100% effective in reducing hatchability (Pochop 1998, Pochop et al. 1998). The method has an advantage over nest or egg destruction in that the incubating birds generally continue incubation and do not re-nest. The EPA has ruled that use of corn oil for this purpose is exempt from registration requirements under FIFRA. To be most effective, the oil should be applied anytime between the fifth day after the laying of the last egg in a nest and at least five days before anticipated hatching. This method is extremely target specific and is less labor intensive than egg addling.

DRC-1339 has proven to be an effective method of starling, blackbird, gull, and pigeon control at feedlots, dairies, airports, and in urban areas for the last 30 years (DeCino et al. 1966, Besser et al. 1967, West et al. 1967). Studies continue to document the effectiveness of DRC-1339 in resolving blackbird/starling problems at feedlots (West and Besser 1976, Glahn 1981, Glahn et al. 1987) and dispersing crow roosts in urban/suburban areas (Boyd and Hall 1987). Blanton et al. (1991) reports that DRC-1339 appears to be a very effective, selective, and safe means of urban pigeon population reduction. Glahn and Wilson (1992) noted that baiting with DRC-1339 is a cost-effective method of reducing damage by blackbirds to sprouting rice.

DRC-1339 is a slow acting avicide that is registered with the EPA for reducing damage from several species of birds, including blackbirds, starlings, pigeons, crows, ravens, magpies, and gulls. DRC-1339 was developed as an avicide because of its differential toxicity to mammals. DRC-1339 is highly toxic to sensitive species but only slightly toxic to non-sensitive birds, predatory birds, and mammals (Schafer 1981, Schafer 1991, Johnston et al. 1999). For example, starlings, a highly sensitive species, require a dose of only 0.3 mg/bird to cause death (Royall et al. 1967). Most bird species that are responsible for damage, including starlings, blackbirds, pigeons, crows, magpies, and ravens are highly sensitive to DRC-1339. Many other bird species such as raptors, sparrows, and eagles are classified as non-sensitive (Schafer 1981). Numerous studies show that DRC-1339 poses minimal risk of primary poisoning to non-target and T&E species (EPA 1995). Secondary poisoning has not been observed with DRC-1339 treated baits, except with crows eating gut contents of pigeons (Krebs 1974). During research studies, carcasses of birds that died from DRC-1339 were fed to raptors and scavenger mammals for 30 to 200 days with no symptoms of secondary poisoning observed (Cunningham et al. 1979). This can be attributed to relatively low toxicity to species that might scavenge on blackbirds and starlings killed by DRC-1339 and its tendency to be almost completely metabolized in the target birds which leaves little residue to be ingested by scavengers. Secondary hazards of DRC-1339 are almost nonexistent (Schafer 1984, Schafer

1991, Johnston et al. 1999). DRC-1339 acts in a humane manner producing a quiet and apparently painless death.

DRC-1339 is unstable in the environment and degrades rapidly when exposed to sunlight, heat, or ultra violet radiation. DRC-1339 is highly soluble in water but does not hydrolyze and degradation occurs rapidly in water. DRC-1339 tightly binds to soil and has low mobility. The half-life is about 25 hours, which means it is nearly 100% broken down within a week, and identified metabolites (*i.e.*, degradation chemicals) have low toxicity. Currently, DRC-1339 has several EPA Registration Labels (56228-10, 56228-17, 56228-28, 56228-29, and 56228-30) depending on the application or species involved in the damage management project.

APPENDIX D
FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES IN NORTH CAROLINA

Table 1 – Species listed as threatened, endangered, or candidate species in North Carolina

Common Name	Scientific Name	Status†	Determination‡
Animals			
Arachnids			
Spruce-fir Moss Spider	*Microhexura montivaga*	E	NE
Birds			
Piping Plover	*Charadrius melodus*	T	MANLAA
Red Knot	*Calidris canutus rufa*	T	NE
Red-cockaded Woodpecker	*Picoides borealis*	E	MANLAA
Roseate Tern	*Sterna dougallii dougallii*	E	NE
Wood Stork	*Mycteria Americana*	T	MANLAA
Clams			
Appalachian Elktoe	*Alasmidonta raveneliana*	E	NE
Carolina Heelsplitter	*Lasmigona decorate*	E	NE
Cumberland Bean Pearlymussel	*Villosa trabalis*	E	NE
Dwarf Wedgemussel	*Alasmidonta heterodon*	E	NE
James Spinymussel	*Pleurobema collina*	E	NE
Littlewing Pearlymussel	*Pegias fabula*	E	NE
Tar River Spinymussel	*Elliptio steinstansana*	E	NE
Yellow Lance	*Elliptio lanceolata*	T	NE
Fishes			
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	E	NE
Cape Fear Shiner	*Notropis mekistocholas*	E	NE
Shortnose Sturgeon	*Acipenser brevirostrum*	E	NE
Spotfin Chub	*Erimonax monachus*	T	NE
Waccamaw Silverside	*Menidia extensa*	T	NE
Roanoke logperch	*Percina rex*	E	NE
Insects			
Saint Francis' Satyr Butterfly	*Neonympha mitchellii francisci*	E	NE
Rusty Patched Bumble Bee	*Bombus affinis*	E	NE
Mammals			
Carolina Northern Flying Squirrel	*Glaucomys sabrinus coloratus*	E	NE
Indiana Bat	*Myotis sodalist*	E	NE
Gray Bat	*Myotis grisescens*	E	NE
Northern Long-eared Bat	*Myotis septentrionalis*	T	NE
Virginia Big-eared Bat	*Corynorhinus townsendii virginianus*	E	NE
Red Wolf	*Canis rufus*	EXPN	NE
West Indian Manatee	*Trichechus manatus*	E	NE
Reptiles			
American Alligator	*Alligator mississippiensis*	SAT	NE
Green Sea Turtle	*Chelonia mydas*	T	NE
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E	NE
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	E	NE
Leatherback Sea Turtle	*Dermochelys coriacea*	E	NE
Loggerhead Sea Turtle	*Caretta caretta*	T	NE
Snails			

Noonday Snail	*Patera clarki Nantahala*	T	NE
Magnificent Ramshorn	*Planorbella magnifica*	C	NE
Plants			
Flowering Plants			
American Chaffseed	*Schwalbea Americana*	E	NE
Blue Ridge Goldenrod	*Solidago spithamaea*	T	NE
Bunched Arrowhead	*Sagittaria fasciculate*	E	NE
Canby's Dropwort	*Oxypolis canbyi*	E	NE
Cooley's Meadowrue	*Thalictrum cooleyi*	E	NE
Dwarf-flowered Heartleaf	*Hexastylis naniflora*	T	NE
Golden Sedge	*Carex lutea*	E	NE
Green Pitcher-plant	*Sarracenia oreophila*	E	NE
Harperella	*Ptilimnium nodosum*	E	NE
Heller's Blazing Star	*Liatris helleri*	T	NE
Michaux's Sumac	*Rhus michauxii*	E	NE
Mountain Golden Heather	*Hudsonia montana*	T	NE
Mountain Sweet Pitcher-plant	*Sarracenia rubra ssp. Jonesii*	E	NE
Pondberry	*Lindera melissifolia*	E	NE
Roan Mountain Bluet	*Hedyotis purpurea var. montana*	E	NE
Rough-leaf Loosestrife	*Lysimachia asperulaefolia*	E	NE
Schweinitz's Sunflower	*Helianthus schweinitzii*	E	NE
Seabeach Amaranth	*Amaranthus pumilus*	T	NE
Sensitive Joint-vetch	*Aeschynomene virginica*	T	NE
Small Whorled Pogonia	*Isotria medeoloides*	T	NE
Small-anthered Bittercress	*Cardamine micranthera*	E	NE
Smooth Coneflower	*Echinacea laevigata*	E	NE
Spreading Avens	*Geum radiatum*	E	NE
Swamp Pink	*Helonias bullata*	T	NE
Virginia Spiraea	*Spiraea virginiana*	T	NE
White Irisette	*Sisyrinchium dichotomum*	E	NE
Lichens			
Rock Gnome Lichen	*Gymnoderma lineare*	E	NE

†T=Threatened; E=Endangered; EXPN=Experimental Population, Non-Essential; C= Candidate, SAT = Similarity of Appearance (Threatened)
‡NE=No effect; MANLAA=May affect, not likely to adversely affect

The USFWS has also designated critical habitat in North Carolina for some of the species listed as threatened or endangered. Table 2 provides a list of those species with critical habitat designated in North Carolina.

Table 2 – Critical habitats designated in North Carolina

Common Name	Scientific Name	Status†	Determination‡
Animals			
Arachnids			
Spruce-fir Moss Spider	*Microhexura montivaga*	CH	NE
Birds			
Piping Plover	*Charadrius melodus*	CH	NE
Clams			
Appalachian Elktoe	*Alasmidonta raveneliana*	CH	NE

Common Name	Scientific Name	Status[†]	Determination[‡]
Carolina Heelsplitter	*Lasmigona decorate*	CH	NE
Fishes			
Cape Fear Shiner	*Notropis mekistocholas*	CH	NE
Spotfin Chub	*Erimonax monachus*	CH	NE
Waccamaw Silverside	*Menidia extensa*	CH	NE
Reptiles			
Loggerhead Turtle	*Caretta caretta*	CH	NE
Plants			
Golden Sedge	*Carex lutea*	CH	NE
Mountain Golden Heather	*Hudsonia montana*	CH	NE

[†]CH=Critical Habitat
[‡]NE=No Effect; No adverse modification

APPENDIX E
STATE THREATENED OR ENDANGERED SPECIES AND SPECIES OF SPECIAL CONCERN IN NORTH CAROLINA

15A NCAC 10I .0103 ENDANGERED SPECIES LISTED

(a) The following species of resident wildlife shall be designated as federally-listed endangered species:

- (1) Amphibians: None Listed At This Time.
- (2) Birds:
  - (A) Bachman's warbler (Vermivora bachmanii);
  - (B) Ivory-billed woodpecker (Campephilus principalis);
  - (C) Kirtland's warbler (Setophaga kirtlandii);
  - (D) Piping plover (Charadrius melodus circumcinctus);
  - (E) Red-cockaded woodpecker (Picoides borealis); and
  - (F) Roseate tern (Sterna dougallii dougallii).
- (3) Crustacea: None Listed At This Time.
- (4) Fish:
  - (A) Cape Fear shiner (Notropis mekistocholas);
  - (B) Roanoke logperch (Percina rex);
  - (C) Shortnose sturgeon (Acipenser brevirostrum), when found in inland fishing waters as defined in G.S. 113-291(9)a. and (9)b.; and
  - (D) Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus), when found in inland fishing waters.
- (5) Mammals:
  - (A) Carolina northern flying squirrel (Glaucomys sabrinus coloratus);
  - (B) Eastern cougar (Puma concolor);
  - (C) Gray bat (Myotis grisescens);
  - (D) Indiana bat (Myotis sodalis);
  - (E) Manatee (Trichechus manatus), when found in inland fishing waters; and
  - (F) Virginia big-eared bat (Corynorhinus townsendii virginianus).
- (6) Mollusks:
  - (A) Appalachian elktoe (Alasmidonta raveneliana);
  - (B) Carolina heelsplitter (Lasmigona decorata);
  - (C) Dwarf wedgemussel (Alasmidonta heterodon);
  - (D) James spinymussel (Pleurobema collina);
  - (E) Littlewing pearlymussel (Pegias fabula);
  - (F) Tan riffleshell (Epioblasma florentina walkeri); and
  - (G) Tar River spinymussel (Elliptio steinstansana).
- (7) Reptiles:
  - (A) Kemp's ridley seaturtle (Lepidochelys kempii);
  - (B) Atlantic hawksbill seaturtle (Eretmochelys imbricata imbricata); and
  - (C) Leatherback seaturtle (Dermochelys coriacea).

(b) The following species of resident wildlife shall be designated as state-listed endangered species:

- (1) Amphibians:
  - (A) Gopher frog (Rana [=Lithobates] capito);
  - (B) Ornate chorus frog (Pseudacris ornata); and
  - (C) River frog (Rana [=Lithobates] heckscheri).
- (2) Birds:
  - (A) American peregrine falcon (Falco peregrinus anatum);
  - (B) Bewick's wren (Thryomanes bewickii);
  - (C) Common tern (Sterna hirundo);
  - (D) Henslow's sparrow (Ammodramus henslowii); and
  - (E) Wayne's black-throated green warbler (Setophaga virens waynei).
- (3) Crustacea: Bennett's Mill cave water slater (Caecidotea carolinensis).
- (4) Fish:
  - (A) Blotchside logperch (Percina burtoni);

(B) Bridle shiner (Notropis bifrenatus);
(C) Dusky darter (Percina sciera);
(D) Orangefin madtom (Noturus gilberti);
(E) Paddlefish (Polyodon spathula);
(F) Robust redhorse (Moxostoma robustum);
(G) Rustyside sucker (Thoburnia hamiltoni);
(H) Sharpnose darter (Percina oxyrhyncus); and
(I) Stonecat (Noturus flavus).

(5) Mammals: None Listed At This Time.

(6) Mollusks:

(A) Atlantic pigtoe (Fusconaia masoni);
(B) Barrel floater (Anodonta couperiana);
(C) Brook floater (Alasmidonta varicosa);
(D) Carolina creekshell (Villosa vaughaniana);
(E) Fragile glyph (Glyphyalinia clingmani);
(F) Green floater (Lasmigona subviridis);
(G) Greenfield rams-horn (Helisoma eucosmium)
(H) Knotty elimia (Elimia christyi);
(I) Longsolid (Fusconaia subrotunda);
(J) Magnificent rams-horn (Planorbella magnifica);
(K) Purple wartyback (Cyclonaias tuberculata);
(L) Savannah lilliput (Toxolasma pullus);
(M) Slippershell mussel (Alasmidonta viridis);
(N) Tennessee clubshell (Pleurobema oviforme);
(O) Tennessee heelsplitter (Lasmigona holstonia);
(P) Tennessee pigtoe (Fusconaia barnesiana);
(Q) Yellow lampmussel (Lampsilis cariosa); and
(R) Yellow lance (Elliptio lanceolata).

(7) Reptiles:

(A) Eastern coral snake (Micrurus fulvius fulvius); and
(B) Eastern diamondback rattlesnake (Crotalus adamanteus).

History Note: *Authority G.S. 113-134; 113-291.2; 113-292; 113-333;*
Eff. June 11, 1977;
Amended Eff. October 1, 2017; August 1, 2016; May 1, 2008; April 1, 2001; February 1, 1994;
November 1, 1991; April 1, 1991; June 1, 1990

15A NCAC 10I .0104 THREATENED SPECIES LISTED

(a) The following species of resident wildlife shall be designated as federally-listed threatened species:

(1) Amphibians: None Listed At This Time.

(2) Birds:

(A) Piping plover (Charadrius melodus melodus);

(B) Red knot (Calidris canutus rufa); and

(C) Wood stork (Mycteria americana).

(3) Crustacea: None Listed At This Time.

(4) Fish:

(A) Spotfin chub (Erimonax monachus); and

(B) Waccamaw silverside (Menidia extensa).

(5) Mammals: Northern long-eared bat (Myotis septentrionalis)

(6) Mollusks: Noonday globe (Patera clarki nantahala).

(7) Reptiles:

(A) Bog turtle (Glyptemys muhlenbergii);

(B) American alligator (Alligator mississipiensis);

(C) Green seaturtle (Chelonia mydas); and

(D) Loggerhead seaturtle (Caretta caretta).

(b) The following species of resident wildlife are designated as state-listed threatened species:

(1) Amphibians:

(A) Eastern tiger salamander (Ambystoma tigrinum tigrinum);

(B) Green salamander (Aneides aeneus);

(C) Junaluska salamander (Eurycea junaluska);

(D) Mabee's salamander (Ambystoma mabeei); and

(E) Wehrle's salamander (Plethodon wehrlei).

(2) Birds:

(A) Bald eagle (Haliaeetus leucocephalus);

(B) Caspian tern (Hydroprogne caspia);

(C) Gull-billed tern (Gelochelidon nilotica aranea); and

(D) Northern saw-whet owl (Aegolius acadicus).

(3) Crustacea: None Listed At This Time.

(4) Fish:

(A) Bigeye jumprock (Moxostoma ariommum);

(B) Carolina madtom (Noturus furiosus);

(C) Carolina pygmy sunfish (Elassoma boehlkei);

(D) Carolina redhorse (Moxostoma sp.)(Pee Dee River and its tributaries and Cape Fear River and its tributaries);

(E) Least brook lamprey (Lampetra aepyptera);

(F) Logperch (Percina caprodes);

(G) Mimic shiner (Notropis volucellus);

(H) Rosyface chub (Hybopsis rubrifrons);

(I) Sharphead darter (Etheostoma acuticeps);

(J) Sicklefin redhorse (Moxostoma sp.)(Hiwassee River and its tributaries and Little Tennessee River and its tributaries);

(K) Turquoise darter (Etheostoma inscriptum); and

(L) Waccamaw darter (Etheostoma perlongum).

(5) Mammals:

(A) Eastern woodrat (Neotoma floridana floridana);

(B) Rafinesque's big-eared bat (Corynorhinus rafinesquii rafinesquii); and

(C) Red wolf (Canis rufus).

(6) Mollusks:

(A) Alewife floater (Anodonta implicata);

(B) Big-tooth covert (Fumonelix jonesiana);

(C) Cape Fear threetooth (Triodopsis soelneri);
(D) Carolina fatmucket (Lampsilis radiata conspicua);
(E) Eastern lampmussel (Lampsilis radiata radiata);
(C) Eastern pondmussel (Ligumia nasuta);
(D) Engraved covert (Fumonelix orestes);
(E) Mountain creekshell (Villosa vanuxemensis);
(F) Notched rainbow (Villosa constricta);
(G) Rainbow (Villosa iris);
(H) Roan supercoil (Paravitrea varidens);
(I) Sculpted supercoil (Paravitrea ternaria);
(J) Smoky Mountain covert (Inflectarius ferrissi);
(K) Squawfoot (Strophitus undulatus);
(L) Tidewater mucket (Leptodea ochracea);
(M) Triangle floater (Alasmidonta undulata);
(N) Waccamaw ambersnail (Catinella waccamawensis);
(O) Waccamaw fatmucket (Lampsilis fullerkati); and
(P) Waccamaw spike (Elliptio waccamawensis).

(8) Reptiles:
(A) Northern pine snake (Pituophis melanoleucus melanoleucus); and
(B) Southern hognose snake (Heterodon simus).

History Note: *Authority G.S. 113-134; 113-291.2; 113-292; 113-333;*
Eff. March 17, 1978;
Amended Eff. June 1, 2008; April 1, 2001; November 1, 1991; April 1, 1991; June 1, 1990;
September 1, 1989;
Temporary Amendment Eff. February 27, 2015;
Amended Eff. October 1, 2017; July 1, 2016; August 1, 2016.

15A NCAC 10I .0105 SPECIAL CONCERN SPECIES LISTED

The following species of resident wildlife shall be designated as state-listed special concern species:

(a) Amphibians:

- (a) Crevice salamander (Plethodon longicrus);
- (b) Dwarf salamander (Eurycea quadridigitata);
- (c) Dwarf black-bellied salamander (Desmognathus folkertsi);
- (d) Eastern hellbender (Cryptobranchus alleganiensis alleganiensis);
- (e) Four-toed salamander (Hemidactylium scutatum);
- (f) Gray treefrog (Hyla versicolor);
- (g) Longtail salamander (Eurycea longicauda longicauda);
- (h) Mole salamander (Ambystoma talpoideum);
- (i) Mountain chorus frog (Pseudacris brachyphona);
- (j) Mudpuppy (Necturus maculosus);
- (k) Neuse River waterdog (Necturus lewisi);
- (l) Southern zigzag salamander (Plethodon ventralis); and
- (m) Weller's salamander (Plethodon welleri).

(2) Birds:

- (a) American oystercatcher (Haematopus palliatus);
- (b) Bachman's sparrow (Peucaea aestivalis);
- (c) Barn owl (Tyto alba);
- (d) Black-capped chickadee (Poecile atricapillus);
- (e) Black rail (Laterallus jamaicensis);
- (f) Black skimmer (Rynchops niger);
- (g) Brown creeper (Certhia americana nigrescens);
- (h) Cerulean warbler (Setophaga cerulea);
- (i) Glossy ibis (Plegadis falcinellus);
- (j) Golden-winged warbler (Vermivora chrysoptera);
- (k) Least bittern (Ixobrychus exilis);
- (l) Least tern (Sternula antillarum);
- (m) Little blue heron (Egretta caerulea);
- (n) Loggerhead shrike (Lanius ludovicianus);
- (o) Painted bunting (Passerina ciris);
- (p) Red crossbill (Loxia curvirostra);
- (q) Snowy egret (Egretta thula);
- (r) Tricolored heron (Egretta tricolor);
- (s) Vesper sparrow (Pooecetes gramineus); and
- (t) Wilson's plover (Charadrius wilsonia).

(3) Crustacea:

- (a) Broad River spiny crayfish (Cambarus spicatus);
- (b) Carolina skistodiaptomus (Skistodiaptomus carolinensis);
- (c) Carolina well diacyclops (Diacyclops jeannelli putei);
- (d) Chowanoke crayfish (Orconectes virginiensis);
- (e) Graceful clam shrimp (Lynceus gracilicornis);
- (f) Greensboro burrowing crayfish (Cambarus catagius);
- (g) Hiwassee headwaters crayfish (Cambarus parrishi);
- (h) Little Tennessee River crayfish (Cambarus georgiae);
- (i) North Carolina spiny crayfish (Orconectes carolinensis);
- (j) Oconee stream crayfish (Cambarus chaugaensis); and
- (k) Waccamaw crayfish (Procambarus braswelli).

(4) Fish:

- (a) American brook lamprey (Lethenteron appendix);
- (b) Banded sculpin (Cottus carolinae);
- (c) Blackbanded darter (Percina nigrofasciata);
- (d) Bluefin killifish (Lucania goodei);
- (e) Blue Ridge sculpin (Cottus caeruleomentum);
- (f) Blueside darter (Etheostoma jessiae);

(9) Broadtail madtom (Noturus sp.)(Lumber River and its tributaries and Cape Fear River and its tributaries);
(10) Carolina darter (Etheostoma collis);
(11) Cutlip minnow (Exoglossum maxillingua);
(12) Freshwater drum (Aplodinotus grunniens)(French Broad River);
(13) Highfin carpsucker (Carpiodes velifer)(Cape Fear River and its tributaries);
(14) Kanawha minnow (Phenacobius teretulus);
(15) Lake sturgeon (Acipenser fulvescens);
(16) Least killifish (Heterandria formosa);
(17) Longhead darter (Percina macrocephala);
(18) Mooneye (Hiodon tergisus);
(19) Mountain madtom (Noturus eleutherus);
(20) Ohio lamprey (Ichthyomyzon bdellium);
(21) Olive darter (Percina squamata);
(22) Pinewoods darter (Etheostoma mariae);
(23) River carpsucker (Carpiodes carpio);
(24) Sandhills chub (Semotilus lumbee);
(25) Smoky dace (Clinostomus sp.)(Little Tennessee River and tributaries);
(26) Striped shiner (Luxilus chrysocephalus);
(27) Tennessee snubnose darter (Etheostoma simoterum);
(28) Thinlip chub (Cyprinella zanema)(Lumber River and its tributaries and Cape Fear River and its tributaries);
(aa) Waccamaw killifish (Fundulus waccamensis);
(bb) Wounded darter (Etheostoma vulneratum); and
(cc) Yellowfin shiner (Notropis lutipinnis)(Savannah River and its tributaries).

(5) Mammals:
(a) Allegheny woodrat (Neotoma magister);
(b) Buxton Woods white-footed mouse (Peromyscus leucopus buxtoni);
(c) Coleman's oldfield mouse (Peromyscus polionotus colemani);
(d) Eastern big-eared bat (Corynorhinus rafinesquii macrotis);
(e) Eastern small-footed bat (Myotis leibii leibii);
(f) Florida yellow bat (Lasiurus intermedius floridanus);
(g) Pungo white-footed mouse (Peromyscus leucopus easti);
(h) Southeastern bat (Myotis austroriparius);
(i) Southern rock vole (Microtus chrotorrhinus carolinensis); and
(j) Star-nosed mole (Condylura cristata parva).

(6) Mollusks:
(a) Appalachian gloss (Zonitoides patuloides);
(b) Bidentate dome (Ventridens coelaxis);
(c) Black mantleslug (Pallifera hemphilli);
(d) Blackwater ancylid (Ferrissia hendersoni);
(e) Blue-foot lancetooth (Haplotrema kendeighi);
(f) Cape Fear spike (Elliptio marsupiobesa);
(g) Clingman covert (Fumonelix wheatleyi clingmanicus);
(h) Dark glyph (Glyphyalinia junaluskana);
(i) Dwarf proud globe (Patera clarki clarki);
(j) Dwarf threetooth (Triodopsis fulciden);
(k) Fringed coil (Helicodiscus fimbriatus);
(l) Glossy supercoil (Paravitrea placentula);
(m) Great Smoky slitmouth (Stenotrema depilatum);
(n) High mountain supercoil (Paravitrea andrewsae);
(o) Honey glyph (Glyphyalinia vanattai);
(p) Lamellate supercoil (Paravitrea lamellidens);
(q) Mirey Ridge supercoil (Paravitrea clappi);
(r) Open supercoil (Paravitrea umbilicaris);
(s) Pink glyph (Glyphyalinia pentadelphia);

(t) Pod lance (Elliptio folliculata);
(u) Queen crater (Appalachina chilhoweensis);
(v) Ramp Cove supercoil (Paravitrea lacteodens);
(w) Ridged lioplax (Lioplax subcarinata);
(x) Roanoke slabshell (Elliptio roanokensis);
(y) Saw-tooth disc (Discus bryanti);
(z) Seep mudalia (Leptoxis dilatata);
(aa) Spike (Elliptio dilatata);
(bb) Spiral coil (Helicodiscus bonamicus);
(cc) Velvet covert (Inflectarius subpalliatus);
(dd) Waccamaw amnicola (Amnicola sp.);
(ee) Waccamaw siltsnail (Cincinnatia sp.); and (ff) Wavy-rayed lampmussel (Lampsilis fasciola).

(5) Reptiles:
(a) Carolina pigmy rattlesnake (Sistrurus miliarius miliarius);
(b) Carolina swamp snake (Seminatrix pygaea paludis);
(c) Carolina watersnake (Nerodia sipedon williamengelsi);
(d) Cumberland slider (Trachemys scripta troostii);
(e) Diamondback terrapin (Malaclemys terrapin);
(f) Eastern chicken turtle (Deirochelys reticularia reticularia);
(g) Eastern smooth green snake (Opheodrys vernalis vernalis);
(h) Eastern spiny softshell (Apalone spinifera spinifera);
(i) Mimic glass lizard (Ophisaurus mimicus);
(j) Outer Banks kingsnake (Lampropeltis getula sticticeps);
(k) Stripeneck musk turtle (Sternotherus minor peltifer); and
(l) Timber rattlesnake (Crotalus horridus).

History Note: *Authority G.S. 113-134; 113-291.2; 113-292; 113-333;*
Eff. September 1, 1989;
Amended Eff. October 1, 2017; August 1, 2016; May 1, 2008; July 18, 2002; April 1, 2001;
November 1, 1991; April 1, 1991; June 1, 1990.