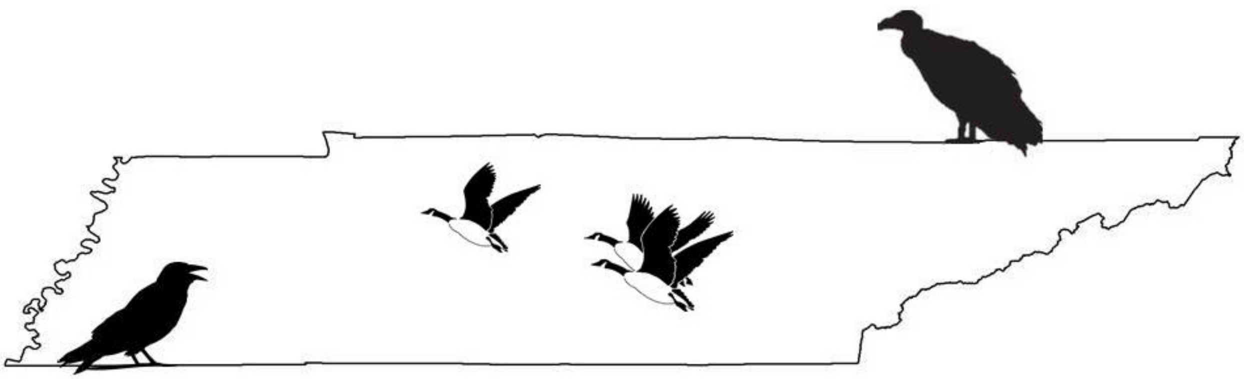
ENVIRONMENTAL ASSESSMENT

Managing Damage Caused by Birds in the State of Tennessee



PREPARED BY:

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

IN COOPERATION WITH:

TENNESSEE VALLEY AUTHORITY

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ACRONYMS

AI	Avian Influenza
APHIS	Animal and Plant Health Inspection Service
AQDO	Aquaculture Depredation Order
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	4,6-dimethyl-2-pyrimidinal
INAD	Investigational New Animal Drug
LD	Median Lethal Dose
LC	Median Lethal Concentration
MANEM	Mid Atlantic/New England/Maritime region
MBTA	Migratory Bird Treaty Act
MFGP	Mississippi Flyway Giant Population
MOU	Memorandum of Understanding
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NRP	Natural Resource Plan
NWRC	National Wildlife Research Center
PRDO	Public Resource Depredation Order
ROD	Record of Decision
SJBP	Southern James Bay Population
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
TDA	Tennessee Department of Agriculture
TDEC	Tennessee Department of Environment and Conservation
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
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: PURPOSE AND NEED FOR ACTION

1.1 PURPOSE

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS)[1] program in Tennessee continues to receive requests for assistance or anticipates receiving requests for assistance to alleviate or prevent damage occurring to agricultural resources, natural resources, and property, including threats to human safety, associated with several bird species, including the Snow Goose (*Chen caerulescens*), Canada Goose (*Branta canadensis*), Mallard (*Anas platyrhynchos*), feral waterfowl[2], Wild Turkey (*Meleagris gallopavo*), Double-crested Cormorant (*Phalacrocorax auritus*), Great Blue Heron (*Ardea herodias*), Great Egret (*Ardea alba*), Snowy Egret (*Egretta thula*), Cattle Egret (*Bubulcus ibis*), Black-crowned Night-Heron (*Nycticorax nycticorax*), Black Vulture (*Coragyps atratus*), Turkey Vulture (*Cathartes aura*), Osprey (*Pandion haliaetus*), Mississippi Kite (*Ictinia mississippiensis*), Bald Eagle (*Haliaeetus leucocephalus*), Sharp-shinned Hawk (*Accipiter striatus*), Cooper's Hawk (*Accipiter cooperii*), Red-tailed Hawk (*Buteo jamaicensis*), Golden Eagle (*Aquila chrysaetos*), Killdeer (*Charadrius vociferous*), Ring-billed Gull (*Larus delawarensis*), Herring Gull (*Larus argentatus*), Rock Pigeon (*Columba livia*), Eurasian Collared-Dove (*Streptopelia decaocto*), Mourning Dove (*Zenaida macroura*), Snowy Owl (*Bubo scandiacus*), Common Nighthawk (*Chordeiles minor*), American Kestrel (*Falco sparverius*), Peregrine Falcon (*Falco peregrinus*), American Crow (*Corvus brachyrhynchos*), Cliff Swallow (*Petrochelidon pyrrhonota*), Barn Swallow (*Hirundo rustica*), American Robin (*Turdus migratorius*), European Starling (*Sturnus vulgaris*), Red-winged Blackbird (*Agelaius phoeniceus*), Eastern Meadowlark (*Sturnella magna*), Common Grackle (*Quiscalus quiscula*), Brown-headed Cowbird (*Molothrus ater*), House Finch (*Haemorhous mexicanus*), and House Sparrow (*Passer domesticus*).

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 E 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.

The Tennessee Valley Authority (TVA) also continues to experience damage and threats of damage associated with birds at facilities or properties they own or manage in Tennessee. Therefore, the TVA could request the assistance of WS to manage damage or threats of damage at those facilities and properties. The goal of WS and the TVA would be to conduct a coordinated program to alleviate bird damage on properties that the TVA owns or manages in accordance with plans and objectives developed by both agencies. The plans and objectives would outline the actions of each agency.

All federal actions are subject to the National Environmental Policy Act (NEPA) (Public Law 9-190, 42 USC 4321 et seq.), including the actions of WS[3] and the TVA. 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

[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 426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 426c).

[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, 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 Duck, and Mallard-Muscovy Hybrids.

[3]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.

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 and the TVA are preparing this Environmental Assessment (EA)[4] 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 and the TVA infuse the policies and goals of the NEPA and the CEQ into the actions of each agency. This EA will also aid WS and the TVA 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 TVA, the United States Fish and Wildlife Service (USFWS), and the Tennessee Wildlife Resources Agency (TWRA)[5].

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 cumulatively the individual projects that WS could conduct to manage the damage and threats that birds cause, including those projects that WS could conduct at the request of the TVA. More specifically, the EA will assist WS and the TVA 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)[6] in compliance with the NEPA and CEQ regulations.

This 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[7] 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 Tennessee 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.

The 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 and the

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[4]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).
[5]Section 1.6 of this EA discusses the roles, responsibilities, and the authorities of each agency.
[6]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).
[7]At the time of preparation, WS' Directives could be found at the following web address: http://www.aphis.usda.gov/wildlife_damage/ws_directives.shtml.

TVA initially developed the issues and alternatives associated with bird damage management in consultation with the USFWS and the TWRA. The USFWS has the overall regulatory authority to manage populations of migratory bird species, while the TWRA has the authority to manage wildlife populations in the State of Tennessee. To assist with identifying additional issues and alternatives to managing damage, WS and the TVA will make this EA available to the public for review and comment prior to the issuance a Decision[8].

WS and the TVA have previously developed an EA that analyzed the need for action to manage damage associated with bird species in Tennessee[9]. That EA identified the issues associated with managing damage that birds cause in Tennessee and analyzed alternative approaches to meet the specific need identified in the EA while addressing the issues associated with managing damage. Changes in the need for action and the affected environment have prompted WS and the TVA 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. Since this EA will re-evaluate those activities conducted under the previous EA 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 EA 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 NEPA. In addition, this new EA will inform the public and coordinate efforts between WS, the TVA, the USFWS, the TWRA, 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 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

[8]After the development of the EA by WS and consulting agencies 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.

[9]See Section 1.4 of this EA for further discussion on the previous EA developed by WS to manage damage caused by birds.

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; however, 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 2010). 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 Tennessee arises from requests for assistance[10] received by WS to reduce and prevent damage from occurring to four major categories: agricultural resources, natural resources, property, and threats to human safety. In addition, the TVA often experiences damage or threats of damage to property and natural resources, electric system operational reliability, as well as threats to human safety at their facilities. WS and the TVA have 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. Table 1.1 lists WS' technical assistance projects involving bird damage or threats of bird damage to those four major resource types in Tennessee from the federal fiscal year[11] (FY) 2009 through FY 2013. Table 1.1 does not include direct operational assistance projects conducted by WS where an entity requested WS to provide assistance through the direct application of methods.

WS provides technical assistance to those people requesting assistance with resolving damage or the threat of damage by providing information and recommendations on damage management activities that a requester could conduct without WS' direct involvement in managing or preventing the damage. Further discussion of technical assistance occurs in Chapter 3 of this EA. The technical assistance projects

[10]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 other comparable document must be signed between WS and the cooperating entity, which lists all the methods the property owner or manager will allow to be used on property they own and/or manage.
[11]The federal fiscal year begins on October 1 and ends on September 30 the following year.

conducted by WS are representative of the damage, actual threats, and perceived threats that birds can cause in Tennessee. From FY 2009 to FY 2013, WS has conducted 2,595 technical assistance projects involving many of the bird species addressed in this assessment. Between FY 2009 and FY 2013, WS conducted 720 technical assistance projects involving resident Canada Geese, which was the highest number of projects conducted. Resident Canada Geese can create a nuisance and sometimes threaten human health where their droppings accumulate in public areas, residential areas, golf courses, or industrial parks. In addition, Canada Geese can present a major threat to aviation safety because of their mass and abundance, and sometimes because of their close proximity to airports in the State. They can also damage golf course turf and newly planted winter wheat that farmers plant for winter grazing of cattle.

Table 1.1 – Technical assistance projects conducted by WS in Tennessee, FY 2009 - FY 2013†

Species	Total	Species	Total
Snow Goose	2	**Ring-billed Gull**	14
Canada Goose	720	**Herring Gull**	7
Mallard	114	**Rock Pigeon**	141
Feral Waterfowl	39	**Eurasian Collared-Dove**	3
Wild Turkey	10	**Mourning Dove**	29
Double-crested Cormorant	7	**Common Nighthawk**	2
Great Blue Heron	47	**American Kestrel**	5
Great Egret	1	**Peregrine Falcon**	1
Cattle Egret	1	**American Crow**	45
Black-crowned Night-Heron	5	**Cliff Swallow**	4
Black Vulture	638	**Barn Swallow**	29
Turkey Vulture	204	**American Robin**	6
Osprey	46	**European Starling**	97
Mississippi Kite	5	**Red-winged Blackbird**	6
Bald Eagle	16	**Eastern Meadowlark**	8
Sharp-shinned Hawk	5	**Common Grackle**	17
Cooper's Hawk	29	**Brown-headed Cowbird**	4
Red-tailed Hawk	144	**Blackbirds (mixed species)**	121
Killdeer	11	**House Sparrow**	12
		TOTAL	**2,595**

†Table does not include direct operational assistance projects conducted by WS where WS was requested to provide assistance through the direct application of methods.

Since FY 2009, the second most frequent request for technical assistance involved vultures. WS completed 842 projects related to the damage caused by vultures between FY 2009 and FY 2013. Vultures often roost in mixed species flocks in large numbers. Fecal droppings often accumulate under areas where vultures roost and loaf. Concerns are often raised about disease transmission to people that encounter fecal droppings on their property. The odor and aesthetically displeasing presence of fecal droppings at roost sites can also be a concern. Damage can also occur to property from vultures pulling and tearing shingles, trim, and rubber material on buildings and vehicles. Vultures can also cause injuries and death to newborn lambs and calves during the birth of the animals. Vultures often attack the soft tissue areas of newborns as they are being expunged from the female. During the birthing process, newborns and mothers are vulnerable and often unable to prevent attacks by large groups of vultures. Vultures often attack the eyes and rectal area of newborns during delivery, which results in serious injury to the lamb or calf and often leads to the death of the animal.
Many of the bird species addressed in this EA 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 could damage in Tennessee occur in Table 1.2 and Appendix E. Most requests for assistance that WS receives are associated with aircraft strike hazards at airports in the State. Nearly all of the bird species addressed in this EA could pose a threat to aircraft when those bird species occur at or near airports. Bird strikes can cause substantial damage to aircraft requiring costly repairs. In addition, bird strikes can lead to the catastrophic failure of aircraft, which can pose a threat to the safety of people.

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

	Resource*					Resource			
Species	**A**	**N**	**P**	**H**	**Species**	**A**	**N**	**P**	**H**
Snow Goose			X	X	Ring-billed Gull	X	X	X	X
Canada Goose	X	X	X	X	Herring Gull	X	X	X	X
Mallard	X		X	X	Rock Pigeon	X	X	X	X
Feral Waterfowl	X	X	X	X	Eurasian Collared-Dove		X	X	X
Wild Turkey	X		X	X	Mourning Dove			X	X
Double-crested Cormorant	X	X	X	X	Snowy Owl			X	X
Great Blue Heron	X	X	X	X	Common Nighthawk			X	X
Great Egret	X		X	X	American Kestrel	X	X	X	X
Snowy Egret	X		X	X	Peregrine Falcon			X	X
Cattle Egret	X		X	X	American Crow	X	X	X	X
Black-crowned Night-Heron			X	X	Cliff Swallow			X	X
Black Vulture	X		X	X	Barn Swallow	X		X	X
Turkey Vulture	X		X	X	American Robin			X	X
Osprey			X	X	European Starling	X	X	X	X
Mississippi Kite			X	X	Red-winged Blackbird	X		X	X
Bald Eagle			X	X	Eastern Meadowlark			X	X
Sharp-shinned Hawk	X	X	X	X	Common Grackle	X		X	X
Cooper's Hawk	X	X	X	X	Brown-headed Cowbird	X	X	X	X
Red-tailed Hawk	X	X	X	X	House Finch			X	X
Golden Eagle			X	X	House Sparrow	X	X	X	X
Killdeer			X	X					

*A=Agriculture, N =Natural Resources, P=Property, H=Human Health and Safety

Some of the species addressed in this assessment 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 cormorants. 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 Alleviate Bird Damage on TVA Properties and at TVA Facilities

The TVA is responsible for the management of 293,000 acres of public land and 11,000 miles of public shoreline along the Tennessee River system. All of those lands support TVA's goals of power generation and transmission, public recreational use, flood control, and economic development of the Tennessee River Valley. The TVA operates hydroelectric dams, coal-fired power plants, nuclear power plants, solar facilities, and a combustion turbine site throughout the Tennessee River Valley. The TVA also owns or maintains electrical power substations, switching stations, and the associated transmission lines and rights-of-way easements in Tennessee. In addition, the TVA operates public recreation areas throughout the Tennessee Valley region, including campgrounds, day-use areas, and boat launching ramps.

Bird damage and threats of damage occurring at facilities and properties owned or managed by the TVA have occurred primarily to property, human safety, and the operational reliability of the electrical system. Birds roosting at facilities can cause considerable economic damage due to the excessive amount of droppings on buildings, equipment, and facilities resulting in constant cleaning. The droppings can occur in work areas, which can be aesthetically displeasing to employees. Additionally, birds can pose a threat to people from the potential transmission of zoonotic diseases when employees contact fecal matter or surfaces contaminated with fecal matter. The fecal droppings make work areas slippery, which can create safety concerns from employees slipping and falling.

For example, fecal droppings can also accumulate under areas where vultures roost and loaf. Fecal droppings can be corrosive to the metal support towers of transmission lines. Accumulation of fecal droppings on and around the structures can present a safety concern for workers that conduct maintenance on the towers. Large accumulations of feces threatens human safety by creating slick surfaces where employees work at extreme heights and increases the risk of zoonotic disease transmission from contact with contaminated surfaces as workers conduct maintenance. The odor and presence of fecal material on equipment is also aesthetically displeasing to employees. Vultures can also pose a risk of large power outages occurring to customers if the birds/fecal material short out the power supply the towers support. These outages can cause violations in reliability standards set by the North American Electric Reliability Corporation that could result in fines to the electric utility.

Birds can also roost on or enter electrical substations and power generation facilities and threaten the interruption of power. Osprey nests are often a threat to the safe operation of electrical equipment due to the risk of outages caused when debris from the nests or debris being carried by osprey comes into contact with transmission equipment. Nests are often constructed of large sticks and twigs that can cause disruptions in the electrical power supply when those 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).

All of those damage situations and others occur throughout TVA owned and managed properties. The TVA has requested assistance from WS to address these in the past and may request assistance with additional bird damage issues in the future.

Need to Alleviate Bird Damage to Agricultural Resources

Agriculture continues to be an important sector in the Tennessee economy. In the 2012 census, the National Agricultural Statistics Service (NASS) reported that almost 11 million acres were devoted to agricultural production in Tennessee with a market value of agricultural products sold estimated at over $3.6 billion (NASS 2014*a*). The top three farm commodities for sales were grains, cattle, and poultry, which together accounted for nearly 72% of the agricultural products sold in the State (NASS 2014*a*). The cattle inventory in 2012 was over 1.8 million head (NASS 2014*a*). There were also over 30 million poultry in the State during 2012 (NASS 2014*a*). The 2013 aquaculture census estimated the market value of aquaculture products in Tennessee at over $3.4 million (NASS 2014*b*). The value of field and other crops grown in Tennessee accounted for over $2 billion (NASS 2014*a*). Agriculture producers grow a variety of crops, including corn, soybeans, wheat, rice, cotton, and tobacco. Tennessee was ranked third in the United States for tobacco production during 2012, with a market value of over $108 million (NASS 2014*a*).

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) 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.

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 Tennessee are trout, catfish, hybrid striped bass, tilapia, freshwater shrimp, and baitfish.

Of primary concern to aquaculture facilities in Tennessee are Double-crested Cormorants, Ring-billed Gulls, Herring Gulls, Ospreys, and various species of herons and egrets. To a lesser extent, waterfowl, Red-tailed Hawks, crows, and Common Grackles may also cause damage or economic loss.

Double-crested Cormorants can feed heavily on fish being raised for human consumption, and on fish commercially raised for bait and restocking (USFWS 2003, USFWS 2009, USFWS 2014*a*). The frequency of cormorant occurrence at a given aquaculture facility can be a function of many interacting factors, including: 1) size of the regional and local cormorant population; 2) the number, size, and distribution of aquaculture facilities; 3) the size distribution, density, health, and species composition of fish populations at facilities; 4) the number, size, and distribution of natural wetlands in the immediate area; 5) the size distribution, density, health, and species composition of natural fish populations in the surrounding landscape; 6) the number, size, and distribution of suitable roosting habitat; and 7) the variety, intensity and distribution of local damage abatement activities. Cormorants are adept at seeking out the most favorable foraging and roosting sites. As a result, cormorants are rarely distributed evenly over a given region but are often 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 1997, Tobin et al. 2002). Thus, some aquaculture producers in a region suffer little or no economic damage from cormorants, while others experience exceptionally high losses.

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.

In addition to cormorants, Great Blue Herons are also known to forage at aquaculture facilities (Parkhurst et al. 1987). 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*). Glahn et al. (1999*a*) found that 80% of the aquaculture facilities surveyed in the northeastern United States perceived birds as posing an economic threat due to predation, which coincided with 81% of the facilities surveyed having birds present on aquaculture ponds. Great Blue Herons were found at 90% of the sites surveyed by Glahn et al. (1999*a*). 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 addition to cormorants and herons, other bird species have also been identified as causing damage or posing threats to aquaculture facilities. 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).

Mallards have been identified by aquaculture facilities as posing a threat of economic loss from 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 leading 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 were observed 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). Since 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 have been observed as feeding 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 was estimated at 145,035 fish captured per year per site.

Also of concern to 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 have been identified as 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 losses (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 has also been documented to occur in North America (USDA 2003). Peters and Neukirch (1986) found the Infectious Pancreatic Necrosis virus in the fecal droppings of herons when the herons were fed Infectious Pancreatic Necrosis infected trout. Olesen and Vestergard-Jorgensen (1982) found herons could transmit the Viral Hemorrhagic Septicaemia (Egtved virus) from beak to fish when the beaks of herons were contaminated with the virus. 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 are also 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 has been found within the intestines and rectal areas of Great Blue Herons and Double-crested Cormorants from aquaculture facilities in Mississippi (Taylor 1992). However, since Enteric Septicemia of Catfish is considered 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, nematods, 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 documented that birds, primarily herons and cormorants, 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 are known to target fish that are diseased and less likely to escape predation at aquaculture facilities (Price and Nickum 1995, Glahn et al. 2002). 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 Tennessee. Economic damage can occur from birds feeding on livestock feed, from birds feeding on livestock, and from the increased risks of disease transmission associated with large concentrations of birds. Although individual or small groups of birds can cause economic damage to livestock producers, such as a vulture or a group of vultures killing a newborn calf, most damage occurs from bird species that congregate in large flocks at livestock operations. 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 be found during the breeding season where suitable nesting habitat exists, such as Barn Swallows. Of primary concern to livestock feedlots and dairies in Tennessee 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 is important and 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 since 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* (Gaukler et al. 2009, LeJeune et al. 2008, 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. 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 since adults are 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 (HP) strains increases the potential for transmission to domestic poultry facilities, which are highly susceptible to HPAI (Nettles et al. 1985, Gauthier-Clerc et al. 2007, Pedersen et al. 2010). The potential impacts from a severe outbreak of HPAI 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).

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 Paramyxovirus. Newcastle Disease can cause high rates of mortality in some bird populations, such as Double-crested Cormorants, 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).

Bovine Coccidiosis is caused by parasites from the *Eimeria* genus. While Canada Geese have been implicated in causing Bovine Coccidiosis in calves, the coccidia that infect cattle is a different species of coccidia than the coccidian that infects Canada Geese (Doster 1998). European Starlings also do not appear to play a role in the transmission of the disease (Carlson et al. 2011*c*).

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. Since 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 contaminating surfaces and areas used by livestock. The rate of transmission is likely very low; however, the threat of transmission exists since birds are known vectors of many diseases transmittable to livestock.

Certain bird species are also known to prey upon livestock, resulting in economic losses to livestock producers. Direct damage to livestock occurs primarily from vultures, but can also include raptors. Vultures are known to prey upon newly born calves and harass adult cattle, especially during the birthing process. The NASS reported that in 2010, 11,900 cows and calves valued at $4.6 million were lost to vultures in the United States (NASS 2011). While both Turkey Vultures and Black Vultures have been documented harassing expectant cattle, livestock predation is generally restricted to Black Vultures. Vulture predation on livestock is distinctive. Lovell (1947, 1952) and Lowney (1999) reported Black Vultures killed pigs by pulling eyes out followed by attacks to the rectal area or directly attacking the rectal area. 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. From FY 2009 to FY 2013, WS in Tennessee has received reports of losses of over $161,000 due to predation or injuries to cattle or calves by vultures.

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 and waterfowl (Hygnstrom and Craven 1994). Free-ranging fowl or fowl allowed to range outside of confinement for a period 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 the consumption of crops (*i.e.*, loss of the crop and revenue), but also consists of trampling of emerging crops and compaction of soil by waterfowl, consumption of cover crops used to prevent erosion and condition soil, damage to fruits associated with feeding, and fecal contamination. In 2012, the sale from all agricultural crops accounted for almost 58% of the total market value of agricultural commodities (livestock and crops) in Tennessee. Some of the crop commodities harvested in 2012 include corn, soybeans, wheat, cotton, and tobacco (NASS 2014*a*). Damage to agricultural crops in Tennessee occurs primarily from European Starlings, American Crows, Red-winged Blackbirds, Common Grackles, Mallards, Canada Geese, Wild Turkey, Mourning Doves, American Robins, and House Sparrows.

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 impact 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).

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 are also known to 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); however, 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 since harvest of the crop typically occurs before apples reach a stage when damage is likely. The likelihood of damage is 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 makes 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 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, Jr. and Linehan 1977). Rogers, Jr. 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.

The most common waterfowl damage to agriculture 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 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). 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 Alleviate Threats that Birds Pose to Human Safety

Several bird species listed in Table 1.2 can be closely associated with human habitation and often exhibit gregarious roosting behavior. These species include vultures, colonial waterbirds, waterfowl, gulls, pigeons, crows, swallows, European Starlings, Red-winged Blackbirds, Common Grackles, and Brown-headed Cowbirds. The close association of these bird species with human activity can pose threats to human safety from the transmission of disease, the safety of air passengers if birds were struck by aircraft and aggressive behavior (primarily from waterfowl).

Threat of Disease Transmission

Birds can play a role in the transmission of diseases where humans may encounter fecal droppings of those birds. Few studies are available on the occurrence of zoonotic diseases in wild birds and on the risks to humans 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. The risk of disease transmission from birds to humans is likely very low; however, human exposure to fecal droppings through direct contact or through the disturbance of fecal droppings where disease organisms are known to occur 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 people may come in direct contact with fecal droppings. 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.

Birds can play a role in the transmission of diseases to humans such as encephalitis, West Nile virus, psittacosis, and histoplasmosis. 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* that causes histoplasmosis in humans (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, workers at an ethanol plant in eastern Nebraska became ill with histoplasmosis after breathing in spores from construction in an area that had a starling roost (Mortality and Morbidity Weekly Report 2004). Ornithosis (*Chlamydia psittaci*) is another respiratory disease that can be contracted by humans, livestock, and pets. Pigeons are most commonly associated with the spread of ornithosis to humans. Ornithosis is a virus that is spread through infected bird droppings when viral particles become airborne after infected bird droppings are disturbed.

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.

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, but the risk of infection is likely low. 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. The USFWS has documented threats to public health from geese and has authorized the take of geese to reduce this threat in the resident Canada Goose Final Environmental Impact Statement (FEIS) (USFWS 2005).

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 a disease caused by a microscopic parasite (*Cryptosporidium spp.*) and is one of the most frequent causes of waterborne disease among humans (CDC 2013). A person can be infected by drinking contaminated water or by direct contact with the fecal material of infected animals (CDC 2013). Exposure can occur from ingestion of contaminated water while swimming in lakes, ponds, streams, and pools (CDC 2013). *Cryptosporidium* can cause gastrointestinal disorders (CDC 2013) 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 through mechanical means in the environment (Graczyk et al. 1998). Kassa et al. (2001) found that *Cryptosporidium* was the most common infectious organism. The organism was 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 is recognized as the most common intestinal parasitic disease affecting humans in the United States (CDC 2011). Giardiasis is contracted by swallowing contaminated water or putting anything in your mouth that has touched the stool of an infected animal or person. Symptoms of giardiasis include diarrhea, cramps, and nausea (CDC 2011). Canada Geese in Maryland were shown with molecular techniques to disseminate infectious *Giardia* 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 humans through the handling of materials soiled with bird feces (Stroud and Friend 1987). Salmonella has been isolated from the gastrointestinal tract of starlings (Carlson et al. 2011*b*). Salmonella causes gastrointestinal illness, including diarrhea.

Chlamydiosis (*Chalmydiosis psitticai*) is a common infection in birds. However, when it infects people, the infection is known as Psitticosis, which 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 C*ampylobacter* occurrences 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 such as geese, crows, and gulls, which all have increased contact with humans, 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 diarrheal 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).

Escherichia 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.

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). 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.

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, Vauk-Hentzelt et al. 1987, 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.*, 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, pigeons, starlings, and House Sparrows 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, starlings, pigeons, and House Sparrows 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 are concerns over the spread of the H5N1 highly pathogenic strain that has shown transmission potential to people 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 humans 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 humans has not been well documented, the potential exists (Luechtefeld et al. 1980, Wobeser and Brand 1982, Hill and Grimes 1984, Pacha et al. 1988, Blankespoor and Reimink 1991, 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 human habitation 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 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.

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. Collisions between aircraft and wildlife are a concern because wildlife strikes threaten passenger safety (Thorpe 1996), erode public confidence in the air transportation industry as a whole (Conover et al. 1995), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996). Those bird species found in Table 1.2 and in Appendix E can all represent a threat to aviation safety. When aircraft strike a bird or 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. 2001).

From 1990 through 2012, 131,096 wildlife strikes have been reported to the Federal Aviation Administration (FAA) in the United States (Dolbeer et al. 2013). From 1990 through 2014, there have been 4,237 reports of birds struck by aircraft in Tennessee (FAA 2014). Birds were involved with over 97% of those reported strikes to civil aircraft in the United States (Dolbeer et al. 2013). The number of bird strikes actually occurring is likely much greater since Dolbeer et al. (2009) estimated that only 39% of strikes involving animals and civil aircraft are actually reported. In Tennessee, almost 97% of all reported aircraft strikes involve birds (FAA 2014). Aircraft in Tennessee have struck at least 90 species of birds (FAA 2014). Generally, bird collisions occur when aircraft are near the ground during take-off and approach to the runway. From 1990 through 2012, approximately 74% of reported bird strikes to general aviation aircraft in the United States occurred when the aircraft was at an altitude of 500 feet above ground level or less. Additionally, approximately 97% occurred less than 3,500 feet above ground level (Dolbeer et al. 2013).

In several instances, wildlife-aircraft collisions in the United States have resulted in human fatalities. Birds being struck by aircraft can cause substantial damage to the aircraft. Bird strikes can cause catastrophic failure of aircraft systems (*e.g.*, ingesting birds into engines), which can cause the plane to become uncontrollable leading to crashes. In 1960, 62 people were killed in Boston after their plane collided with a flock of European Starlings (Terres 1980). In 1995, 24 lives were lost when a military aircraft struck a flock of Canada Geese and crashed at Elmendorf, Alaska. 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). Globally, wildlife strikes have killed more than 250 people and strikes have destroyed over 229 aircraft since 1988 (Dolbeer et al. 2013). Between 1990 and 2012, 24 people have died in a civil aircraft after striking birds in the United States (Dolbeer et al. 2013). Of those 24 fatalities involving bird strikes, seven fatalities occurred after striking birds that were not identified while eight fatalities occurred after strikes involving Red-tailed Hawks (Dolbeer et al. 2013). Injuries can also occur to pilots and passengers from bird strikes. Between 1990 and 2012, 51 strikes involving waterfowl have resulted in injuries to 58 people, while 31 strikes involving vultures resulted in injuries to 38 people (Dolbeer et al. 2013).

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 8-15 lbs which exceeds the 4-lb 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 2012, there were 1,400 reported strikes involving Canada Geese in the United States, resulting in over $116 million in damage and associated costs to civil aircraft (Dolbeer et al. 2013). 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 (Dolbeer et al. 2009, Wright 2010). Though the aircraft was destroyed after sinking in the river, all 150 passengers and 5 crewmembers survived (Wright 2010). 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 2013).

Gulls, pigeons/doves, raptors, and waterfowl have been the bird groups most frequently struck by aircraft in the United States. Of the total known birds struck in the United States from 1990 through 2012, gulls and pigeons/doves both comprised 15% of the strikes where identification occurred, while raptors accounted for 13%, and waterfowl were identified in 7% of reported strikes (Dolbeer et al. 2013).

Vultures and raptors can also present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Vultures are considered the most hazardous bird for an aircraft to strike based on the frequency of strikes, effect on flight, and amount of damage caused by vultures throughout the country (Dolbeer et al. 2000). Mourning Doves also present 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 increases the risk of bird-aircraft collisions.

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 occurs that can lead those species to exhibit threatening behavior toward people. This threatening behavior continues to increase as human populations expand and the populations of those species that adapt to human activity increase. Threatening behavior can be 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. Waterfowl and various species of raptors can aggressively defend their nests, nesting areas, and young and may attack or threaten pets, children, and adults (Smith et al. 1999, Morrison et al. 2006). For example, in April 2012, a man drowned in Des Plains, Illinois when he was attacked by a mute swan that knocked him out of his kayak (Golab 2012).

Feral waterfowl and Canada Geese often nest in high densities in areas used by people for recreational purposes, 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. Additionally, waterfowl, such as ducks, turkeys, and other birds can present a traffic hazard. Trying to avoid striking birds in roadways can result in automobile accidents if drivers leave the roadway or stop short in traffic resulting in a rear end collision. Traffic accidents can result in human injury or even death.

Need to Alleviate Bird Damage Occurring to Property

As shown in Table 1.2 and in Appendix E, all of the bird species addressed in this assessment are known to cause damage to property in Tennessee. Property damage can occur in a variety of ways and can result in costly repairs and clean-up. Bird damage to property occurs through direct damage to structures, through roosting behavior, and through their nesting behavior. 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 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. Direct damage can also result from birds that act aggressively toward their reflection in mirrors and windows, which can scratch paint and siding. Aircraft striking birds can also cause substantial damage requiring costly repairs and aircraft downtime.

Property Damage to Aircraft from Bird Strikes

Target bird species 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. Vultures and raptors can also present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Vultures are considered the most hazardous bird for an aircraft to strike based on the frequency of strikes, effect on flight, and amount of damage caused by vultures throughout the country (Dolbeer et al. 2000).

Gulls, raptors, waterfowl, and pigeons/doves are the bird groups most frequently struck by aircraft in the United States. When struck, 26% of the reported gull strikes resulted in damage to the aircraft or had a negative effect on the flight, while 64% of the reported waterfowl strikes resulted in damage or negative effects on the flight compared to 25% of strikes involving raptors and 11% of strikes involving pigeons and doves (Dolbeer et al. 2013). Since 1990, over $212 million in damages to civil aircraft have been reported from over 4,000 strikes involving waterfowl (Dolbeer et al. 2013). Of those reported strikes, Canada Geese were found to be responsible for 1,400 strikes and over $116 million in damages to aircraft (Dolbeer et al. 2013). Aircraft strikes involving herons, bitterns, and egrets have resulted in over $13.8 million in damages to aircraft (Dolbeer et al. 2013). In total, aircraft strikes involving identified birds has resulted in over $451 million in reported damages to civil aircraft since 1990 in the United States (Dolbeer et al. 2013).

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. Vulture species can also present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Vultures are considered one of the most hazardous birds for an aircraft to strike based on the percentage of strikes resulting in an adverse effect to the aircraft (*i.e.*, a strike resulting in damage to the aircraft and/or having a negative effect on the flight) (Dolbeer et al. 2012). Gulls also present a strike risk to aircraft and are responsible for most of the damaging strikes reported in coastal areas.

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.

Canada Geese and other species of waterfowl 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 (USFWS 2005). Property damage most often involves goose fecal matter that contaminates landscaping and walkways, often at golf courses and waterfront property. 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). 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). 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).

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). 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 birds, 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.

In addition to damage caused by the accumulation of droppings, damage can also occur in other ways. Damage from vultures can include tearing and consuming latex window caulking or rubber gaskets sealing windowpanes, asphalt and cedar roof shingles, vinyl seat covers from boats, patio furniture, and other equipment. Similarly, nesting colonies of gulls frequently cause damage to structures when they nest on rooftops and peck at spray-on-foam roofing and rubber roofing material, including caulking. 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. Waterfowl can cause damage to landscaping, when they consume or trample flowers, gardens, and lawns (Conover 1991). Gulls pick up refuse at landfills and carry it off the property to feed, resulting in garbage being deposited on buildings, equipment, and vehicles in neighboring areas. 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).

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. These materials 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). 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 (Avery et al. 2002, USGS 2005, Pruett-Jones et al. 2007). Nesting material can also be aesthetically displeasing, or in the case of some species can cause a fire hazard (Fitzwater 1994). Additionally, because the active nests of most species are protected under the Migratory Bird Treaty Act of 1918, problems arise when birds nest in areas where new construction or maintenance is scheduled to occur (Coates et al. 2012). Private property losses associated with cormorants include impacts to privately owned lakes and ponds stocked with fish and damage to boats, marinas, or other properties and vegetation near cormorant breeding or roosting sites (USFWS 2003).

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, Belant et al. 1998, Gabrey 1997, 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). 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.

Need to Alleviate Bird Damage Occurring to Natural Resources

Birds can also negatively affect natural resources through habitat degradation, competition with other wildlife, and through direct depredation of 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 be aesthetically displeasing. Competition can occur when two species compete (usually to the detriment of one species) for available resources, such as food or nesting sites. 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.

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 (Trial and Baptista 1993).

Crows and gulls will consume a variety of food items, including the eggs and chicks of other birds (Pierotti and Good 1994, Burger 1996, Good 1998, Verbeek and Caffrey 2002, Pollet et al. 2012). These species in particular are among the most frequently reported avian predator of colonial nesting waterbirds in the United States (Frederick and Collopy 1989). 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. Impacts on the productivity and survivorship of rare or threatened colonial waterbirds can be severe when nesting colonies become targets of avian predators. 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.

Double-crested Cormorants are known to have a negative effect on wetland habitats (Jarvie et al. 1997, Shieldcastle and Martin 1997) and wildlife, including T&E species (Korfanty et al. 1997). Concentrations of gulls often affect the productivity and survivorship of rare or endangered colonial species such as terns and prey upon the chicks of colonial waterbirds (Hunter et al. 2006). 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).

Double-crested Cormorants are known to displace other colonial nesting waterbird species, such as herons, egrets, and terns through competition for nest sites (USFWS 2003). Cuthbert et al. (2002) examined potential impacts of cormorants on Great Blue Herons and Black-crowned Night-Herons in the Great Lakes and found that cormorants have not negatively influenced breeding distribution or productivity of either species at a regional scale, but did contribute to declines in heron presence and increases in site abandonment in certain site-specific circumstances. Similarly, gulls can also displace other colonial nesting birds (USFWS 1996). 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, Wilmer 1987, Bechard and Bechard 1996), Red-bellied Woodpeckers (*Centurus carolinus*), Gila Woodpeckers (*Centurus uropygialis*) (Kerpez and Smith 1990, Ingold 1994), Northern Flickers (*Colaptes auratus*), Purple Martins (Allen and Nice 1952), and Wood Ducks (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.

Degradation of habitat can occur from the continuous accumulation of fecal droppings under nesting colonies of birds or under areas where birds consistently roost. Over time, the accumulation of fecal droppings under those areas can lead to the loss of vegetation from the ammonium nitrogen found in the fecal droppings of birds. Hebert et al. (2005) noted that ammonium toxicity caused by an accumulation of fecal droppings from Double-crested Cormorants might be an important factor contributing to the declining presence of vegetation on some islands in the Great Lakes. 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, these effects can be so severe on islands that all woody vegetation is eliminated (Cuthbert et al. 2002) and some islands can be completely denuded of vegetation (USFWS 2003). 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 (Bedard et al. 1999, Hatch and Weseloh 1999). Similarly, a study conducted in Oklahoma found fewer annual and perennial plants in locations where crows roosted over several years (Hicks 1979).

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 1997) and wildlife, including state and federally listed T&E species (Korfanty et al. 1997). 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, Bedard et al. 1995, Weseloh and Collier 1995, Weseloh et al. 1995, Korfanty et al. 1997, Hebert et al. 2005). For example, Cuthbert et al. (2002) found that cormorants have a negative effect on normal plant growth and survival on a localized level in the Great Lakes region.

Based on survey information provided by Wires et al. (2001), biologists in the Great Lakes region reported cormorants as having an impact to herbaceous layers and trees where nesting occurred. Damage to trees was mainly caused by fecal deposits and resulted in tree die-off at breeding colonies and roost sites. Impacts to the herbaceous layer of vegetation were also reported due to fecal deposition, and often this layer was reduced or eliminated from the colony site. In addition, survey respondents reported that the impacts to avian species from cormorants occurred primarily from habitat degradation and from competition for nest sites (Wires et al. 2001). Although loss of vegetation can have an adverse effect on many species, some colonial waterbirds such as pelicans and terns prefer sparsely vegetated substrates.

Degradation of habitat can also occur when large concentrations of waterfowl remove shoreline vegetation resulting in erosion (USFWS 2005). 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.

Excessive numbers of Canada Geese have been reported to be sources of nutrients and pathogens in water. Canada Geese are attracted to waste water treatment plants because of the water and available vegetation. 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.

Large concentrations of waterfowl have affected water quality around beaches and in wetlands by acting as nonpoint source pollution. There are four forms of nonpoint source pollution: sedimentation, nutrients, toxic substances, and pathogens. Large concentrations of waterfowl can remove shoreline vegetation resulting in erosion of the shoreline and soil sediments being carried by rainwater into lakes, ponds, and reservoirs (USFWS 2005). WS has assisted cooperators in the State in managing Canada Geese and free-ranging or domestic waterfowl damage to sites where excessive grazing on emergent vegetation necessitated re-planting of the site at significant costs. Overabundant resident Canada Geese can negatively affect crops and habitats that are maintained as food and cover for migrant waterfowl and other wildlife.

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).

As the population of Double-crested Cormorants has increased, so has concern for sport fishery populations (USFWS 2003). Cormorants can have a negative effect on recreational fishing on a localized level (USFWS 2003). Recreational fishing benefits local and regional economies in many areas of the United States, with some local economies relying heavily on income associated with recreational fisheries (USFWS 2003). The collapse of sport fisheries can have negative economic impacts on businesses and can result in job losses (Shwiff et al. 2009).

The health of a lake's fishery can have an effect on the economies surrounding that lake. For example, when the walleye (*Sander vitreus*) and yellow perch (*Perca flavescens*) fishery collapsed on Oneida Lake in New York after the colonization of the lake by cormorants (VanDeValk et al. 2002, Rudstam et al. 2004), research biologists with the National Wildlife Research Center (NWRC) sought to identify the actual monetary damage associated with the declines of those sport fish populations. The total estimated revenue lost in the Oneida Lake region from 1990 to 2005 due to declines in the sport fisheries on the lake ranged from $122 million to $539 million. That lost revenue from the collapse of the fisheries resource resulted in the loss of 3,284 to 12,862 jobs in the Oneida Lake region from 1990 to 2005 (Shwiff et al. 2009). In 1998, the WS program in New York was requested to assist with managing damage associated with cormorants on Oneida Lake. Cormorant damage management activities conducted on Oneida Lake from 1998 to 2005 prevented the loss of an estimated $48 million to $171 million in revenue, which allowed between 1,446 and 5,014 jobs to be retained in the Oneida Lake region (Shwiff et al. 2009).

The degree to which cormorant predation affects sport fishery populations in a given body of water is dependent on a number of variables, including the number of birds present, the time of year at which predation is occurring, prey species composition, and physical characteristics such as depth or proximity to shore (which affect prey accessibility). In addition to cormorant predation, environmental and human-induced factors affect aquatic ecosystems. Those factors can be classified as biological/biotic (*e.g.*, overexploitation, exotic species), chemical (*e.g.*, water quality, nutrient and contaminant loading), or physical/abiotic (*e.g.*, dredging, dam construction, hydropower operation, siltation). Such activities may lead to changes in species density, diversity, and/or composition due to direct effects on year class strength, recruitment, spawning success, spawning or nursery habitat, and/or competition (USFWS 1995).

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, mammals, and impact 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).

1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

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, and agricultural resources on federal, state, tribal, municipal, and private land within the State of Tennessee 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.

The methods available for use to manage bird damage are discussed in Appendix B. The alternatives and Appendix B also discuss how methods would be employed 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 permitted by the USFWS pursuant to the Migratory Bird Treaty Act (MBTA).

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 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 orders. Under authorities in the MBTA, the USFWS is the federal agency responsible for the issuance of depredation permits or the establishment of depredation 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.

Native American Lands and Tribes

The WS program in Tennessee would only conduct damage management activities on Native American lands when requested by a Native American Tribe. WS would only conduct activities after a Memorandum of Understanding (MOU), work initiation document, or other similar document had been signed between WS and the Tribe requesting assistance; therefore, the Tribe would determine when WS' assistance was required and what activities would be allowed. 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.

Federal, State, County, City, and Private Lands

WS could continue to provide assistance on federal, state, county, municipal, and private land in Tennessee under two of the alternatives analyzed in detail when the appropriate resource owner or manager requested such services from WS. In those cases where a federal agency requests WS' assistance with managing damage caused by birds, the requesting agency would be responsible for analyzing those activities in accordance with the NEPA. However, this EA could cover such actions if the requesting federal agency determined the analyses and scope of this EA were appropriate for those actions and the requesting federal agency adopted this EA through their own Decision based on the analyses in this EA. Therefore, the scope of this EA analyzes actions that WS could take on federal lands.

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 and the TVA 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 Tennessee and damage management activities that WS could conduct on property owned or managed by the TVA under the selected alternative.

Site Specificity

WS could take actions to reduce threats to human health and safety, reduce damage to agricultural resources, alleviate property damage, and protect native wildlife, including T&E species, in the State. As mentioned previously, WS would only conduct damage management activities when requested by the appropriate resource owner or manager. In addition, WS' activities that could involve the lethal removal of birds under the alternatives would only occur when permitted by the USFWS, when required, and only at levels permitted.

This EA analyzes the potential effects of alternative approaches to managing damage associated with birds that WS could conduct on private and public lands in Tennessee 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 services when requested, within the constraints of available funding and workforce, it is conceivable that additional efforts could occur. Thus, this EA anticipates those additional efforts and analyzes the impacts of such efforts as part of the alternatives.

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. Planning for the management of bird damage must be viewed as being conceptually similar to the actions of other entities whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they would occur are unknown but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire departments, police departments, emergency clean-up organizations, and insurance companies. Some of the sites where bird damage could occur can be predicted; however, specific locations or times where such damage would occur in any given year cannot be predicted. 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. 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.

Chapter 2 of this EA identifies and discusses issues relating to bird damage management in Tennessee. The standard WS Decision Model (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). 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.

The analyses in this EA are intended to apply to any action that may occur in any locale and at any time within the State of Tennessee. 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.

Summary of Public Involvement

WS and the TVA initially developed issues related to bird damage management and the alternatives to address those issues in consultation with the USFWS and the TWRA. Issues were defined and preliminary alternatives were identified through the scoping process. As part of this process, and as required by the CEQ and APHIS' NEPA implementing regulations, this document will be noticed to the public for review and comment. This EA will be noticed to the public through legal notices published in local print media, through direct mailings to interested parties, and by posting the EA on the APHIS website.

WS and the TVA 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 and the TVA will clearly communicate to the public and interested parties the analyses of potential environmental impacts on the quality of the human environment. New issues or alternatives identified after publication of notices announcing the availability of the EA will be fully considered to determine whether the EA should be revisited and, if appropriate, revised prior to issuance of a Decision.

1.4 RELATIONSHIP OF THIS DOCUMENT TO OTHER ENVIRONMENTAL DOCUMENTS

Environmental Impact Statement: Double-crested Cormorant Management in the United States

The USFWS has issued a FEIS that evaluated the management of Double-crested Cormorants (USFWS 2003). WS was a formal cooperating agency during the development of the FEIS. WS has adopted the FEIS to support program decisions involving the management of cormorant damage. WS completed a Record of Decision (ROD) on November 18, 2003 (see 68 FR 68020).

Environmental Assessment: Extended Management of Double-crested Cormorants under 50 CFR 21.47 and 21.48

The cormorant management FEIS developed by the USFWS, in cooperation with WS, established a Public Resource Depredation Order (PRDO; 50 CFR 21.48) and made changes to the 1998 Aquaculture Depredation Order (AQDO; 50 CFR 21.47). To allow for an adaptive evaluation of activities conducted under the PRDO and the AQDO established by the FEIS, those Orders are subject to review and renewal every five years (USFWS 2003). An EA developed in 2009 (USFWS 2009) and again in 2014 (USFWS 2014*a*) determined that a five-year extension of the expiration date of the PRDO and the AQDO would not threaten cormorant populations and activities conducted under those Orders would not have a significant impact on the human environment (74 FR 15394-15398; USFWS 2009, USFWS 2014*a*).

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

The USFWS, in cooperation with WS, has issued a 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 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 the lesser snow geese (*Chen caerulescens caerulescens*), greater snow geese (*C. c. atlantica*), and Ross's geese (*C. rossii*) that nest in Arctic and sub-Arctic regions of Canada and migrate and winter throughout the United States. A Record of Decision (ROD) and Final Rule were published by the USFWS and the Final Rule went into effect on December 5, 2008. Pertinent and current information available in the FEIS has been incorporated by reference into this EA.

Environmental Assessment: Proposal to Permit Take as Provided Under the Bald and Golden Eagle Protection Act

The EA developed by the USFWS evaluated the issues and alternatives associated with permitting the "*take*" of bald eagles and golden eagles as defined under the Bald and Golden Eagle Protection Act. The preferred alternative in the EA evaluated the authorized disturbance of eagles, which constitutes "*take*" as defined under the Bald and Golden Eagle Protection Act, authorizes the removal of eagle nests where necessary to reduce threats to human safety, and evaluated the issuance of permits authorizing the lethal take of eagles in limited circumstances. A Decision and FONSI was issued for the preferred alternative in the EA (USFWS 2010).

Environmental Assessment: Bird Damage Management in the Tennessee Wildlife Services Program

WS previously developed an EA that analyzed the need for action to manage damage associated with birds. The EA identified the issues associated with managing damage associated with birds in the State and analyzed alternative approaches to meet the specific need identified in the EA 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. Since activities conducted under the EA will be re-evaluated under this EA to address the new need for action and the associated affected environment, the previous EA that addressed managing bird damage will be superseded by this analysis and the outcome of the Decision issued based on the analyses in this EA.

Southeast United States Waterbird Conservation Plan

A regional waterbird conservation plan for the southeastern region of the United States has been developed 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 (BCRs) and 2 pelagic BCRs (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.

North American Waterfowl Management Plan

The United States signed a joint venture with Canada, and later Mexico, in an international effort to conserve declining populations of migratory waterfowl and to protect and restore sustainable habitat. The goals set forth by the North American Waterfowl Management Plan in the 2012 revision are to have 1) abundant and resilient waterfowl populations to support hunting and other uses without imperiling habitat, 2) wetlands and related habitats sufficient to sustain waterfowl populations at desired levels while providing ecological services and recreational benefits to society, and 3) growing numbers of waterfowl hunters, conservationists, and other citizens who enjoy and actively support waterfowl and wetlands conservation (USFWS 2012).

TVA Natural Resource Plan (NRP)

The TVA has developed an extensive plan to strategically evaluate both renewable and nonrenewable resources and fulfill the responsibilities associated with good stewardship of TVA lands and resources. The NRP is designed to integrate the objectives of six resource areas (biological, cultural, recreation, water, public engagement and reservoir lands planning); provide optimum public use benefit; and balance competing and sometimes conflicting resource uses (TVA 2011*a*).

TVA Environment Impact Statement Assessing the Natural Resource Plan

The TVA has also prepared an EIS to assess the impacts of the NRP and its reasonable alternatives on the environment. It specifically describes the stewardship programs that are ongoing and are being evaluated for future implementation as part of the NRP; and assesses the potential environmental impacts associated with implementing the various alternatives. Pertinent information available in the FEIS has been incorporated by reference into this EA (TVA 2011*b*).

TWRA Comprehensive Wildlife Conservation Strategy

The TWRA has developed an extensive wildlife conservation plan that evaluates all species of plant and animal known to exist within the State. This plan identifies all of the species and habitats that are currently listed as endangered, threatened, or species of concern, both federally by the United States Fish and Wildlife Service (USFWS) (USFWS 2014*b*) and at the state level by the TWRA and the Tennessee Department of Environment and Conservation's (TDEC)-Natural Heritage Inventory Program (TDEC 2009, TDEC 2014). It also incorporates additional species of which little is known or with questionable population trends, and creates a comprehensive prioritized list of species in need of conservation.

1.5 AUTHORITY OF FEDERAL AND STATE AGENCIES

Below are brief discussions of the authorities of WS, the TVA, 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 426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 426c). 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.

Tennessee Valley Authority

The TVA is a federal corporation created by an Act of Congress in May 18, 1933 [48 Stat. 58-59, 16 USC Sec. 831, as amended]. The TVA provides electricity to 9 million people, businesses, and industries, and manages 293,000 acres of public land and 11,000 miles of reservoir shoreline in the seven-state Tennessee Valley Region (Tennessee, Alabama, Mississippi, Kentucky, Georgia, North Carolina, and Virginia – an area of 80,000 square miles). The TVA operates 29 hydroelectric dams, 11 coal-fired power plants, three nuclear plants, 11 natural gas-fired power facilities, a pump-storage plant, as well as solar, wind, and other renewable energy production sites that can produce about 34,000 megawatts of electricity, delivered over 16,000 miles of high-voltage power lines. The TVA also provides flood control, navigation, land management, and recreation for the Tennessee River system and works with local utilities and state and local governments to promote economic development across the region.
The TVA may request assistance from WS to provide wildlife damage management on land and at facilities owned by the TVA. The TVA also makes its public lands available for use for continuation and expansion of the WS' oral rabies vaccination program across the states within the Tennessee River Basin and Valley.

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 orders that allow for the take of migratory birds. Under depredation/control orders, lethal removal can occur when those bird species are causing damage or when those species are about to cause 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.

Tennessee Wildlife Resources Agency

The TWRA is authorized under Tennessee Code 70-1-3 to manage most wildlife species in the State under the direction of the Tennessee Wildlife Resources Commission. The TWRA commission is made up of 13 individuals experienced and well-informed on conservation of game animals, birds, and fish within the State. The 13 member commission includes the Commissioner of Environment, the Commissioner of Agriculture, 9 citizens appointed by the Governor, one citizen appointed by the Speaker of the Senate, and one citizen appointed by the Speaker of the House. In addition, the TWRA and WS have a MOU that establishes a cooperative relationship, outlines responsibilities, and sets forth objectives and goals of each agency with the goal of resolving wildlife damage issues in the State.

Tennessee Department of Agriculture (TDA)

The Department of Agriculture is authorized under the Tennessee Insecticide, Fungicide, and Rodenticide Act (Tennessee Code 43-8) to regulate the registration, sale, distribution, usage, storage, disposal, and application of all pesticides in the State. The TDA is also responsible for the education and certification of applicators.

1.6 COMPLIANCE WITH LAWS AND STATUTES

Several laws or statutes authorize, regulate, or otherwise would affect the activities that the WS program and the TVA conduct. WS and the TVA 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 and the TVA could conduct in the State.

National Environmental Policy Act

All federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.). WS and the TVA follow the CEQ regulations implementing the NEPA (40 CFR 1500 et seq.). In addition, WS follows the USDA (7 CFR 1b) and APHIS Implementing Guidelines (7 CFR 372) as part of the decision-making process. Those laws, regulations, and guidelines generally outline five broad types of activities to be accomplished as part of any project: public involvement, analysis, documentation, implementation, and monitoring. The NEPA also sets forth the requirement that all major 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. Federal activities affecting the physical and biological environment are regulated in part by the CEQ through regulations in 40 CFR 1500-1508. In accordance with the CEQ and USDA regulations, APHIS guidelines concerning the implementation of the NEPA, as published in the Federal Register (44 CFR 50381-50384), provide guidance to WS regarding the NEPA process.

Pursuant to the NEPA and the CEQ regulations, this EA documents the analyses of potential federal actions, informs decision-makers, and the public of reasonable alternatives that could be capable of avoiding or minimizing adverse effects, and serves as a decision-aiding mechanism to ensure that the policies and goals of the NEPA are infused into federal agency actions. This EA was prepared by integrating as many of the natural and social sciences as warranted, based on the potential effects of the alternatives. The direct, indirect, and cumulative impacts of the proposed action are analyzed.

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 Collared-Doves, House Sparrows, 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 European Starlings, Rock Pigeons, Eurasian Collared-Doves, House Sparrows, and feral waterfowl. 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

As discussed previously, the USFWS developed an EIS to evaluate alternatives to address increasing resident goose populations across the United States and to reduce associated damage (USFWS 2005). In addition, several depredation orders were established to manage damage associated with resident Canada Geese without a depredation permit from the USFWS when certain criteria are occurring. 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, Canada Geese can be lethally taken without a permit from the USFWS in those states designated, including Tennessee, 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). Since 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 or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance. Those bird species that could be lethally taken under the blackbird depredation order that are addressed in the assessment include American Crows, Fish Crows, Red-winged Blackbirds, Common Grackles, Boat-tailed Grackles, and Brown-headed Cowbirds.

Depredation Order for Double-crested Cormorants at Aquaculture Facilities (50 CFR 21.47)

The AQDO was established to reduce cormorant depredation of aquacultural stock at private fish farms and state and federal fish hatcheries. Under the AQDO, cormorants can be lethally taken at commercial freshwater aquaculture facilities and state and federal fish hatcheries in 13 states, including Tennessee. The Order authorizes landowners, operators, and tenants, or their employees/agents, that are actually engaged in the production of aquaculture commodities to lethally take cormorants causing or about to cause damage at those facilities without the need for a depredation permit. Those activities can only occur during daylight hours and only within the boundaries of the aquaculture facility. The AQDO also authorizes WS to take cormorants at roost sites near aquaculture facilities at any time, from October through April, without the need for a depredation permit when appropriate landowner permissions have been obtained.

Depredation Order for Double-crested Cormorants to Protect Public Resources (50 CFR 21.48)

The purpose of the PRDO is to reduce the actual occurrence, and/or minimize the risk, of adverse impacts of cormorants to public resources. Public resources, as defined by the PRDO, are natural resources managed and conserved by public agencies. Public resources include fish (free-swimming fish and stocked fish at federal, state, and tribal hatcheries that are intended for release in public waters), wildlife, plants, and their habitats. The Order authorizes WS, state fish and wildlife agencies, and federally recognized Tribes in 24 states to conduct damage management activities involving cormorants without the need for a depredation permit from the USFWS, including Tennessee. It authorizes the take of cormorants on "*all lands and freshwaters*" including public and private lands; however, landowner/manager permission must be obtained before cormorant damage management activities may be conducted at any site.

Bald and Golden Eagle Protection Act (16 USC 668)

Congress enacted the Bald Eagle Protection Act (16 USC 668) in 1940; thereby, making it a criminal offense for any person to "*take*" or possess any Bald Eagle (or any part, egg, or nest). The Act contained several exceptions that permitted take under certain circumstances. The Secretary of the Interior could allow take and possession of eagles for scientific or exhibition purposes of public museums, scientific societies, and zoological parks; possession of any Bald Eagle (or part, nest, or egg) taken prior to 1940 was not prohibited; and the terms of the Act did not apply to Alaska. Since its original enactment, the Act has been amended several times to increase protections for eagles and/or provide exemptions for specific types of activities. For example, the amendment in 1962 was designed to give greater protection to immature Bald Eagles and to include Golden Eagles. The 1962 amendment also created two exceptions to the Act. Those exceptions allowed the taking and possession of eagles for religious purposes of Native American tribes and provided that the Secretary of the Interior, on request of the governor of any state, could authorize the taking of Golden Eagles to seasonally protect domesticated flocks and herds in that state.

While Bald Eagles were federally listed as a threatened species, the ESA was the primary regulation governing the management of Bald Eagles in the lower 48 states. Now that Bald Eagles have been removed from the federal list of T&E species, the Bald and Golden Eagle Protection Act is the primary regulation governing Bald Eagle management. Under the Bald and Golden Eagle Protection Act (16 USC 668-668c), the take of an eagle, any part, egg, or nest is prohibited without a permit from the USFWS. Under the Act, the definition of "*take*" includes actions that can "*molest*" or "*disturb*" eagles. For the purposes of the Act under 40 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."* Under the new regulations, WS must now have in place a non-purposeful programmatic take permit. This permit allows for any take that is associated with, but not the purpose of, an activity, when the take cannot practicably be avoided, and all advanced conservation practices have been implemented (see 50 CFR 22.26).

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 (NHPA) of 1966, as amended

The NHPA and its implementing regulations (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 Sec. 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. None of the methods described in this EA that could be available for use under the alternatives cause major ground disturbance, any physical destruction or damage to property, any alterations of property, wildlife habitat, or landscapes, nor involves the sale, lease, or transfer of ownership of any property. In general, such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas in which they are used that could result in effects on the character or use of historic properties; therefore, the methods that could be used by WS under the relevant alternatives are not generally the types of activities that would have the potential to affect historic properties. If an individual activity with the potential to affect historic resources were planned under an alternative selected because of a decision on this EA, the site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary.

Noise-making methods, such as firearms, that are used at or in close proximity to historic or cultural sites for the purposes of hazing or removing animals have the potential for audible effects on the use and enjoyment of historic property; however, such methods would only be used at a historic site at the request of the owner or manager of the site to alleviate a damage problem, which means such use, would be to the benefit of the historic property. A built-in minimization factor for this issue is that virtually all the methods involved would only have temporary effects on the audible nature of a site and could be ended at any time to restore the audible qualities of such sites to their original condition with no further adverse effects. Site-specific consultation as required by the Section 106 of the NHPA would be conducted as necessary in those types of situations.

Native American Graves and Repatriation Act of 1990

The Native American Graves Protection and Repatriation Act 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 projects would discontinue work until a reasonable effort has been made to protect the items and the proper authority has been notified.

Federal Insecticide, Fungicide, and Rodenticide Act

The FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The EPA is responsible for implementing and enforcing the FIFRA. All pesticides employed and/or recommended by the WS' program in Tennessee pursuant to the alternatives would be registered with the EPA and registered for use in Tennessee by the TDA, when applicable. All pesticides would be employed by WS pursuant to label requirements when providing direct operational assistance under the alternatives. In addition, WS would recommend that all label requirements be adhered to when recommending the using of chemical methods while conducting technical assistance projects under the alternatives.

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.

Investigational New Animal Drug (INAD)

The FDA can grant permission to use investigational new animal drugs commonly known as INAD (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 B 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. All activities are evaluated for their impact on the human environment and compliance with Executive Order 12898.

WS would only use legal, effective, and environmentally safe methods, tools, and approaches. Chemical methods employed by WS would be regulated by the EPA through FIFRA, the FDA, the TDA, by MOUs with land managing agencies, and by WS' Directives. WS would properly disposes of any excess solid or hazardous waste. It is not anticipated that the alternatives would result in any adverse or disproportionate environmental impacts to minority and low-income people or populations. In contrast, two of the alternatives analyzed in detail may benefit minority or low-income populations by reducing threats to public health and safety and property damage.

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. WS and the TVA make it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children. WS and the TVA have considered the impacts that this proposal might have on children. The proposed activities would occur by using only legally available and approved methods where it is highly unlikely that children would be adversely affected. For these reasons, WS and the TVA conclude that it would not create an environmental health or safety risk to children from implementing the proposed action alternative or the other alternatives.

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.

Memorandum of Understanding

WS has established a MOU with various agencies in Tennessee, including the University of Tennessee Agricultural Extension Service, the TDA, the Tennessee Department of Health and Environment, the TWRA, and the Tennessee Department of Environment and Conservation. The objectives for this MOU is to: 1) establish a collaborative relationship among the named participants for planning, coordinating, and implementing of animal damage control policies developed to prevent or minimize damage caused by wild animal species, including threatened and endangered species, to agriculture, horticulture, animal husbandry, forestry, wildlife, and human health, safety, or other property; and 2) facilitate the exchange of information. This MOU allows Tennessee agencies concerned with protection of resources and public health to collaborate with WS to achieve mutual objectives. WS consults with these various agencies from time to time in the process of assisting Tennessee residents in resolving wildlife damage conflicts and these agencies refer appropriate wildlife damage complaints to WS.

1.7 DECISIONS TO BE MADE

The TVA owns and operates numerous electrical power generation sites and transmission structures within Tennessee, including electrical substations and transmission lines. In addition, the TVA manages lands within the State for recreational, natural, and cultural resources. Many of those sites experience damage associated with birds. The TVA would be the primary decision-maker for bird damage management activities occurring on sites owned or managed by the TVA. Management of migratory birds is the responsibility of the USFWS. As the authority for the overall management of bird populations, the USFWS was involved in the development of the EA and provided input throughout the EA preparation process to ensure an interdisciplinary approach according to the NEPA and agency mandates, policies, and regulations. The TWRA is responsible for managing wildlife in the State of Tennessee, including birds. The TWRA 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 assessment. For migratory birds, the TWRA can establish hunting seasons for those species under frameworks determined by the USFWS.

WS' activities to reduce and/or prevent bird damage in Tennessee would be coordinated with the USFWS and the TWRA, which would ensure WS' actions were incorporated 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; therefore, the take of those bird species to alleviate damage or reduce threats of damage would only occur at the discretion of the USFWS.

Based on the scope of this EA, the decisions to be made are: 1) should WS, in cooperation with the TVA, conduct bird damage management to alleviate damage and threats of damage; 2) should WS conduct disease surveillance and monitoring in the bird population when requested by the TWRA, the USFWS, and other agencies; 3) should WS, in cooperation with the TVA, implement an integrated damage management strategy, including technical assistance and direct operational assistance, to meet the need for bird damage management; 4) if not, should WS and/or the TVA attempt to implement one of the other alternatives described in the EA; and 5) would the alternatives result in effects to the human environment requiring the preparation of an EIS.

CHAPTER 2: AFFECTED ENVIRONMENT AND ISSUES

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 and the TVA identified but will not be considered in detail, with rationale. Pertinent portions of the affected environment will be included in this chapter during the discussion of the issues. Additional descriptions of affected environments will be incorporated into the discussion of the environmental effects in Chapter 4.

2.1 AFFECTED ENVIRONMENT

Damage or threats of damage caused by those bird species addressed in this EA can occur statewide in Tennessee 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 has 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 breeding. In addition, many of the bird species occur throughout the year in the State. Since most 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. Additional information on the affected environment is provided in Chapter 4.

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 Tennessee to reduce damages and threats associated with birds to agricultural resources, natural resources, property, and threats to human safety. 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 Tennessee that are currently being conducted under a MOU, work initiation document, or a similar document with WS where activities have been and currently are being conducted. 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 also 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.

TVA Facilities

In addition, bird damage management could occur at facilities owned or managed by the TVA when those bird species addressed in this assessment cause damage or pose threats of damage to property, natural resources, pose a threat to human safety, or threaten the reliability of electric system transmission. Damage management activities could be conducted at any of the 51 TVA power generation facilities, 263 TVA electrical substations, or along any of the 9,444 circuit miles of transmission lines and right-of-way easements owned by the TVA in Tennessee. Activities could also be conducted on recreational, natural, or cultural lands owned or managed by the TVA in Tennessee.

Airports

Because many bird species are ubiquitous throughout the State, it is possible for those species to be present at nearly any airport or military airbase. WS could receive requests for assistance to address threats of aircraft strikes from airport authorities at any of the airports or airbases in the State where those bird species addressed in this assessment pose a threat to aircraft and passenger safety.

Federal Property

Many federal properties are controlled access areas with security fencing. Those properties often are unconcerned with the presence of birds until the populations of those species are large enough to negatively affect natural resources on the facility or the aesthetic value of property or landscaping. Examples of those types of federal facilities include, but are not limited to, military bases, research facilities, and federal parks. WS may be requested to assist facilities managers in the management of bird damage at such facilities. In those cases where a federal agency requests WS' assistance with managing damage caused by birds, the requesting agency would be responsible for analyzing those activities in accordance with the NEPA.

State Property

Activities could be conducted on properties owned and/or managed by the state when requested, such as parks, forestland, historical sites, natural areas, scenic areas, conservations areas, and campgrounds. Damage management activities could be requested to occur on state highway right-of-ways and interstate right-of ways.

Municipal Property

Activities under the alternatives could be conducted on city, town, or other local governmental properties when requested by those entities. Those areas could include, but would not be limited to city parks, landfills, woodlots, cemeteries, greenways, treatment facilities, utilities areas, and recreational areas. Similar to other areas, birds can cause damage to natural resources, agricultural resources, property, and threaten human safety in those areas. Areas could also include properties in urban and suburban areas of the State.

Private Property

Requests for assistance to manage bird damage and threats could also occur from private property owners and/or managers of private property. Private property could include areas in private ownership in urban, suburban, and rural areas, which could include agricultural lands, timberlands, pastures, industrial parks, residential complexes, subdivisions, businesses, railroad right-of-ways, and utility right-of-ways.

Environmental Status Quo

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 affects 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 natural resources agency (*e.g.*, the TWRA), 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 some bird species, take during the hunting season is regulated pursuant to the MBTA by the USFWS through the issuance of frameworks that include the allowable length of hunting seasons, methods of harvest, and harvest limits, which are implemented by the TWRA. 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 species identified in the order are found committing damage, when about to commit damage, or when posing a human safety threat. Cormorants can be lethally taken in the State without the need for a depredation permit from the USFWS under the PRDO and the AQDO. Resident Canada Geese can be addressed under several depredation/control orders. Muscovy Ducks can also be addressed under a control order. Pursuant to the MBTA, the USFWS can issue depredation permits to those entities experiencing damage associated with birds, when deemed appropriate.

If a bird species is not afforded protection under the MBTA (see 50 CFR 10.13), then a depredation permit from the USFWS is not required to address damage or threats of damage associated with those species. European Starlings, House Sparrows, Rock Pigeons, Eurasian Collared-Doves, and free-ranging or feral domestic waterfowl, including Mute Swans, are not afforded protection under the MBTA and a depredation permit is not required to address damage associated with those species.

When a non-federal entity (*e.g.*, agricultural producers, health agencies, municipalities, counties, private companies, individuals, or any other 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[12] 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 since the entity could take the action in the absence of WS' involvement. Since 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 requestor had conducted the action in the absence of WS' involvement in the action.

In addition, most methods for resolving damage would be available to WS and to other entities; therefore, WS' decision-making ability would be restricted to one of three alternatives. Under those three alternatives, WS could provide technical assistance with managing damage only, take the action using the specific methods as decided upon by the non-federal entity, or take no action. If no action were taken by WS, the non-federal entity could take the action anyway either without the need for a permit, during the hunting season, under a depredation/control order, or through the issuance of a depredation permit by the USFWS. Under those circumstances, WS would have virtually no ability to affect the environmental status quo since the action would likely occur in the absence of WS' direct involvement.

Therefore, based on the discussion above, in those situations where a non-federal entity has already made the decision to remove or otherwise manage birds to stop damage with or without WS' assistance, WS' participation in carrying out that action would not affect the environmental status quo.

2.2 ISSUES ASSOCIATED WITH BIRD DAMAGE MANAGEMENT ACTIVITIES

Issues are concerns of the public and/or professional community raised regarding potential adverse effects that might occur from a proposed action. Such issues must be considered in the NEPA decision-making process. Those issues identified in the management of resident Canada Geese FEIS (USFWS 2005) and the cormorant management FEIS (USFWS 2003) were considered during the development of this EA. Issues related to managing damage associated with birds in Tennessee were developed by WS and the TVA in consultation with the USFWS and the TWRA. This EA will also be made available to the public for review and comment to identify additional issues.

[12]If a federal permit were required to conduct damage management activities, the issuing federal agency would be responsible for compliance with the NEPA for issuing the permit.

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 alleviate 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.

In addition, some of the bird species addressed in this EA can be harvested in the State during annual hunting seasons. 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. 2014). 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). The statistical significance of a trend for a given species is also determined using BBS data (Sauer et al. 2014).

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).

Annual Harvest Data

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 TWRA. Those species addressed in this EA that have established hunting seasons include Snow Geese, Canada Geese, Mallards, Wild Turkeys, Eurasian Collared-Doves, Mourning Doves, Sandhill Cranes, and American Crows. In addition, the waterfowl and game species addressed in Appendix E along with Fish Crows can be harvested during annual hunting seasons.

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 migratory game bird permit 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 TWRA in published reports.

Bird Conservation Regions

BCRs are areas in North America that are characterized by distinct ecological habitats that have similar bird communities and resource management issues. Tennessee falls within several of these conservation regions. The central portion of Tennessee is within the Central Hardwoods Region (BCR 24). As the name suggests, this area is mostly composed of hardwood forest stands, predominately oak and hickory species. The Appalachian Mountains Region (BCR 28) covers the easternmost portion of the State. This region is mostly hardwoods in the lower elevations, but predominately covered in pine, hemlock, fir, and spruce in the higher elevations. The longleaf, slash, and loblolly dominated pine forests of the Southeastern Coastal Plain (BCR 27) meet the alluvial floodplains of the Mississippi Alluvial Valley (BCR 26) in the western part of the State (USFWS 2000).

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 are 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 B.

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 Tennessee are further discussed in Appendix B.

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 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. 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. In addition to the potential risks to the public associated with WS' methods, risks to employees would also be an issue. WS' employees could potentially be exposed to damage management methods as well as subject to workplace accidents. 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 assessment. DRC-1339 is currently registered with the EPA for use by WS to manage damage associated with Rock Pigeons, European Starlings, Red-winged Blackbirds, Brown-headed Cowbirds, Common Grackles, crows, and gulls. However, formulations registered with the EPA must also be registered with the TDA for use in the State. The WS program would only employ those products that are registered with the EPA and the TDA.

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 assessment, Avitrol is registered with the EPA to manage damage associated with House Sparrows, Red-winged Blackbirds, Common Grackles, Brown-headed Cowbirds, European Starlings, Rock Pigeons, 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 TDA, and by WS' directives. Chemical methods are further discussed in Appendix B 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 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 improved animal husbandry practices, 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, high-pressure water spray, bird-proof barriers, electronic distress calls, effigies, mylar tape, lasers, eyespot 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.

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 Tennessee would be available for use under any of the alternatives and could be employed by any entity when permitted. Risks to human safety from the use of non-chemical methods will be further evaluated as this issue relates to the alternatives in Chapter 4.

Effects of Not Employing Methods to Reduce Threats to Human Safety

An issue that WS and the TVA 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 the State. 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 can cause "*stress*" (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. 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.

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; however, geese will form new pairs bonds even when their previous mate is still alive (MacInnes et al. 1974). Goose family units generally migrate together during the fall migration period and spend much of the fall and winter together (Raveling 1968, Raveling1969). 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.

Issue 6 - Effects of Bird Damage Management Activities on the Regulated Harvest of Birds

Another issue commonly identified is a concern that damage management activities conducted by WS would affect the ability of persons 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. Those species that are addressed in this EA that can also be hunted during regulated seasons in the State include Snow Geese, Canada Geese, Mallards, Wild Turkeys, Eurasian Collared-Doves, Mourning Doves, Sandhill Cranes, and American Crows. In addition, the waterfowl and game species addressed in Appendix E along with Fish Crows can be harvested during annual hunting seasons.

Potential impacts could arise from the use of non-lethal or lethal damage management methods. Non-lethal methods used to reduce or alleviate damage caused by those birds species are used to reduce bird densities through dispersal in areas where damage or the threat of damage is occurring. Similarly, lethal methods used to reduce damage associated with those birds could lower densities in areas where damage is occurring resulting in a reduction in the availability of those species during the regulated harvest season. WS' bird damage management activities would primarily be conducted on populations in areas where hunting access is restricted (*e.g.*, airports, TVA facilities, and urban areas) or has been ineffective. The use of non-lethal or lethal methods often disperses birds from areas where damage is occurring to areas outside the damage area, which could serve to move those bird species from those less accessible areas to places accessible to hunters.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

Additional issues were also identified by WS, TVA, the TWRA, and the USFWS during the scoping process of this EA. The following issues were considered; however, those issues will not receive detailed analyses for the reasons provided.

Appropriateness of Preparing an EA (Instead of an EIS) For Such a Large Area

A concern was raised that an EA for an area as large as the State of Tennessee would not meet the NEPA requirements for site specificity. Wildlife damage management falls within the category of federal or other regulatory 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 and sites where some kinds of wildlife damage will occur, the program cannot predict the specific locations or times at which affected resource owners will determine a damage problem has become intolerable to the point that they request assistance from WS. 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 wild animal 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.

Lead agencies have the discretion to determine the geographic scope of their analyses under the NEPA (Kleppe v Sierra Club, 427 U.S. 390, 414 (1976), CEQ 1508.25). Ordinarily, according to APHIS procedures implementing the NEPA, WS' individual wildlife damage management actions could be categorically excluded (7 CFR 372.5(c)). 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. Based on previous requests for assistance, the WS program in Tennessee would continue to conduct bird damage management on a small percentage of the land area in the State where damage is occurring or likely to occur.

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 were removed. WS operates on a small percentage of the land area of Tennessee 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.

A Loss Threshold Should Be Established Before Allowing Lethal Methods

One issue identified through WS' implementation of the NEPA process is a concern that a threshold of loss should be established before employing lethal methods to resolve damage and that wildlife damage should be a cost of doing business. Some damage and economic loss can be tolerated by cooperators until the damage reaches a threshold where 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 addition, establishing a threshold would be difficult or inappropriate to apply to human health and safety situations.

In a ruling for Southern Utah Wilderness Alliance et al. vs. Hugh Thompson, Forest Supervisor for the Dixie National Forest et al., the United States District Court of Utah denied plaintiffs' motion for a preliminary injunction. In part, the court found that a forest supervisor only needed to show that damage from wildlife was threatened, to establish a need for wildlife damage management (Civil No. 92-C-0052A January 20, 1993). Thus, there is judicial precedence indicating that it is not necessary to establish a criterion such as a percentage of loss of a particular resource to justify the need for damage management actions.

Bird Damage Management Should Not Occur at Taxpayer Expense

Another issue identified is the concern that wildlife damage management should not be provided at the expense of the taxpayer or that activities should be fee-based. Funding for activities is derived from federal appropriations and through cooperative funding. Activities conducted in the State for the management of damage and threats to human safety from birds will be funded through cooperative service agreements with individual property owners or associations. A minimal federal appropriation is allotted for the maintenance of a WS program in Tennessee. The remainder of the WS program is entirely fee-based. Technical assistance is provided to requesters as part of the federally funded activities, but most direct assistance requests in which WS' employees perform damage management activities is funded through cooperative service agreements between the requester and WS.

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. The cost effectiveness of methods and the effectiveness of methods are linked. The issue of cost effectiveness as it relates to the effectiveness of methods is discussed in the following issue.

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 reassortment (Clark and Hall 2006).

There are two types of avian influenza viruses, low pathogenic avian influenza and high pathogenic avian influenza (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). 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).

Recently, the occurrence of the H5N1 strain of the high pathogenic avian influenza has raised concerns regarding the potential impact on wild birds, domestic poultry, and human health should it be introduced into the United States. It is thought that a change occurred in a low pathogenic avian influenza virus of wild birds, allowing the virus to infect chickens, followed by further change into the H5N1 strain of the high pathogenic avian influenza. The H5N1 strain of high pathogenic avian influence has been circulating in Asian poultry and fowl resulting in death to those species. The H5N1 strain of the high pathogenic avian influenza virus likely underwent further change allowing infection in additional species of birds, mammals, and humans. More recently, this virus moved back into wild birds resulting in mortality of some species of waterfowl and other birds. This is only the second time in history that the high pathogenic form of the avian influenza virus has been recorded in wild birds. Numerous potential routes for introduction of the virus into the United States exists, including the illegal movement of domestic or wild birds, contaminated products, infected travelers, and the migration of infected wild birds. WS has been one of several agencies and organizations conducting surveillance for the avian influenza virus in migrating birds (USDA 2006). The nationwide surveillance effort has detected some instances of low pathogenic avian influenza viruses, as was expected given that waterfowl and shorebirds are considered the natural reservoirs for avian influenza. Tens of thousands of birds have been tested, but there has been no evidence of the highly pathogenic form of the H5N1 virus in North America. Currently, there is no evidence to suggest avian influenza has negatively affected bird populations in North America. As stated previously, most strains of avian influenza do not cause severe illnesses or death in bird populations.

Bird Damage Should Be Managed By Private Nuisance Wildlife Control Agents

Wildlife control agents and private entities could be contacted to reduce bird damage when deemed appropriate by the resource owner. The TWRA maintains a website of nuisance wildlife trappers in the

State[13]. In addition, WS could refer persons requesting assistance to agents and/or private trappers under all of the alternatives fully evaluated in this EA.

WS Directive 3.101 provides guidance on establishing cooperative projects and interfacing with private businesses. WS only responds to requests for assistance received. When responding to requests for assistance, WS would inform requesters that other service providers, including private entities, might be available to provide assistance.

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 B, 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

[13]The website can be accessed at https://twra.state.tn.us/ADC/Pages/Login/ViewActivePermits.aspx; accessed October 1, 2014.

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 small game hunting in general, lead contamination from such sources would be minimal to nonexistent.

Since 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 since 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*b*, 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.

A Site Specific Analysis Should Be Made For Every Location Where Bird Damage Management Could Occur

The underlying intent for preparing an EA is to determine if a proposed action might have a significant impact on the human environment. WS' EA development process is issue driven, meaning issues that were raised during the interdisciplinary process and through public involvement that were substantive, were used to drive the analysis and determine the significance of the environmental impacts of the proposed action and the alternatives; 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. In addition to the analysis contained in this EA, WS' personnel use the WS Decision Model (Slate et al. 1992) described in Chapter 3 as a site-specific tool to develop the most appropriate strategy at each location. The WS Decision Model is an analytical thought process used by WS' personnel for evaluating and responding to requests for assistance.

As discussed previously, one EA analyzing effects for the entire State would provide a more comprehensive and less redundant analysis than multiple EAs covering smaller areas. A single EA would also allow for a better cumulative impact analysis. 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.

CHAPTER 3: ALTERNATIVES

Chapter 3 contains a discussion of the alternatives that were developed to address the identified issues discussed in Chapter 2. Alternatives were developed for consideration based on the issues using the WS Decision model (Slate et al. 1992). The alternatives will receive detailed environmental impact analysis in Chapter 4 (Environmental Consequences). Chapter 3 also discusses alternatives considered but not analyzed in detail, with rationale. SOPs for bird damage management in Tennessee are also discussed in Chapter 3.

3.1 DESCRIPTION OF THE ALTERNATIVES

The following alternatives were developed 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 Tennessee. A major goal of the program would be to alleviate and prevent bird damage and to reduce threats to human safety[14]. To meet this goal, WS, in consultation the USFWS, the TWRA, and the TVA 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 Tennessee regularly provides technical assistance to individuals, organizations, and other federal, state, and local government agencies for managing bird damage. Technical assistance 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. Between FY 2009 and FY 2013, WS has conducted 2,595 technical assistance projects in Tennessee associated with many of the bird species addressed in this assessment. 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

[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.

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.

The WS Decision Model (see WS Directive 2.201) described by Slate et al. (1992) depicts how WS' personnel would use a thought process for evaluating and responding to requests for assistance. WS' personnel would assess the problem and then evaluate the appropriateness and availability (legal and administrative) of strategies and methods based on biological, 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 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'

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

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 biological, 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, nest/egg destruction, lure crops, visual deterrents, live traps, translocation, exclusionary devices, frightening devices, alpha chloralose, reproductive inhibitors, and chemical repellents (see Appendix B 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, 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. For some

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

bird species (*e.g.*, waterfowl, turkeys, crows, doves), lethal take can occur during a hunting season that the TWRA implements. In most cases, the use of non-lethal dispersal methods and the destruction of inactive nests would not require a permit from the USFWS and/or the TWRA.

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 B 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 since 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 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.

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

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 associated with birds 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 B 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, 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, a depredation permit could be issued 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 TWRA, 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 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 B would be available for use by other agencies and private entities to manage damage and threats associated with birds. All methods described in Appendix B 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 by the interagency team. 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 B 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 alleviate the damage situation or reduce threats to human safety at each damage situation, lethal methods would be employed to alleviate 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 add 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 alleviate damage caused by birds in Tennessee. Only those methods discussed in Appendix B 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, 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.

Although some people may disagree, the destruction of active nests is often considered a non-lethal method. If considered a non-lethal method, the take of nests and eggs could occur under this alternative. Since the destruction of nests and eggs would be prohibited by the MBTA, the USFWS would still be required to issue depredation permits for the take of bird nests under this alternative, when required. The USFWS and/or the TWRA could continue to issue depredation permits to those people experiencing damage or threats associated with birds under this alternative. Therefore, the lethal take of birds could continue to occur under this alternative. The number of nests of each species of birds addressed in this EA that would be destroyed to address damage and threats under this alternative would likely be similar to the levels analyzed under the proposed action.

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 under this alternative since no take of birds would occur unless nests or eggs were destroyed.

In situations where non-lethal methods were impractical or ineffective to alleviate damages, WS could refer requests for information regarding lethal methods to the TWRA, 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 alleviate damage caused by birds, those methods would be used or recommended under the proposed action. Since 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 since the take of birds and the destruction of nests could continue at the levels analyzed in the proposed action alternative. The USFWS and/or the TWRA 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*b*, 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.

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 could 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 TWRA, and/or the property owner where the translocated birds would be placed prior to live-capture and translocation.

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 TWRA; therefore, the translocation of birds by WS would only occur as directed by those agencies. When requested by the USFWS and/or the TWRA, 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. Since WS does not have the authority to translocate birds in the State unless permitted by the USFWS and/or the TWRA, 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 alleviate 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), and 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 Rock Pigeons; however, the only reproductive inhibitor currently available in Tennessee is OvoControl P, a formulation of nicarbazin, which is used 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.

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 TWRA 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, 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 TWRA 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.

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 animal 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.

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

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

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

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

- 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.*, late night or 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 TDA, 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 alleviate damage or threats to human safety would be agreed upon 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.

Issue 6 - Effects of Bird Damage Management Activities on the Regulated Harvest of Birds

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

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

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

- WS' activities to manage damage and threats caused by birds would be coordinated with the USFWS and the TWRA.

- WS' lethal take of birds would be reported to and monitored by the USFWS and/or the TWRA to ensure WS' take was considered as part of management objectives for those bird species in the State.

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

- WS would continue to recommend the use of legal hunting practices to address local populations in areas where hunting was permitted.

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. The following resource values in the State are not expected to be significantly impacted by any of the alternatives analyzed: soils, geology, minerals, water quality/quantity, flood plains, wetlands, critical habitats (areas listed in T&E species recovery plans), visual resources, air quality, prime and unique farmlands, aquatic resources, timber, and range. Those resources will not be analyzed further.

The activities proposed in the alternatives would have a negligible effect on atmospheric conditions including the global climate. Meaningful direct or indirect emissions of greenhouse gases would not occur because of any of the alternatives. Those alternatives would meet the requirements of applicable laws, regulations, and Executive Orders including the Clean Air Act and Executive Order 13514.

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 TVA, the USFWS, the TDA, and the TWRA.

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 TWRA to ensure activities occurred within management objectives for those species. WS would submit annual activity reports to the USFWS. The USFWS would monitor the total take of birds from all sources and would factor in survival rates from predation, disease, and other mortality data. Ongoing contact with the USFWS and the TWRA 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, nest/egg destruction, exclusionary devices, frightening devices, nets, and chemical repellents (see Appendix B 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, 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*b*), 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 would 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 since 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*b*, 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 since 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 use of lethal methods could result in local reductions of birds in the area where damage or threats were occurring. The number of birds removed from the 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 since a reduction in the number of birds at a location leads to a reduction in damage, which would be applicable whether using lethal or non-lethal methods. The use of lethal methods has been successful in reducing bird damage (Boyd and Hall 1987, Gorenzel et al. 2000). 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.

The avicide DRC-1339 could also be used under the proposed action and applied as part of an integrated approach. The intent in using DRC-1339 would be to reduce the number of birds present at a location where damages or threats of damage were occurring. Reducing the number of birds at a location where damage or threats were occurring either using non-lethal methods or lethal methods could lead to a reduction in damage. The dispersal of birds using non-lethal methods can reduce the number of birds using a location, which has been correlated with a reduction in damage occurring at that location (Avery et al. 2008*b*, Chipman et al. 2008). This scenario could occur if lethal methods were employed. Similarly, the use of DRC-1339 is intended to reduce the number of birds using a location. 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.

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 B 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 B often requires repeated application to discourage birds from returning to locations, which increases costs, moves birds to other areas where they could cause damage, and are temporary if conditions where damage was occurring remains unchanged. Dispersing and the relocating of birds could be viewed as moving 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 B. 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. The USFWS has evaluated and implemented long-term approaches to managing resident Canada Goose and Double-crested Cormorant populations with the intent of reducing damage associated with those species (USFWS 2003, USFWS 2005). 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*b*, 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*b*) 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*b*). 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*b*) 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 TWRA 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 Tennessee. 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 B 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.

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.

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 B 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.

Therefore, the USFWS could: 1) deny WS' application for a depredation 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. 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. The potential impacts on the populations of target bird species from the implementation of the proposed action are analyzed for each species below.

As previously stated, lethal take of birds can occur either without a permit if those species are non-native, during hunting seasons, under depredation/control orders, or through the issuance of depredation permits by the USFWS. The USFWS issues permits for those species of birds protected under the MBTA while the TWRA may issue permits for non-migratory resident bird species, such as Wild Turkey. Management actions taken by non-federal entities would be considered the *environmental status quo*.

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. Nest and egg destruction methods are considered non-lethal when conducted before the development of an embryo. 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 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 nesting activity and WS would destroy nests/eggs at the localized level only. As with the lethal take of birds, the USFWS must authorize the take of nests. Therefore, the number of nests that WS destroys would occur at the discretion of the USFWS.

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, 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 TWRA, 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 TWRA, and/or the property owner where the translocated birds would be placed prior to live-capture. When authorized by the USFWS and/or the TWRA, 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.

SNOW GOOSE BIOLOGY AND POPULATION IMPACT ANALYSIS

The Snow Goose is a medium to large-sized goose and one of the most abundant species of waterfowl in the world (Mowbray et al. 2000). There are two recognized subspecies: Lesser Snow Goose and Greater Snow Goose. The Lesser Snow Goose is the smaller of the two subspecies and dimorphic, with two color phases. The light phase goose has a white plumage and the dark phase goose looks almost blue. Until recently, the two color morphs were once thought to be two separate species (Mowbray et al. 2000). The Greater Snow Goose is very similar to the white phase Lesser Snow Goose, only slightly larger in size.

The two subspecies are similar in many ways, but vary in geographical range. Both subspecies breed in large colonies in the subarctic and arctic tundra (Mowbray et al. 2000). The Greater Snow Goose makes up the Eastern Population while the Lesser Snow Goose makes up the Midcontinental and Western Populations (Mowbray et al. 2000). There is also a variation among color morphs of the Lesser Snow Goose. While it is not uncommon for Lesser Snow Goose populations to be mixed, the highest proportion of blue morph Snow Geese breed on the southwest coast of Baffin Island, Nanavut, Canada (Mowbray et al. 2000). There is also some geographical variation throughout the wintering grounds as migration patterns roughly parallel longitudes from the breeding colonies (Mowbray et al. 2000).

The Midcontinental Population of Lesser Snow Geese are the most often observed in Tennessee, although Greater Snow Geese have also been seen. During the 2014 midwinter survey, the Midcontinental Population of Lesser Snow Geese was estimated at around 3.8 million geese, a 17% decrease from the 2013 estimate (USFWS 2014*c*). Since 2005, the survey has indicated an increase of 7% annually (USFWS 2014*c*). The Greater Snow Goose population has been estimated at around 796,000 geese, showing no trend over the past 10 years, indicating a stable population (USFWS 2014*c*).

Like many waterfowl species, hunters can harvest Snow Geese in Tennessee during a regular hunting season that traditionally occurs during the fall migration period of waterfowl. However, hunters can also harvest Snow Geese during their spring migration period in Tennessee under a Conservation Order established by the USFWS (see 50 CFR 21.60) and authorized under the Arctic Tundra Habitat Emergency Conservation Act (Public Law 106-108, Nov. 24, 1999, 113 Stat. 1491). The Conservation Order is intended to allow for the maximum number of Snow Geese to be taken annually in attempts to reduce the overall population of snow geese. During the regular harvest season and during the Conservation Order season up to 20 geese can be harvested daily with no possession limit and during the Conservation Order season, expanded hunting hours and special methods are allowed (unplugged shotguns and electric calls) (TWRA 2014*a*). The overall population of Snow Geese has increased dramatically since the mid-1970s and has reached historic highs across their breeding and wintering range (Mowbray et al. 2000). The current population level of snow geese has led to serious damage of its arctic breeding habitat, and in some areas its wintering habitat (Mowbray et al. 2000). Current populations could be considered environmentally unsustainable (Mowbray et al. 2000). Despite the introduction of special seasons, biologists remain concerned about their high population (USFWS 2014*c*).

The primary conflict with Snow Geese in Tennessee arises with large flocks on or near airports. As a gregarious species with high population numbers, some flocks can reach hundreds of thousands of individuals. Large-sized birds in large numbers can create a severe threat risk to aviation. For this reason, WS anticipates taking up to 100 Snow Geese to alleviate the threat of damage. The take of up to 100 individuals would not affect the overall population of Snow Geese; however, any take would be authorized by the USFWS and would occur within allowable take levels to ensure desired population objectives for the species were achieved.

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. There are seven recognized subspecies of Canada Geese found in North America (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 is divided into four administrative units: the Atlantic, Mississippi, Central, and Pacific Flyway Councils. Tennessee is considered part of the Mississippi Flyway Council; although, there is occasionally some overlap in the easternmost portion of the State from species traveling the Atlantic Flyway. The Mississippi Flyway is comprised of 14 states in the United States and three Canadian Provinces. 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 (USFWS 2005). Canada Geese did not historically breed in many of the states in the southern United States. The native breeding populations of Canada Geese in the United States were nearly extirpated following settlement in the 19th century (Mississippi Flyway Council 1996, USFWS 2005). 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. Due to those restoration and pioneering efforts, Canada Geese now breed and reside throughout the year in every state, including Tennessee (Mowbray et al. 2002, USFWS 2005). 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 (USFWS 2005).

One of the Canada Geese subspecies that historically could be found breeding in the central United States and southern Canada was the Giant Canada Goose (*Branta canadensis maxima*). At the time of European settlement, the nesting range of the Giant Canada Goose subspecies probably extended from central Alberta, Saskatchewan, and Manitoba, south to central Kansas and Missouri, and east to the shores of Lake Erie (USFWS 2005). In Tennessee, a breeding population of the Giant Canada Goose subspecies likely historically occurred along the Mississippi River in far western Tennessee but geese likely did not breed in other areas of the State (USFWS 2005). Historical accounts of Canada Geese in Tennessee indicate the only breeding population was at Reelfoot Lake in western Tennessee until the 1950s when someone brought a dozen geese from North Carolina into the State (Mississippi Flyway Council 1996). These geese propagated and eventually spread to Old Hickory Reservoir in central Tennessee (Mississippi Flyway Council 1996). The TWRA then initiated a propagation program in the 1960s on Old Hickory

Reservoir (Mississippi Flyway Council Technical Section 1996). In cooperation with the TVA and with additional release efforts by the USFWS, resident Canada Goose populations were established throughout Middle and East Tennessee by the early 1980s and can now be found throughout the State (Mississippi Flyway Council 1996).

Other subspecies of Canada Geese augment the breeding population of Canada Geese in the State during the migration periods and during the winter. Therefore, there are two behaviorally distinct types of Canada Goose populations that may be present in the State depending on the time of year. The two distinct types of geese that could be present are "*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 one of several criteria is met. Those criteria include geese that nest and/or reside on a year round basis within the contiguous United States. Those geese that nest within the lower 48 States during the months of March, April, May, or June and those geese that reside within the lower 48 States and the District of Columbia in the months of April, May, June, July, and August (see 50 CFR 21.11) (Rusch et al. 1995, Ankney 1996, USFWS 2005). The Mississippi Flyway Council defines resident Canada Geese as geese nesting in states comprising the Mississippi Flyway as well as Canada south of latitude 50° N in Ontario and 54° N in Manitoba (Mississippi Flyway Council 1996). 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.

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 (USFWS 2005). 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).

Most geese found in the Mississippi Flyway are of the Giant Canada Goose subspecies collectively referred to as the Mississippi Flyway Giant Population (MFGP). In the Flyway, resident Canada Geese were nearly extirpated by the early 1930s through overexploitation and habitat loss. Resident Canada Goose restoration efforts began in the 1980s by federal, state, local, and private entities and are the foundation of the increasing population trends observed currently (Mississippi Flyway Council 1996). Spring surveys conducted in 2014 indicated there were 1.46 million Canada Geese in the Mississippi Flyway (USFWS 2014*c*). The 2014 spring estimate was 9% lower than the estimate during the previous breeding season (see Figure 4.1). The average annual growth rate has slowed down in recent following many years of increasing trends (USFWS 2014*c*). However, the resident Canada goose population in the Flyway is considered an over-abundant population (USFWS 2014*c*).

During 2004, the statewide population of resident Canada Geese in the State was estimated at 53,254, with a population objective of 45,000 geese (USFWS 2005). During 2008, the statewide breeding population was estimated at 71,720 geese (Mississippi Flyway Council 2008), which exceeds the statewide population objective by 59%. In Tennessee, the number of resident Canada Geese observed along routes surveyed during the BBS have shown an increasing trend, estimated at 20.9% annually between 1966 and 2012, and 20.8% annually from 2002 through 2012 (Sauer et al. 2014).

In Tennessee, 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. Non-breeding resident Canada geese that have failed nesting attempts sometimes move to other areas in late spring prior to molting (Nelson and Oetting 1998).

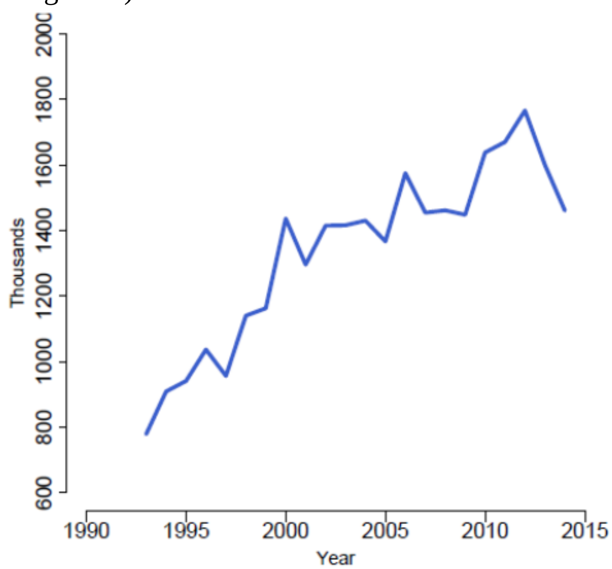


Figure 4.1 - Number of breeding Canada Geese in the Mississippi Flyway, 1993-2012 (USFWS 2012)

As resident goose populations have increased across the United States, including the resident population in Tennessee, the number of requests for assistance to manage damage associated with geese has also increased (USFWS 2005). Damage and the threat of damage associated with increasing populations of resident Canada Geese are well documented (*e.g*., see Mississippi Flyway Council 1996, USFWS 2005, 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 1996, USFWS 2005, 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 1996, USFWS 2005, 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 1996, USFWS 2005, 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 1996, USFWS 2005, Atlantic Flyway Council 2011).

The Mississippi Flyway Council developed a management plan for resident Canada Geese in the Mississippi Flyway during 1996 to help manage harvest and manage human/goose conflicts. The Mississippi Flyway Giant Canada Goose Management Plan outlines the main goals relating to resident Canada Geese in the Mississippi Flyway (Mississippi Flyway Council 1996). The Giant Canada Goose plan outlines the main goal of all agencies involved "*...to manage the population…at a level that provides* *maximum recreational opportunities consistent with social acceptability*" (Mississippi Flyway Council 1996). There are three main subject areas covered in the Plan as those subject areas relate to population management focusing on population objectives, harvest management, and population control. Population objectives, as outlined in the management plan, are to maintain a population of approximately 1 million giant Canada Geese, as measured by coordinated spring surveys, distributed in the Flyway in proportion to state and provincial objectives. During development of the management plan, the population of resident MFGP was estimated at over 1 million geese (Mississippi Flyway Council 1996). The spring 2014 estimate for the MFGP resident Canada Goose population was estimated at almost 1.5 million geese, which was 9% less than the 2013 estimate of 1.6 million geese (USFWS 2014*c*), but still exceeded the population objective recommended by the Mississippi Flyway Council in their resident Canada Goose management plan (Mississippi Flyway Council 1996).

Harvest objectives are to provide maximum harvest opportunity for giant Canada Geese that is consistent with the population objectives identified in the Plan, the objectives for other Canada Geese populations in the Flyway, and the control of over-abundant goose populations in areas with high human/goose conflicts. Population management objectives involving Canada Geese were to manage local populations of giant Canada Geese where they create conflicts, such as endangering human health or safety, damaging crops, damaging habitats important to other wildlife populations, or creating other injurious or nuisance situations (Mississippi Flyway Council 1996).

To address the increasing population of resident Canada Geese and the personal and public property damage and public health concerns associated with this increase, the USFWS developed a FEIS that evaluated alternative strategies to reduce, manage, and control the population and related damages (USFWS 2005). During the development of the FEIS evaluating management strategies for the resident Canada goose population, the USFWS estimated the resident Canada goose population at 3.2 million birds in the United States. The population estimate was approximately 30% to 35% above the number of geese the states believed to be acceptable based on their needs to manage conflicts and problems caused by resident Canada geese (USFWS 2005). Under the selected alternative in the resident Canada Goose FEIS, the USFWS established several mechanisms to allow the States to further manage resident goose populations and goose damage (USFWS 2005).

The selected alternative in the FEIS established regulations that created specific control and depredation orders designed to address resident Canada Goose depredation, damage, and conflicts. The selected alternative also provided expanded hunting methods and opportunities to increase the number of resident Canada Geese harvested during existing September seasons[18] and authorized the implementation of a resident Canada Geese population control program. More specifically, the selected alternative in the FEIS modified existing regulations by including the definition of a resident Canada goose (see 50 CFR 20.11, 50 CFR 21.3). The FEIS also made modifications by allowing the use of shotguns holding more than three shells during resident Canada goose seasons, and by allowing the use of electronic calls during harvest seasons targeting resident Canada geese (see 50 CFR 20.21). The FEIS 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 FEIS added 50 CFR 21.61 to establish the resident Canada goose population control program.

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 2009 through FY 2013, WS in Tennessee employed several different non-lethal techniques to capture or disperse nuisance Canada Geese

[18]The September hunting season for Canada geese is intended to target resident geese before migratory geese arrive in the State

including alpha chloralose, vehicles, firearms, lasers, nets, pyrotechnics, human presence, paintballs, spotlights, and a variety of live-capture traps. Using non-lethal methods, the WS program in Tennessee dispersed 17,834 geese and translocated 5,401 geese from FY 2009 through FY 2013. In addition, WS employed lethal methods to take 4,435 geese in response to damage or threats of damage. Table 4.1 lists the number of geese addressed by WS to alleviate damage or threats of damage, as well as hunter harvests from 2009 through 2013.

Based on the number of requests received for assistance previously 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 the proposed action, the nests and/or eggs of resident Canada Geese could be destroyed by WS as part of an integrated approach to managing damage, with up to 1,000 nests destroyed annually by WS.

Table 4.1 – Canada Geese addressed in Tennessee from 2009 to 2013

Year	Addressed by WS[1]			Harvest Season[2]	
	Take	Translocated	Dispersed	September	Regular
2009	795	1,704	1,719	14,400	28,300
2010	442	1,386	2,919	6,000	23,100
2011	184	1,270	2,274	13,100	7,800
2012	689	618	5,415	14,800	14,800
2013	2,325	423	5,507	4,000	8,000
TOTAL	**4,435**	**5,401**	**17,834**	**52,300**	**82,000**

[1]Reported by FY

[2]Data adapted from Raftovich (2011), Raftovich (2012), Raftovich (2014)

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.

If the statewide goose population remained relatively stable from the 2008 estimate of 71,720 geese, the annual take of 3,000 geese by WS would represent 4.2% of the estimated statewide goose population in 2008. However, the resident goose population in the State has likely increased from the 2008 estimate based on the 20.8% annual increase observed from 2002 through 2012 in the State during the BBS.

From 2009 through 2013, hunters harvested 52,300 geese in the State during the September hunting season intended to target resident populations of Canada Geese. During the September hunting season in the State, hunters have harvested an average of 10,460 geese per year from 2009 through 2013. The average annual harvest of geese during the September hunting season represents 14.6% of the statewide population of geese using the 2008 goose population estimated at 71,720 geese. During the combined goose seasons in the State during 2013, an estimated 12,000 geese were harvested, which represents nearly 16.7% of the estimated statewide population in 2013; however, the geese that hunters harvest during the regular season likely includes some migratory geese. The number of resident geese that hunters harvest during the regular hunting season in the State is unknown.

Considering the cumulative take of Canada geese in Tennessee for the past five years, WS' take of geese equaled 3.3% of the total estimated cumulative take by all entities. Despite the cumulative take of resident Canada geese occurring in the State, data from the BBS continues to indicate the resident goose population in the State is increasing. As stated previously, the population goal in Tennessee is 45,000 resident Canada geese. The take of 3,000 geese by WS would represent 6.7% of the population goal if the goal were reached in the State. Under the proposed action alternative, WS would continue to translocate and release geese based on the availability of suitable habitat and on the willingness of landowners and resource managers to accept geese on property they own or manage. Due to the continued increase in resident Canada Goose populations in Tennessee, the number of suitable release sites and the number of property owners willing to accept geese as part of a translocation program have decreased. The number of geese translocated by WS in the State declined every year from FY 2009 through FY 2013 due to a lack of adequate release sites and lack of interest by property owners; however, WS would continue to translocate geese when WS can identify suitable release sites with willing landowners.

All take by WS occurs under depredation permits issued by the USFWS. WS' take of up to 3,000 geese annually would be dependent upon the USFWS authorizing the take at that level annually. Take by WS would not exceed the permitted take allowed under depredation permits issued by the USFWS. With management authority for migratory birds, the USFWS can adjust allowed take through the regulated harvest season and take under depredation permits and orders to meet population objectives. Therefore, the USFWS 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 Canada 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 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 removal and destruction should have little adverse effect on the resident goose population in Tennessee. In general, nest and egg destruction methods are non-lethal when conducted before the development of an embryo. Additionally, 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, this activity 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 very 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 resident Canada Goose management FEIS developed by the USFWS concluded that a nest and egg depredation order would have minimal impacts on goose populations with only localized reductions in the number of geese occurring (USFWS 2005).

The reproductive inhibitor known as nicarbazin has been registered with the EPA for use to manage Canada Goose and domestic waterfowl populations on a local scale by reducing the likelihood that eggs laid will hatch. Nicarbazin, as a reproductive inhibitor for geese and domestic waterfowl, has been registered with the EPA as a pesticide pursuant to the FIFRA under the trade name OvoControl® G (Innolytics, LLC, Rancho Sante Fe, California). Label requirements of OvoControl® G restrict the application of the product to urban areas, which limits the extent of the products use for reducing localized waterfowl populations. Based on current information, WS' use or recommendation of nicarbazin formulated under the trade name OvoControl® G would not adversely affect Canada Goose populations in Tennessee since WS' activities would not be additive to those activities that could occur in the absence of WS' use of the product. 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 birds are not fed an appropriate dose of nicarbazin daily, the reduction in the population could be fully reversed if treated bait is no longer supplied and other conditions (*e.g.*, food, disease) are favorable for population growth. At this time, OvoControl® G is not registered for use on Canada Geese in Tennessee, but there is the possibility that it may be in the future.

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). Most authorities currently recognize 11 subspecies of Canada Geese, which differ primarily in body size and color (Bellrose 1980). 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 be found in the State during the migration periods and during the winter occur primarily from three breeding populations. Those populations include the MFGP, the Eastern Prairie Population (EPP), and the Southern James Bay Population (SJBP), with geese from the Mississippi Valley population possibly wintering in the extreme northwest corner of the State. The wintering migratory population in Tennessee is mostly comprised of geese from the MFGP and the SJBP (USFWS 2014*c*).

The SJBP of geese nest primarily on Akimiski Island and in the Hudson Bay Lowlands to the west and south of James Bay in Canada (USFWS 2014*c*). The estimated number of breeding Canada Geese in the SJBP during the spring of 2014 was 78,200 geese, which was similar to the 2013 estimate of 60,900 geese. The total population index of 81,300 geese in 2014 was similar to the 2013 index of 64,100 geese. Neither of those indices of geese for the SJBP showed a trend over the 2004 to 2013 timespan (USFWS 2014*c*). Historically, large numbers of geese from the SJBP have wintered in Alabama, Tennessee, Kentucky, North Carolina, and South Carolina, but there has been a drastic decline in the number of migrant geese arriving in this area in the past two decades, particularly at Wheeler National Wildlife Refuge in Alabama (Abraham and Warr 2003). Abraham and Warr (2003) suggested the widespread increase of resident Canada geese, mild winters, and changing farm practices are factors influencing the decline in the number of migrants arriving in the area (*i.e.*, migrants may not be travelling as far south as they did historically).

The Mississippi Flyway Council and the Atlantic Flyway Council jointly developed a similar management plan for the SJBP of migratory Canada Geese with management objectives focused on population size, distribution, and habitat management (Abraham and Warr 2003). The purpose of this plan was "*…to establish management practices, determine research needs, and promote action to properly manage the Southern James Bay Population (SJBP) of Canada Geese*" (Abraham and Warr 2003).

The MFGP of Canada Geese nest across the Mississippi Flyway and some migratory movements likely occur. Based on surveys conducted in the spring of 2014, the MFGP of geese was estimated at 1.46 million geese, which was 9% lower than the 2013 estimate of 1.6 million geese (USFWS 2014*c*). The MFGP is considered over-abundant in the Flyway (USFWS 2014*c*) and continues to exceed the population objective for the Flyway (Mississippi Flyway Council 1996, USFWS 2005).

As discussed previously, the MFGP and the SJBP of Canada Geese can be found wintering or migrating through the State. The number of Canada geese observed in the State during the CBC has shown an overall declining trend since 1966 with a relative stable trend since late-1990s (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 lethally take 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, requests could be received to reduce damage or threats to other resources. Based on an increase in the number of requests received for the lethal take of geese during those periods of time when geese present in the State would be considered migratory, WS may take up to 200 geese annually during those periods when geese could be considered migratory.

Under frameworks for the harvest of waterfowl developed by the USFWS, the TWRA allows hunters to harvest Canada Geese during regulated seasons in the State. From 2009 to 2013, hunters harvested an estimated 82,000 geese, or an average of 16,400 geese per year, in the State during the regular season when those geese present in the State could be migratory geese (see Table 4.1). 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 by other entities in the State is unknown. From 2009 to 2013, hunters harvested an average of 16,400 geese during the regular hunting season. If 38% of those geese harvested during the regular season between 2009 and 2013 were migratory geese, hunters harvested 6,232 migratory geese per year on average in the State. WS' take of up to 200 geese that could be migratory would represent 3.2% of the average number of geese taken during the regular hunting season that could be considered migratory.

The number of migratory geese potentially removed by WS on an annual basis in Tennessee 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 the proposed action alternative would involve the resident Canada geese population. WS' proposed take could be considered of low magnitude when compared with the number of geese that are harvested 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. The take of migratory Canada geese could only occur when authorized through the issuance of depredation permits by the USFWS. The permitting of the take by the USFWS pursuant to the MBTA 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 IMPACT 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 Tennessee, 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 Tennessee during the BBS has increased an estimated 10.2% each year since 1966 and 6.9% annually from 2002 through 2012 (Sauer et al. 2014). Across all BBS routes surveyed in the United States, the number of Mallards observed annually has increased at an estimated rate of 1.4% annually since 1966 (Sauer et al. 2014). Breeding population estimates provided by the USFWS (2014*b*) estimate Mallard abundance in areas surveyed during the spring to be around 10.4 million birds. The statewide population of Mallards is unknown. The number of Mallards observed in the State during the CBC has shown a slightly decreasing trend since 1966, with a notable amount of cyclic survey results (National Audubon Society 2010).

Like other waterfowl species, hunters can harvest Mallards during a regulated season in the State. An estimated 92,700 Mallards were harvested in the State during 2012 and 94,094 Mallards were harvested in the State during 2013 (Raftovich et al. 2014). Since 2009, hunters have harvested an estimated 504,375 mallards in the State during the regulated season (see Table 4.2), which is an average of 100,875 Mallards harvested annually from 2009 through 2013.

In addition to the harvest of Mallards during the hunting seasons, the WS program in Tennessee lethally removed 137 Mallards to alleviate damage from FY 2009 through FY 2013. In Tennessee, 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 4.2 lists the number of Mallards addressed by WS to alleviate damage or threats of damage. The WS program has employed non-lethal harassment methods to disperse 1,104 Mallards in the State. WS has also live-captured and translocated 14 Mallards between FY 2009 and FY 2013. No lethal take of Mallards pursuant to depredation permits issued by the USFWS has occurred previously.

Table 4.2 – Mallards addressed in Tennessee from 2009 to 2013

Year	WS[1]			TN Hunter Harvest[2]
	Take	Translocated	Dispersed	
2009	56	1	7	128,946
2010	36	0	270	112,500
2011	22	0	43	76,135
2012	13	13	258	92,700
2013	10	0	526	94,094
TOTAL	**137**	**14**	**1,104**	**504,375**

[1]Reported by FY

[2]information from Raftovich et al. (2011), Raftovich et al. (2012), Raftovich et al. (2014)

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 the proposed action. Since 2009, the average number of Mallards harvested in the State has been 100,875 birds. Based on this average, the annual take of 300 Mallards by WS would only represent 0.3% 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 300 nests annually in the State. All lethal take or destruction of nests/eggs by WS would occur pursuant to depredation permits issued by the USFWS, which would ensure the USFWS 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, the proposed actions of WS would not limit the ability of hunters to harvest Mallards in the State. WS' proposed take would be a limited component of the overall harvest of Mallards occurring annually.

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, were derived from the Mallard (Drilling et al. 2002).

Many waterfowl of domestic or semi-wild genetic backgrounds have been released by people 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 (2.5 to 3.5 pounds).

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 defined as a 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. Under Tennessee Code 70-4-412, "*it is unlawful to release any class of wildlife in Tennessee except in accordance with the rules and regulations promulgated by the commission.*"

Federal law does not protect domestic varieties of waterfowl (see 50 CFR 21), nor are domestic waterfowl specifically protected by State law in Tennessee. 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.

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 these domestic waterfowl species could provide some benefit to other native bird species since 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. Those birds often occur in areas where resident Canada Geese inhabit. Currently, there are no population estimates for domestic and feral waterfowl in Tennessee. Domestic and feral waterfowl are not protected by federal and state laws 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. The USFWS has recently changed the regulations governing Muscovy Ducks. Because Muscovy Ducks now 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 Tennessee. 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 Tennessee. 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 depredation order to allow control of Muscovy Ducks, their nests, and eggs without a permit.

People introduced Mute Swans to North America in the 1800s for 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 2009 through FY 2013, WS used non-lethal methods to address 43 feral waterfowl to alleviate damage and threats of damage (see Table 4.3). In addition, WS employed lethal methods to address 53 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.

Table 4.3 – Feral Waterfowl addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed/Translocated	Eggs/Nests Removed
2009	2	7	19
2010	12	27	0
2011	3	0	0
2012	3	8	0
2013	33	1	116
TOTAL	**53**	**43**	**135**

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 300 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 since 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 to the natural environment.

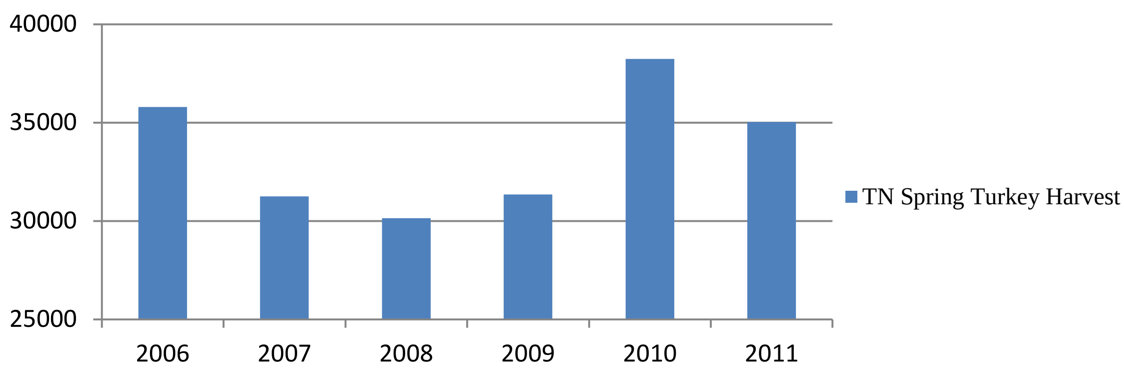
WILD TURKEY BIOLOGY AND POPULATION IMPACT ANALYSIS

A non-migratory bird, Wild Turkeys can be found from southern Canada south across the United States (Eaton 1992). There are five distinct subspecies of Wild Turkeys found in the United States: Eastern Wild Turkey, Osceola Wild Turkey, Gould's Wild Turkey, Merriam's Wild Turkey, and the Rio Grande Wild Turkey (NWTF 2010*a*). Subspecies can interbreed, creating hybrid species where distribution ranges overlap. The only Wild Turkey found in Tennessee is the Eastern subspecies. The Eastern Wild Turkey subspecies is endemic to the eastern half of the United States and is the most abundant and most widely distributed subspecies (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, west to Texas, Missouri, Iowa, and Minnesota (Kennamer 2010). In the Eastern United States, Wild Turkeys inhabit hardwood, mixed, and pine forests foraging on a variety of acorns, fruits, seeds, and insects. There are an estimated 7 million Eastern Wild Turkeys in the United States and Canada (NWTF 2010*b*).

Like many eastern states, the Wild Turkey population in Tennessee saw a decline in the early 1900s, but after a successful restoration project, the Wild Turkey population in the State has made a successful rebound. Presently, turkeys occur statewide and populations are sufficient to allow for annual spring and fall hunting seasons (TWRA 2014*b*). The number of turkeys observed in areas surveyed in the State during the BBS has shown an increasing trend estimated at 19% since 1966, with a 20.3% annual increase observed from 2002 through 2012 (Sauer et al. 2014). The current population of turkeys in Tennessee is unknown, but the TWRA (2012) has estimated the population to be between 300,000 and 350,000 birds.

The number of turkeys harvested annually from 2006 through 2011 in the State during the spring season occurs in Figure 4.2. Since 2006, the highest number of turkeys harvested during the spring hunting season occurred in 2010 when hunters harvested 38,241 turkeys. The lowest harvest occurred in 2008 when hunters harvested 30,138 turkeys. From 2006 to 2011, hunters harvested an average of 33,633 turkeys in the State during the spring hunting season. Hunters harvested an average of 2,238 turkeys from 2006 through 2011during the fall hunting season.

Figure 4.2 - Tennessee Spring Turkey Harvest (2006-2011)



Requests for assistance received by the WS program in Tennessee 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.

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 TWRA manages and regulates Wild Turkeys as a game species in Tennessee. Since the MBTA does not provide protection to turkeys, the lethal take of turkeys does not require a depredation permit from the USFWS.

To alleviate damage or threats of damage in the State, the WS program has lethally removed three turkeys between FY 2009 and FY 2013. WS anticipates the possibility of receiving additional requests to conduct management activities related to Wild Turkey damage in addition to continuing efforts at airports in the State; therefore, WS anticipates the possibility of taking up to 300 Wild Turkeys in Tennessee in any single year. However, the take of Wild Turkeys in the State by WS would only occur at levels allowed by the TWRA. If WS had lethally removed 300 turkeys in FY 2008, the take would have represented 1% of the number of turkeys harvested in the State during the spring hunting season of that year, which was the lowest harvest level in the State between 2006 and 2011. With a population estimated around 300,000 individuals, the take of 300 turkeys in any year would represent 0.1% of the population in the State.

As stated previously, most requests received by WS in the State are associated with threats of turkeys at airports, which are restricted areas and the airport authorities for those airports do not allow hunting on airport property. The lethal removal of turkeys by WS would not reach a magnitude where the ability to harvest turkeys in the State during the regulated seasons would be affected. WS based this determination on the areas where requests for assistance were likely to occur and on the low magnitude of take that would likely occur when compared to the annual harvest of turkeys.

DOUBLE-CRESTED CORMORANT BIOLOGY AND POPULATION IMPACT ANALYSIS

Double-crested Cormorants are large fish-eating, colonial waterbirds widely distributed across North America (Hatch and Weseloh 1999). As stated in the cormorant management FEIS developed by the USFWS, the recent increase in the North American Double-crested Cormorant population, and subsequent range expansion, has been well documented along with concerns of negative impacts associated with the expanding cormorant population (USFWS 2003). Wires et al. (2001) and Jackson and Jackson (1995) have 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. There appears to be a correlation between increasing cormorant populations and growing concern about associated negative impacts, thus creating a very real management need to address those concerns (USFWS 2003, USFWS 2009, USFWS 2014*a*).

The Double-crested Cormorant is one of six species of cormorants breeding in North America and has the widest range (Hatch 1995). Double-crested Cormorants range throughout North America, from the Atlantic coast to the Pacific coast (USFWS 2003). During the last 20 years, the cormorant population has expanded to an estimated 372,000 nesting pairs, with the population (breeding and non-breeding birds) in the United States estimated to be greater than 1 million birds (Tyson et al. 1997). The USFWS estimated the continental population at approximately 2 million cormorants during the development of the cormorant management FEIS (USFWS 2003). Tyson et al. (1997) found that the cormorant population increased about 2.6% annually during the early 1990s. The greatest increase occurred 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. 1997). From the early 1970s to the early 1990s, the Atlantic population of cormorants has 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. 1997). The number of breeding pairs of cormorants in the Atlantic and Interior population was estimated at over 85,510 and

256,212 nesting pairs, respectively (Tyson et al. 1997). The breeding population in the southeastern United States has been estimated at 10,600 breeding pairs (Hunter et al. 2006).

Since 1966, cormorant populations have increased annually at an estimated 33.3% in areas surveyed across Tennessee during the BBS and 39.8% annually between 2002 and 2012 (Sauer et al. 2014). In all areas surveyed across the United States, cormorant populations have increased at an estimated 4.6% annually since 1966 and 9.5% annually between 2002 and 2012 (Sauer et al. 2014). The number of cormorants observed in areas of the State people surveyed during the CBC has fluctuated throughout the years, but is showing an overall increasing trend since 1966 (National Audubon Society 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 Conservation Plan is to maintain no more than 15,000 pairs of Double-crested Cormorants in the Southeast United States Region and no more than 1,000 breeding pairs occurring in the West Gulf Coastal Plain and Mississippi Alluvial Valley (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).

To address cormorant damage to aquaculture facilities and other resources, the USFWS, in cooperation with WS, prepared a FEIS that evaluated alternative strategies to managing cormorant populations in the United States (USFWS 2003, USFWS 2009, USFWS 2014*a*). The selected alternative in the FEIS modified the existing AQDO and established a PRDO that allow for the take of cormorants without a depredation permit when cormorants are committing or about to commit damage to those resource types. The modified AQDO allows cormorants to be taken in 13 States, including Tennessee, without a depredation permit to reduce depredation on aquaculture stock at private fish farms and state and federal fish hatcheries (see 50 CFR 21.47). The PRDO allows for the take of cormorants without a depredation permit in 24 states, including Tennessee, when those cormorants cause or pose a risk of adverse effects to public resources (*e.g.*, fish, wildlife, plants, and their habitats) (see 50 CFR 21.48). All other take of cormorants to alleviate damage or the threat of damage requires a depredation permit issued by the USFWS.

The cormorant management FEIS developed by the USFWS predicted the number of cormorants taken by authorized entities under the PRDO would increase by 4,140 cormorants per State above the take level that had occurred previously in each of the 24 States covered under the PRDO, including Tennessee (USFWS 2003). The FEIS estimated that authorized entities would lethally remove 99,360 cormorants annually pursuant to the PRDO in those 24 States where take would be authorized (USFWS 2003). The FEIS predicted the total combined take under the PRDO, the expanded AQDO, and take pursuant to depredation permits would result in the lethal take of 159,635 cormorants annually. The FEIS predicted the total combined take evaluated under the selected alternative would result in the authorized lethal take of up to 8.0% of the continental cormorant population on an annual basis (USFWS 2003).

This includes cormorants killed in Tennessee under the AQDO along with cormorants lethally removed pursuant to the PRDO and those cormorants lethally removed under depredation permit that the USFWS issues. Table 4.4 shows the cumulative take of cormorants from 2005 through 2012 under the depredation orders and under depredation permits in the 24 States included in the PRDO. On average, people have lethally removed 44,787 cormorants annually pursuant to the two depredation orders (PRDO and AQDO) and under depredation permits issued by the USFWS between 2005 and 2012, including those cormorants lethally removed in Tennessee. The USFWS (2009, 2014*a*) estimated the take of cormorants under the depredation orders and depredation permits involved primarily those cormorants that Tyson et al. (1997) considered a part of the Interior cormorant population, and to a lesser extent, the southern population. Tyson et al. (1997) considered those cormorants found in Tennessee to be a part of the Interior population of cormorants.

Table 4.4 – Double-crested Cormorant take in the 24 States included in the PRDO*

Year	Take by Depredation Order or Permit			TOTAL
	PRDO	AQDO	Depredation Permits	
2005	11,221	21,513	4,745	**37,479**
2006	21,043	32,057	3,435	**56,535**
2007	20,256	17,393	3,980	**41,629**
2008	18,889	17,561	5,102	**41,552**
2009	25,612	16,338	4,659	**46,609**
2010	18,637	14,632	6,883	**40,152**
2011	28,704	12,980	6,542	**48,226**
2012	26,313	14,216	5,583	**46,112**

*preliminary take data provided by the USFWS

As shown in Table 4.4, the annual take of cormorants from 2005 through 2012 has not exceeded 159,635 cormorants in any given year that the FEIS anticipated people would remove annually. The highest level of cormorant take occurred in 2006 when people removed 56,535 cormorants, which represents 35.4% of the 159,635 cormorants evaluated in the cormorant management FEIS. The FEIS determined an annual take of 159,635 cormorants annually would be sustainable at the state, regional, and national level (USFWS 2003, USFWS 2009, USFWS 2014*a*). The take that has occurred since the implementation of the preferred alternative in the FEIS that implemented the PRDO and modified the existing AQDO has only reached a high of 35.4% of the level evaluated in the FEIS, which determined the higher level of take would not significantly affect cormorant populations. Upon further evaluation, the USFWS determined the implementation of the preferred alternative in the FEIS that has allowed the annual take level of cormorants under the PRDO, the AQDO, and under depredation permits has not reached a level where undesired adverse effects to cormorant populations would occur (USFWS 2009, USFWS 2014*a*). The USFWS subsequently extended the expiration dates of the PRDO and the current AQDO in 2009 and again in 2014 (USFWS 2009, USFWS 2014*a*).

From FY 2009 through FY 2013, the WS program in Tennessee has not received requests for direct operational assistance associated with cormorants. Subsequently, no lethal take of cormorants to alleviate damage has occurred by WS in Tennessee. WS may occasionally receive requests for technical assistance or an entity may ask WS to provide a damage assessment as part of an application for a depredation permit from the USFWS. However, as cormorant numbers continue to increase in Tennessee, WS could receive requests for direct operational assistance. As part of direct operational assistance, WS could lethally remove cormorants to alleviate damage or threats of damage in the State. To address requests for assistance to manage damage associated with Double-crested Cormorants in the future, WS could kill up to 2,500 cormorants and destroy up to 1,000 nests, including eggs, in the State under the proposed action alternative to alleviate damage and threats. The Double-crested Cormorant management FEIS developed by the USFWS predicted the number of Double-crested Cormorants lethally removed by authorized entities under the selected alternative would increase (USFWS 2003). As cormorants are colonial birds, even one request for assistance could require the removal or dispersal of hundreds of birds to alleviate damage. In Tennessee, requests for assistance are likely to originate from airports and aquaculture facilities.

The total take of Double-crested Cormorants by all entities in the United States on an annual basis from 2005 through 2012 has not exceeded the predicted increased take evaluated and the total cumulative take authorized annually (159,636 birds) under the selected alternative in the FEIS (see Table 4.4). WS' proposed take of up to 2,500 Double-crested Cormorants annually to address damage and threats combined with the average take occurring under the PRDO, the AQDO, and depredation permits would not exceed this level of take (USFWS 2003, USFWS 2009, USFWS 2014*a*).

WS' proposed take of up to 1,000 double-crested cormorant nests is anticipated to have minimal effects on regional or continental cormorant populations (USFWS 2003, USFWS 2009, USFWS 2014*a*). The USFWS determined the destruction of nests, including the destruction of eggs, allowed under the PRDO and under permits would not reach a level where an undesired adverse effect on cormorant populations would occur (USFWS 2003). The USFWS further evaluated nest destruction activities from 2004 through 2012 and determined the number of nests destroyed since 2004 and the continued destruction of nests evaluated in the FEIS would not reach a magnitude that would cause undesired declines in cormorant populations (USFWS 2009, USFWS 2014*a*). Cormorants are a long-lived species, and egg-addling programs are anticipated to have minimal effects on regional or continental cormorant populations (USFWS 2003).

Bird band recovery models have been developed to estimate temporal trends in hatch-year, second-year, and after second-year survival of cormorants banded in the Great Lakes region from 1979 through 2006 (Seamans et al. 2012). The period evaluated encompassed the time of rapid cormorant population increase in the Great Lakes, the establishment of the AQDO in 1998 by the USFWS, and the establishment of the PRDO and changes to the AQDO implemented in 2003 by the USFWS. Survival in hatch-year birds decreased throughout the study period and negatively correlated with abundance estimates for cormorants in the Great Lakes area. Density-dependent factors may have led to the decline. However, there was also evidence that the depredation orders were contributing to the decreasing survival in hatch-year birds. The data was unclear on whether the depredation orders were reducing the survival of second-year or after second-year cormorants even though lethal removal of cormorants in the Great Lakes increased after the implementation of the depredation orders. Seamans et al. (2012) found that the survival rates of second-year and after second-year cormorants did decrease from 2004 through 2006 based on banding data, but survival rates for those two age classes were still within the range observed for previous years. Additional time may be required before the models used by Seamans et al. (2012) detect any changes in mortality rates resulting from the establishment of the PRDO and the modification of the AQDO that occurred in 2003 due to the lag effect.

Blackwell et al. (2000) examined the relationship between the number of fish-eating birds reported killed under depredation permits issued by the USFWS to aquaculture facilities in New York, New Jersey, and Pennsylvania and population trends of those bird species lethally removed within those respective States. Blackwell et al. (2000) found that the USFWS issued 26 depredation permits to nine facilities from 1985 through 1997 allowing the lethal take of eight species of fish-eating birds but only six species were reported killed to reduce aquaculture damage. Those species lethally taken under those permits included Black-crowned Night-Herons, Double-crested Cormorants, Great Blue Herons, Herring Gulls, Ring-billed Gulls, and Mallards. Blackwell et al. (2000) concluded the number of birds reported killed, relative to systematic long-term population trends, would have a negligible effect on the population status of those species.

As stated previously, the cormorant management FEIS developed by the USFWS predicted the number of cormorants taken by authorized entities under just the PRDO would total 4,140 cormorants per State in each of the States included in the PRDO (USFWS 2003). The take under the PRDO would be in addition to take occurring under the AQDO and under depredation permits. Furthermore, the USFWS predicted through the analyses that the authorized take of cormorants and their eggs for the management of Double-crested Cormorant damage would not significantly affect regional or continental Double-crested Cormorant populations (USFWS 2003, USFWS 2009, USFWS 2014*a*). This includes cormorants that people could kill in the State under depredation permits the USFWS issues.

GREAT BLUE HERON BIOLOGY AND POPULATION IMPACT ANALYSIS

The head of the Great Blue Heron is largely white with dark under parts and the body is primarily bluish in color. 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 Tennessee (Vennesland and Butler 2011). Great Blue Herons are most often located in freshwater and brackish marshes, lakes, rivers, and lagoons (MANEM Region Waterbird Working Group 2006). 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 Region Waterbird Working Group 2006). Great Blue Herons feed mainly on fish but they are also known to capture invertebrates, amphibians, reptiles, birds, and mammals (Vennesland and Butler 2011).

Great Blue Herons are showing an annual increase across all survey routes of the BBS and occurs year-round in Tennessee. Since 1966, the number of Great Blue Herons observed across the United States has increased at an annual rate of 1.3%, with a 1.9% annual increase occurring from 2002 through 2012 (Sauer et al. 2014). In Tennessee, herons observed on BBS routes are showing an increasing trend estimated at 10% annually since 1966 and 10.7% annually from 2002 through 2012 (Sauer et al. 2014). In the Central Hardwoods region (BCR 24), the number of herons observed has also shown an increasing trend along routes surveyed from 1966 through 2012 estimated at 3.8% annually (Sauer et al. 2014). In the Southeastern Coastal Plain region (BCR 27) and the Mississippi Alluvial Valley region (BCR 26), the number of herons observed in areas surveyed during the BBS has shown an annual increasing trend estimated at 1.9% and 3.6%, respectively, from 1966 through 2012 (Sauer et al. 2014). The highest annual increase has been observed in the Appalachian Mountains region (BCR 28) with an annual increase of 4.4% since 1966 (Sauer et al. 2014).

In 2006, the breeding population of Great Blue Herons was estimated at 69,331 breeding pairs or 138,662 adult herons in the southeastern United States (Hunter et al. 2006). 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 Mississippi Alluvial Valley region (BCR 26), and the Appalachian Mountains region (BCR 28), the breeding population of herons has been estimated at 26,700 breeding pairs, 14,000 breeding pairs, and 3,200 breeding pairs, respectively (Hunter et al. 2006). The breeding population in Tennessee is currently unknown. Herons observed overwintering in Tennessee during the CBC have shown an increasing trend (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*). They are also an occasional visitor to airfields where they can pose a strike risk to aircraft. To alleviate damage throughout Tennessee, WS has lethally removed 45 Great Blue Herons and employed non-lethal methods to disperse 28 Great Blue Herons from FY 2009 through FY 2013 (see Table 4.5). In addition to the take of herons by WS to alleviate damage or threats, the USFWS has issued depredation permits to other entities for the take of Great Blue Herons. During 2013, the USFWS authorized the lethal removal of up to 45 Great Blue Herons by entities other than WS in the State.

Table 4.5 – Great Blue Herons addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed
2009	5	3
2010	4	3
2011	15	4
2012	13	1
2013	8	17
TOTAL	**45**	**28**

A conservative estimate of Great Blue Herons across the Mississippi Alluvial Valley, the Southeastern Coastal Plain, and the Appalachian Mountains is 20,000 breeding pairs (40,000 individuals) (Hunter et al. 2006). With an increasing trend in populations, WS anticipates the annual take of up to 150 Great Blue Herons and up to 50 nests to alleviate damage and threats of damage in Tennessee. The take of 150 herons by WS in Tennessee would represent 0.4% of the conservative breeding population estimate across all BCRs or 0.1% of the breeding population estimate for the southeastern United States. If the USFWS continued to issue permits to entities other than WS for the lethal removal of up to 45 herons, the cumulative take of herons by WS and by other entities would represent 0.5% of the breeding population estimate across all BCRs and 0.1% of the breeding population estimate for the southeastern United States. The permitting of take by the USFWS ensures the cumulative take of herons in the southeastern United States, including the take proposed by WS in Tennessee under this assessment and other entities with a depredation permit, 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.

GREAT EGRET BIOLOGY AND POPULATION IMPACT ANALYSIS

Great Egrets are large white birds of intermediate size between the larger herons and smaller egrets commonly found in the United States (McCrimmon et al. 2011). They can be found in freshwater, estuarine, and marine wetlands (McCrimmon et al. 2011). Great Egrets are year-round residents throughout the Mississippi Alluvial Valley region and the Southeastern Coastal Plains region (McCrimmon et al. 2011). In Tennessee, they are more likely to be found in the western portion of the State, along the eastern shore of the Mississippi River (McCrimmon et al. 2011).

The overharvest of Great Egrets that occurred primarily from 1870 to 1910 for plumes and the millinery trade reduced the population in North America by >95% (McCrimmon et al. 2011). During surveys conducted in 1911 and 1912, the total known nesting population of Great Egrets was estimated at 1,000 to 1,500 breeding pairs in 13 colonies in seven states (McCrimmon et al. 2011). Following regulations that ended plume-hunting, Great Egret populations rapidly recovered with increases reported as early as the late 1920s and 1930s (McCrimmon et al. 2011).

Great Egret observations during the winter CBC in Tennessee have shown a relatively stable trend since 1966 (National Audubon Society 2010). The number of Great Egrets observed across all BBS routes of the Southeastern Coastal Plain region is showing an annual increasing trend estimated at 1.7% since 1966 (Sauer et al. 2014). Breeding populations of Great Egrets in the Central Hardwoods region, the Mississippi Alluvial Valley region, and the Appalachian Mountains region are also showing growing trends estimated at 14.8%, 10.3%, and 14.7%, respectively, since 2002 (Sauer et al. 2014). The Southeast United States Regional Waterbird Conservation Plan has estimated the Great Egret population at 28,244 breeding pairs in the Southeastern Coastal Plain and 25,000 in the Mississippi Alluvial Valley (Hunter et al. 2006), which include portions of western Tennessee. The population of Great Egrets in Tennessee likely fluctuates throughout the year and is probably highest during migration periods. The number of Great Egrets that winter and nest in the State is currently unknown.

Of the five tiers of action levels for waterbirds in the southeastern United States, Hunter et al. (2006) assigned Great Egrets 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 Hunter et al. (2006) considered above management levels and could require population management. The North American Waterbird Conservation Plan classifies the Great Egret in a category of conservation concern considered as currently not at risk (Kushlan et al. 2002).

Similar to other waterbirds addressed in this assessment, Great Egrets can cause damage to aquaculture resources by consuming aquatic wildlife raised for sale and from the threats associated with disease transmission between aquaculture ponds and facilities. Egrets can also pose strike risks with aircraft at airports in the State. The USFWS can issue depredation permits pursuant to the MBTA that allow the take of egrets to manage damage and threats. However, the USFWS did not issue depredation permits to other entities for the take of Great Egrets in the State during 2013. When receiving a request for assistance, WS may employ non-lethal methods to disperse egrets in order to alleviate damage, threats of damage, or strike risks (see Appendix B); however, lethal take could occur when non-lethal harassment methods have failed to disperse egrets or when posing an imminent threat to aircraft and human safety. Between FY 2009 and FY 2013, the WS program in the State lethally removed four great egrets and employed non-lethal methods to disperse 59 egrets. The highest annual take by WS occurred in FY 2009 when WS removed three Great Egrets during damage management activities.

To alleviate damage and threats associated with Great Egrets, WS could take up to 50 egrets each year to alleviate damage or threats of damage. This take of egrets would represent 0.2% of the estimated breeding population in the Southeastern Coastal Plain and 0.2% of the breeding population estimate in the Mississippi Alluvial Valley. Similar to other migratory birds addressed in this assessment, the take of Great Egrets by WS would only occur at the discretion of the USFWS and only at levels permitted by the USFWS. Therefore, the USFWS would have the opportunity to evaluate the cumulative take of Great Egrets pursuant to the objectives of the MBTA. Permitting take by the USFWS ensures that take would occur within allowable take levels to achieve the desired population objectives for Great Egrets in the State. Given the increasing population trends observed for egrets and the limited take proposed by WS when compared to the estimated breeding population in the southeastern United States, the magnitude of WS' estimated take could be considered low. The permitting of the take by the USFWS ensures the cumulative take of egrets in the southeastern United States, including the take proposed by WS in Tennessee, would not reach a magnitude where undesired adverse effects occurred.

SNOWY EGRET BIOLOGY AND POPULATION IMPACT ANALYSIS

Snowy Egrets are medium-sized herons with entirely white plumage and characteristic black legs with bright yellow feet (Parsons and Master 2000). Snowy Egrets feed on a wide range of invertebrate and vertebrate species, including earthworms, annelid worms, shrimp, prawns, crayfish, snails, freshwater and marine fish, frogs, toads, snakes, and lizards (Parsons and Master 2000).

The Snowy Egret is an uncommon local summer resident that nests in small numbers in mixed-species heronries in the lowlands region of the State and the Mississippi River Valley (Parsons and Master 2000). The spring migration period for Snowy Egrets begins in late February and concludes in mid-May with the peak period occurring in March and April (Parsons and Master 2000). The fall migration period begins in mid-July and extends into mid-November with peak periods occurring from August through October (Parsons and Master 2000). Nesting begins in March with eggs being laid from mid-March through early

July. Nestlings are present in nests from mid-April until the first part of August with the peak occurring from early May through mid-July (Parsons and Master 2000).

Similar to Great Egrets, people sought Snowy Egrets for their plumage to meet demands for the millinery trade in the late 1800s and early 1900s. After the passage of laws that ended plume hunting, populations of Snowy Egrets began to rebound and appeared to expand their breeding range in the United States (Parsons and Master 2000). Since 1966, the number of Snowy Egrets observed along routes surveyed during the BBS across the United States has increased at an estimated rate of 1.2% annually with a 3.6% annual increase observed from 2002 to 2012 (Sauer et al. 2014). Like Great Egrets, the breeding population of Snowy Egrets occurs primarily in the western portion of the State along the Mississippi River (Parson and Master 2000). Since 1966, the number of Snowy Egrets observed across all routes surveyed in the Mississippi Alluvial Valley, which includes the western portion of the State along the Mississippi River, has also shown an increasing trend estimated at 6.5%, with an estimated increase of 10.1% from 2002 through 2012 (Sauer et al. 2014). Surveyors during the CBC have not observed Snowy Egrets in areas of the State surveyed during the CBC (National Audubon Society 2010).

Hunter et al. (2006) placed Snowy Egrets in the southeastern United States into the planning and responsibility action level, which is the second lowest tier in action priority. The waterbird conservation for the Americas plan ranks Snowy Egrets as a species of high concern in the Western Hemisphere (Kushlan et al. 2002). Species of high concern are those species that are not highly imperiled, but are known or thought to be declining and have some known or potential threat in addition to the declining population trends (Kushlan et al. 2002). Known or potential threats could include habitat degradation and loss along with competition for nest sites with Cattle Egrets, which share similar habitat requirements (Burger 1978, Parsons and Master 2000, Hunter et al. 2006).

The WS program in Tennessee has not received requests for assistance associated with Snowy Egrets previously. However, Snowy Egrets are a common bird species that cause damage to aquaculture resources (Parkhurst et al. 1987, Parsons and Master 2000). Damage primarily occurs during the migration periods when Snowy Egrets can be present in higher numbers. Snowy Egrets are also occasional visitors to airports where they can pose an aircraft strike risk. Therefore, the WS program could receive requests for assistance associated with Snowy Egrets in the State. To address requests for assistance, WS could employ non-lethal and/or lethal methods under the proposed action alternative. WS could employ non-lethal methods to disperse Snowy Egrets from areas where damage or threats were occurring. In addition, WS could employ lethal methods to kill up to 25 Snowy Egrets annually in the State to alleviate damage or threats of damage. The lethal take of Snowy Egrets by WS would occur pursuant to depredation permits issued by the USFWS. The USFWS did not issue depredation permits to other entities to take Snowy Egrets in the State in 2013.

Hunter et al. (2006) estimated the southeastern population of Snowy Egrets to be about 45,000 breeding pairs, with approximately 10,630 breeding pairs of Snowy Egrets occurring in the Mississippi Alluvial Valley region. The lethal take of up to 25 Snowy Egrets by WS annually to alleviate damage and threats in the State would represent 0.1% of the breeding population in the Mississippi Alluvial Valley region. Given the increasing breeding population trends observed during the BBS and the limited number of Snowy Egrets that WS could lethally remove annually to alleviate damage and threats, the magnitude of take by WS could be considered low. The permitting of the take by the USFWS would also ensure take by WS and take by other entities does not adversely affect Snowy Egret populations.

CATTLE EGRET BIOLOGY AND POPULATION IMPACT ANALYSIS

The Cattle Egret is a relatively new arrival to the North American continent with the first record for the continental United States occurring in south Florida in 1941 (Telfair II 2006). Today, Cattle Egrets can be found across much of North America, from New England to south Texas (Telfair II 2006). As their name implies, Cattle Egrets are closely associated with cattle where they forage on invertebrates disturbed by foraging livestock, primarily grasshoppers, crickets, and flies (Telfair II 2006). Cattle Egrets are also known to consume fish, frogs, and birds, including eggs and nestlings (Telfair II 2006).

Cattle Egrets form gregarious nesting colonies, or heronries, generally in medium to tall upland trees found in woodlands, swamps, and wooded islands adjacent to water; however, proximity to water is not a requirement of egret nesting sites with many heronries located in or near residential areas (Telfair II 2006). The accumulation of droppings under heronries can defoliate and kill vegetation which can cause herons to abandon nest sites and create heronries in other areas (Telfair II 2006). Telfair II and Bister (2004) noted that the composition of vegetation under heronries rapidly changed within two to three years after the establishment of a Cattle Egret heronry in Texas due to large concentrations of feces. Egret heronries located near airports also pose a threat of being struck by aircraft, which can cause damage to property and threaten passenger safety.

The BBS indicates the number of egrets observed in areas surveyed across all areas in the United States are showing an annual decreasing trend estimated at -0.8% since 1966; however, Cattle Egrets have shown an increasing trend estimated at 6.1% annually in Tennessee since 1966 (Sauer et al. 2014). Between 2002 and 2012, the number of Cattle Egrets observed in the State during the BBS has increased annually estimated at 9.2% (Sauer et al. 2014). Surveyors have only occasionally observed Cattle Egrets in areas of the State surveyed during the CBC (National Audubon Society 2010) since most egrets have migrated further south during the winter (Telfair II 2006). The Southeast United States Regional Waterbird Conservation Plan ranks Cattle Egrets in the "*population control*" action level meaning those species' populations are increasing to a level where damages to economic ventures or adverse effects to populations of other species are occurring (Hunter et al. 2006).

The increases in populations and the range expansion exhibited by Cattle Egrets have been attributed to the species broad use of terrestrial habitats relative to other waterbirds (Hunter et al. 2006, Telfair II 2006). Cattle Egrets have also been implicated as contributing to the declining trends of Little Blue Herons and Snowy Egrets given the aggressive behavior exhibited by Cattle Egrets and the use of similar nesting habitats (Burger 1978, Hunter et al. 2006, Telfair II 2006). Hunter et al. (2006) estimated the breeding Cattle Egret population in the southeastern United States to be 335,000 breeding pairs, with 32,700 breeding pairs occurring in the Mississippi Alluvial Valley and 56,826 breeding pairs occurring in the Southeastern Coastal Plain region. The conservation plan calls for the reduction of Cattle Egret populations in the southeastern United States to less than 200,000 breeding pairs of Cattle Egrets; therefore, the plan calls for reducing the Cattle Egret population by 270,000 egrets in the southeastern United States (Hunter et al. 2006). In the Mississippi Alluvial Valley region and the Southeastern Coastal Plain region, the plan recommends a breeding population of 10,000 pairs and 17,000 pairs, respectively (Hunter et al. 2006).

The WS program in the State has not previously received requests for assistance associated with Cattle Egrets. However, as the population of Cattle Egrets increases, WS could receive requests to manage damage or threats of damage, primarily at aquaculture facilities and at airports where egrets may pose an aircraft strike hazard. Under the proposed action alternative, WS could employ non-lethal and/or lethal methods to address situations where Cattle Egrets were causing damage or posing a threat of damage. As discussed previously, the use of non-lethal methods would generally have no effect on bird populations since those birds would likely disperse to other areas. The disturbance caused by using non-lethal methods would not be widespread enough to cause adverse effects to reproduction or survivability that would result in population declines. If, based on the use of the WS Decision Model, a WS' employee determines the use of lethal methods was the most appropriate response to alleviate damage or threats of damage, WS anticipates that up to 50 Cattle Egrets could be lethally removed annually in the State.

As stated previously, the objective of the Waterbird Conservation Plan for the Southeastern United States is to reduce the breeding population of Cattle Egrets (Hunter et al. 2006). Take of up to 50 egrets annually by WS would represent 0.1% of the breeding population in the Mississippi Alluvial Valley and 0.04% of the estimated breeding population in the Southeastern Coastal Plain. The MBTA prohibits the take of Cattle Egrets unless authorized by the USFWS through the issuance of depredation permits; therefore, the number of egrets taken annually by WS in the State would be at the discretion of the USFWS and based on allowable take levels and population information.

BLACK-CROWNED NIGHT-HERON BIOLOGY AND POPULATION IMPACT ANALYSIS

The medium-sized Black-crowned Night-Heron is the most widespread heron, breeding on every continent except Antarctica and Australia (Hothem et al. 2010). Like other herons, this species also nests in large colonies (often accompanied by Franklin's Gulls, other heron species, and ibises) on islands, in swamps, or over water (Hothem et al. 2010). This heron species is often used as an indicator of environmental quality due to its feeding habits, flexibility in selection of nesting and foraging habitats, wide distribution, tendency to accumulate contaminants, and ability to habituate to disturbance (Hothem et al. 2010). This heron can be found year-round in the Mississippi Alluvial Valley and Southeastern Coastal Plain of Tennessee (Sibley 2000).

The number of night-herons present in the State throughout the year likely fluctuates. No data is available on the number of night-herons breeding in the State or the number that may be present during the winter or during the migration periods. BBS data has shown an increasing annual trend for Black-crowned Night-Herons in Tennessee estimated at 1.2 % since 1966 and 0.6% from 2002 through 2012 (Sauer et al. 2014). From 2002 through 2012, there has been an estimated 1.7% annual increase across all survey routes in the United States; however, there is a declining annual trend estimated at -0.2% since 1966 (Sauer et al. 2014). The coastal breeding populations are still showing strong increasing trends (*e.g.*, Mississippi has shown a 23.7% annual increasing trend since 1966) (Sauer et al. 2014). The number of herons observed during the CBC in Tennessee has shown a variable, but overall stable trend since the early 1980s (National Audubon Society 2010). Hunter et al. (2006) estimated the southeast breeding population of Black-crowned Night-Herons to be around 7,000 breeding pairs. A combined breeding population estimate for the Mississippi Alluvial Valley, the Southeastern Coastal Plain, and the Appalachian Mountain regions totals 2,600 breeding pairs, or 5,200 individuals (Hunter et al. 2006).

Requests for assistance that WS receives in Tennessee associated with Black-crowned Night-Herons are primarily for strike hazards at airports from night-herons nesting over water near runways or for predation issues at fish hatcheries in the State. Between FY 2009 and FY 2013, the WS program in Tennessee has lethally removed three Black-crowned Night-Herons to alleviate damage or threats of damage in the State. Under the proposed action alternative, WS could employ non-lethal methods to address requests for assistance with managing damage or threats of damage associated with night-herons in the State, including nest removal; however, lethal methods may be necessary if non-lethal methods were not effective at reducing damage or threats of damage. Based on previous requests for assistance and in anticipation of additional efforts, WS could lethally take up to 50 Black-crowned Night-Herons and up to 100 nests annually in the State to alleviate damage.

The take of 50 night-herons in the State annually by WS would represent 1.0% of the 5,200 night-herons estimated in the Mississippi Alluvial Valley, the Southeastern Coastal Plain, and the Appalachian Mountain regions during the breeding season. The USFWS has also authorized other entities within the State to lethally remove Black-crowned Night-Herons to alleviate damage or threats of damage. During 2013, the USFWS authorized other entities to lethally remove up to 30 Black-crowned Night-Herons in the State. If WS lethally removed 50 night-herons and other entities removed 30 night-herons, the cumulative take would represent 1.5% of the estimated breeding population in the Mississippi Alluvial Valley, the Southeastern Coastal Plain, and the Appalachian Mountain regions. All take would be authorized by and occur at the discretion of the USFWS. The take of Black-crowned Night-Herons would only occur at levels authorized by the USFWS, which would ensure cumulative take could be considered as part of population management objectives for this species.

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). In Tennessee, Black Vultures occur statewide throughout the year (Buckley 1999). 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). Black Vultures are highly social, roosting communally with other Black Vultures and 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. (2014), the number of Black Vultures observed in the State during the breeding season has increased at an annual rate of 7.6% since 1966, with a 7.7% annual increase occurring from 2002 through 2012. Similar increasing trends have been observed for Black Vultures in the Appalachian Mountains and the Central Hardwoods with estimated increasing trends of 5.2% and 7.0%, respectively, since 1966 (Sauer et al. 2014). In the Southeastern Coastal Plain, the number of Black Vultures observed in areas surveyed has shown increasing trends since 1966 estimated at 3.1% annually with a 3.9% annual increase estimated from 2002 through 2012 (Sauer et al. 2014). The number of Black Vultures observed overwintering in the State has also shown a general increasing trend since 1966 during the annual CBC (National Audubon Society 2010). The population of Black Vultures in the State is currently unknown.

Table 4.6 shows the number of Black Vultures lethally removed or dispersed by WS to alleviate damage and threats. From FY 2009 through FY 2013, WS has lethally removed 6,529 Black Vultures in the State to alleviate damage and threats. In addition, WS has employed non-lethal harassment methods to disperse 38,856 Black Vultures in the State to address requests for assistance to manage damage. WS addressed almost 86% of the Black Vultures from FY 2009 through FY 2013 using non-lethal harassment methods. The highest level of take of vultures by WS to alleviate damage and threats of damage occurred in FY 2011 when WS lethally removed 2,047 vultures to alleviate damage or threats of damage. Between FY 2009 and FY 2013, an average of nearly 1,306 vultures per year have been lethally removed by WS in the State, while an average of 7,771 vultures per year have been addressed using non-lethal methods (see Table 4.6). On average, the WS program in the State has addressed 9,077 Black Vultures each year using either lethal or non-lethal methods. In addition to the take by WS, the USFWS has issued depredation permits to other entities for the take of Black Vultures. During 2013, the USFWS authorized other entities in the State to lethally remove 773 Black Vultures to alleviate damage or to alleviate the threat of damage.

Under the proposed action alternative, WS could continue to employ non-lethal and/or lethal methods in an integrated 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 the proposed action alternative, WS could lethally remove up to 3,000 Black Vultures annually and WS could destroy up to 100 nests annually to alleviate damage and threats.

Table 4.6 – Black Vultures addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed
2009	797	1,146
2010	1,429	3,072
2011	2,047	8,422
2012	1,487	16,751
2013	769	9,465
TOTAL	**6,529**	**38,856**

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.

The take of vultures could only occur when authorized through the issuance of depredation permits by the USFWS. The permitting of the take by the USFWS pursuant to the MBTA 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 100 vulture nests to alleviate damage or threats of damage to affect adversely the population of vultures based on previous discussions.

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 (Kirk and Mossman 1998). In Tennessee, Turkey Vultures occur throughout the year across the State (Kirk and Mossman 1998). Similar to Black Vultures, Turkey Vultures occur in virtually all habitats but are most abundant where open land interrupts forest (Kirk and Mossman 1998). Turkey Vultures nest on rock cliffs, in tree cavities, and on the ground in thickets (Kirk and Mossman 1998). Turkey Vultures are social and often roost in large groups in trees, on cliffs, power lines, communication towers, or on homes or other buildings (Kirk and Mossman 1998) where they can cause property damage from droppings or by pulling and tearing shingles. Turkey Vultures can occur in groups numbering up to 300 (Kirk and Mossman 1998). Turkey Vultures generally feed on carrion but they will eat virtually anything including insects, fish, reptiles, amphibians, young birds, decayed fruit, cow manure, pumpkins, and recently hatched heron and ibis chicks (Brauning 1992, Kirk and Mossman 1998).

The statewide population of Turkey Vultures is currently unknown, but the Partners in Flight Science Committee (2013) estimated the breeding population at 90,000 birds 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 4.1% annually from 1966 through 2012, with an estimated 4.9% increase between 2002 and 2012 (Sauer et al. 2014). 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).

Between FY 2009 and FY 2013, the WS program in Tennessee dispersed 3,355 Turkey Vultures in the State to alleviate damage or threats of damage (see Table 4.7). In addition, the WS program lethally removed 475 Turkey Vultures between FY 2009 and FY 2013 to alleviate damage. In addition, the USFWS authorized other entities to remove up to 144 Turkey Vultures lethally in the State to alleviate damage or the threat of damage during 2013.

Based on current population trends for Turkey Vultures in the State, the number of requests for assistance with managing damage associated with Turkey Vultures and the number of vultures addressed to meet those requests is likely to increase. Therefore, based on previous requests for assistance and in anticipation of an increasing number of requests and the subsequent need to address more vultures, WS could lethally remove up to 1,000 Turkey Vultures annually in the State to address requests for assistance. In addition, the WS program could destroy up to 50 Turkey Vulture nests annually under the proposed action alternative to alleviate damage and threats.

Table 4.7 – Turkey Vultures addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed
2009	59	102
2010	90	539
2011	117	504
2012	147	1,559
2013	62	651
TOTAL	**475**	**3,355**

Based on population estimates by the Partners in Flight Science Committee (2013), the take of up to 1,000 Turkey Vultures annually by WS under the proposed action alternative would represent 1.1% of the estimated Turkey Vulture population in the State. During 2013, the USFWS authorized other entities to kill 144 Turkey Vultures in the State to alleviate damage. If the USFWS continues to authorize other entities to kill up to 144 Turkey Vultures annually and the annual take by other entities reached 144 vultures, the annual cumulative take of vultures by all entities would represent 1.3% of the statewide population if the take by WS reached 1,000 vultures. The take of vultures could only occur when authorized through the issuance of depredation permits by the USFWS. The permitting of the take by the USFWS pursuant to the MBTA 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 50 vulture nests to alleviate damage or threats of damage to affect adversely the population of vultures, which was addressed in additional detail previously.

OSPREY BIOLOGY AND POPULATION IMPACT ANALYSIS

Ospreys are large raptors most often associated with shallow aquatic habitats where they feed primarily on fish (Poole et al. 2002). Historically, Osprey constructed their 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 (Poole et al. 2002). 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 (Poole et al. 2002).

In Tennessee, breeding populations of Ospreys occur along the major river systems of the State and near large lakes (Poole et al. 2002). However, there is no trend data available from the BBS for Tennessee (Sauer et al. 2014). The Partners in Flight Science Committee (2013) estimated the statewide population of Osprey at 200 birds. Along routes surveyed all across the United States during the BBS, the number of Osprey observed since 1966 has shown an increasing trend estimated at 2.8% annually, with an estimated 4.6% annual increase from 2002 through 2012 (Sauer et al. 2014). Ospreys migrating between breeding areas further north and wintering areas further south also pass through the State during the migration periods. Although observers have recorded Ospreys in areas of the State surveyed during the CBC, those observations occur infrequently and involve one or two Ospreys (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. Between 1990 and 2012, there have been 240 reported aircraft strikes involving osprey in the United States, resulting in 2,597 hours of aircraft downtime and nearly $402,000 in aircraft damages. Of those reported strikes, two caused injuries to people (Dolbeer et al. 2013).

Damage can also occur associated with their nesting behavior. Historically, osprey constructed nests in tall trees and on rocky cliffs. Today, ospreys are more commonly found nesting on man-made structures, such as power poles, cell towers, and man-made nesting platforms (Poole et al. 2002, USGS 2005). 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 were located on utility structures and could inhibit access to utility structures for maintenance by creating obstacles to workers. For example, the average size of an osprey nest in Corvallis, Oregon was 41-inches in diameter and weighed 264 pounds (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).

WS has responded to requests for assistance involving Osprey previously by providing technical assistance and direct operational assistance. Between FY 2009 and FY 2013, the WS program in Tennessee employed non-lethal methods to disperse 52 Ospreys to alleviate damage and employed lethal methods to remove nine Ospreys that were causing damage or posing a threat of damage. WS would continue to use primarily non-lethal methods to address requests for assistance involving Ospreys. Under the proposed action alternative, 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. In anticipation of additional efforts involving Osprey, WS could lethally take up to 20 ospreys and destroy up to 40 osprey nests (including eggs) annually in the State to alleviate damage and threats when non-lethal techniques were unsuccessful.

The take of up to 20 ospreys under the proposed action alternative would represent 10% of the breeding population in the State. However, most requests for assistance that occur during the breeding season are 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.

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. The permitting of take by the USFWS pursuant to the MBTA would ensure take by WS and other entities occurred within allowable take levels to achieve desired population objectives for Ospreys.

MISSISSIPPI KITE BIOLOGY AND POPULATION IMPACT ANALYSIS

The Mississippi Kite is a crow-sized raptor that breeds in the central and southern Great Plains, in isolated areas of the southwest, and in the southern states from Arkansas and Louisiana to eastern South Carolina (Parker 1999). Kites are woodland nesters, using a variety of habitats throughout the range of the species, including mature forests, shelterbelts, and wooded parks in urban areas. Kites are often gregarious, especially in the western portion of their range. Groups of 10 or more Kites can be found near nests and roosts, with urban nests and roosts commonly found in city parks, residential areas, and golf courses (Parker 1999). Foraging flocks of 25 or more Kites can be found anytime of the year. Kites are often described as insect eaters, but are also known to prey on frogs, lizards, small birds, and small mammals (Parker 1999). Kites are also known to aggressively defend their nests and often attack people that get too close, mainly in urban areas (Parker 1999).

The population of Mississippi Kites has seen major fluctuations since the 1850s due to shooting, egg collecting, and deforestation that affected their distribution, especially around the fringes of their range (Parker 1999); however, in the 1940s and 1950s, the population and range of Kites began to expand, likely due to protection under the MBTA, agricultural lands that likely increased their prey base, and tree plantings for shelterbelts in the western portion of their range. Urbanization may also have played a role with range expansion and population increases as Kites began utilizing urban habitats for nesting (Parker 1999).

The Mississippi Kite breeds in the western portion of the State, but sightings throughout the State are not uncommon (Parker 1999, Sibley 2000). According to BBS trend data, Mississippi Kite populations have increased at an annual rate of 0.4% across all survey areas in the United States since 1966, with a 3.5% annual increase from 2002 through 2012 (Sauer et al. 2014). The numbers of Mississippi Kites observed along routes surveyed in the Southeastern Coastal Plain, Mississippi Alluvial Valley, and Central Hardwoods during the annual BBS have shown increasing trends estimated at 6.2%, 4.4%, and 10.7%, respectively, since 1966 (Sauer et al. 2014). In Tennessee, kites are also showing large growth trends with an estimated annual increase of 13.2% since 1966 and 14.2% between 2002 and 2012 (Sauer et al. 2014). The population of Mississippi Kites in Tennessee has been estimated at 1,000 birds (Partners in Flight Science Committee 2013).

Since the majority of their diet consists of insects along with some small vertebrates, the open areas of airports provide ideal foraging habitat for kites; therefore, most requests for assistance received by WS occur at airports where Mississippi Kites pose an aircraft strike risk. Between FY 2009 and FY 2013, the WS program in Tennessee lethally removed three Mississippi Kites and employed non-lethal methods to disperse two kites to alleviate damage or threats of damage.

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[19]For the purposes of the analysis, WS will consider nestlings euthanized as part of the take of up to 20 ospreys. As discussed previously, the destruction of eggs is generally considered a non-lethal method.

Based on the number of requests received to alleviate the threat of damage associated with Mississippi Kites and the number of Mississippi Kites addressed previously to alleviate those threats, WS anticipates that employees could lethally remove up to 15 kites annually in the State to alleviate damage or the threat of damage. With an estimated breeding population of 1,000 kites, the lethal removal of up to 15 Kites by WS would represent 1.5% of the estimated breeding population. Like many other bird species, the take of Mississippi Kites by WS to alleviate damage would only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits. Therefore, the take of Mississippi Kites by WS would only occur at levels authorized by the USFWS, which ensures the USFWS has the opportunity to consider WS' take, and the take by all entities, to achieve the desired population management levels of Mississippi Kites in the State.

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, eagles have been documented nesting 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 has been a key symbol for Native Americans (Buehler 2000). During the migration period, eagles can be found throughout the United States and parts of Mexico (Buehler 2000). The migration of eagles has been labeled 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, Bald 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 with eggs present in nests from late May through the end of May. Eaglets can be found in nests generally from late May through mid-September (Buehler 2000). 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. Population declines have been attributed to the loss of nesting habitat, hunting, poisoning, and pesticide contamination. To curtail steep declining trends in Bald Eagles, the Bald Eagle Protection Act was passed in 1940, which prohibited the taking or possession of Bald Eagles or any parts of eagles. 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 (see Section 1.7). Certain populations of Bald Eagles were listed as "*endangered*" under the Endangered Species Preservation Act of 1966, which was extended when the modern ESA of 1973 was passed. 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 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 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 Eagle now is afforded protection under the Bald and Golden Eagle Protection Act.

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). The USFWS developed an EA that evaluated alternatives and issues associated with regulations establishing new permits for the take of eagles pursuant to the Act (USFWS 2010). Based on the evaluations in the EA and a FONSI, the selected alternative in the EA established new permit regulations for the "*take*" of eagles (see 50 CFR 22.26) and a provision to authorize the removal of eagle nests (see 50 CFR 22.27).

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. 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.

Under 50 CFR 22.26, 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. Under this proposed action alternative, WS could employ harassment methods to disperse eagles from airports or surrounding areas when authorized and permitted by the USFWS pursuant to the Act; therefore, if no permit were issued by the USFWS to harass eagles that are posing a threat of aircraft strikes, no activities would be conducted by WS. Activities would only be conducted by WS when a permit allowing for the harassment of eagles has been issued to WS or to an airport authority where WS is working as a subpermittee under the permit issued to the airport. No lethal take of eagles would occur under this proposed action alternative.

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. The USFWS determined that the issuance of permits allowing the "*take*" of eagles as defined by the Act would not significantly affect the human environment when permits were issued for "*take*" of eagles under the guidelines allowed within the Act (USFWS 2010). Therefore, the issuance of permits to allow for the "*take*" of eagles, including permits issued to WS or other entities has been fully evaluated in a separate analysis (USFWS 2010).

SHARP-SHINNED HAWK BIOLOGY AND POPULATION IMPACT ANALYSIS

Sharp-shinned Hawks can be found throughout North America, from Alaska and across Canada, down through the western Caribbean, and even in parts of South America (Bildstein and Meyer 2000). In Tennessee, Sharp-shinned Hawks can be found throughout the year (Bildstein and Meyer 2000). Sharp-shinned hawks are generally found in forested areas, but will use open areas with wooded vegetation interspersed or adjacent to old fields, pastures, or marshlands (Bildstein and Meyer 2000). The open habitat and abundant prey items available at airports make attractive locations for Sharp-shinned Hawks.

The number of Sharp-shinned Hawks observed in the State along routes surveyed during the BBS has shown an increasing trend estimated at 3.1% annually since 1966, with a 4.5% annual increase estimated between 2002 and 2012 (Sauer et al. 2014). A similar trend has been observed for the number of Sharp-shinned Hawks observed across all survey routes in the United States, which has been estimated to be increasing 0.7% annually since 1966 (Sauer et al. 2014). The number of Sharp-shinned Hawks observed in the State during the CBC has also shown an increasing trend (National Audubon Society 2010). The statewide breeding population of Sharp-shinned Hawks has been estimated at 5,000 birds (Partners in Flight Science Committee 2013).

The WS program in Tennessee has not previously received requests for assistance associated with Sharp-shinned Hawks. However, WS could receive requests for assistance in the future. Requests for assistance to manage damage and threats associated with Sharp-shinned Hawks would primarily occur at airports in the State. WS anticipates the number of airports requesting assistance with managing damage and threats associated with Sharp-shinned Hawks to increase. To address those requests for assistance in the future, WS could take up to 15 Sharp-shinned Hawks and up to 10 nests annually under the proposed action.

The take of up to 15 Sharp-shinned Hawks annually by WS would represent 0.3% of the estimated breeding population of these birds in the State. Given the increasing population trends for Sharp-shinned Hawks and the limited take proposed by WS to alleviate damage and threats, WS' proposed take should not have an adverse effect on Sharp-shinned Hawk populations. The take of Sharp-shinned Hawks can only occur when permitted by the USFWS; therefore, all take, including take by WS, would require authorization from the USFWS and would occur at the discretion of those agencies. The take of Sharp-shinned Hawks would only occur at levels authorized by the USFWS, which ensures those agencies have the opportunity to consider cumulative take as part of population management objectives for these birds.

COOPER'S HAWK BIOLOGY AND POPULATION IMPACT ANALYSIS

Cooper's Hawks are widespread throughout the United States and can be found year-round in Tennessee (Curtis et al. 2006). During fall migration, Cooper's Hawks are generally found in forested areas, but will use open areas with wooded vegetation interspersed or adjacent to old fields, pastures, or marshlands; however, Cooper's Hawks are also tolerant of human disturbance and fragmentation (Curtis et al. 2006). Their populations have been increasing in suburban and urban areas in recent years (Curtis et al. 2006). The open habitat and abundant prey items (*e.g.*, European Starlings and pigeons) available at airports and in urban areas make attractive locations for Cooper's Hawks.

In Tennessee, the number of Cooper's Hawks observed during the BBS has shown an increasing trend estimated at 6% annually since 1966, with an annual increase of 6.1% between 2002 and 2012 (Sauer et al. 2014). A similar trend has been observed for the number of Cooper's Hawks observed across all BBS survey routes in the United States where the population has shown an increase at an estimated 2.9% annually since 1966, with an estimated 4.9% since 2002 (Sauer et al. 2014). The number of Cooper's Hawks observed in the State during the CBC has also shown an increasing trend (National Audubon Society 2010). Using data from the BBS, the Partners in Flight Science Committee (2013) estimated the statewide breeding population of Cooper's Hawks to be 19,000 birds.

Between FY 2009 and FY 2013, the WS program in Tennessee employed lethal methods to remove eight Cooper's Hawks and non-lethal methods to disperse two hawks, primarily at airports where those hawks posed a strike risk to aircraft. Future requests for assistance to manage damage and threats associated with Cooper's Hawks are likely to originate primarily at airports, although Cooper's Hawks can also pose a threat to chickens and other domestic fowl. WS anticipates the number of requests for assistance with managing damage and threats associated with Cooper's Hawks to increase. To address these requests for assistance, up to 20 Cooper's Hawks and 10 nests could be taken annually by WS under the proposed action alternative.

The take of up to 20 Cooper's Hawks annually by WS would represent 0.1% of the estimated population of Cooper's Hawks in the State. Given the limited take proposed by WS when compared to the estimated population, the magnitude of WS' take could be considered low. All take would be authorized by the USFWS and would occur at the discretion of those agencies. The take of Cooper's Hawks would only occur at levels authorized by the USFWS, which would ensure those agencies have the opportunity to consider cumulative take as part of population management objectives for Cooper's Hawks.

RED-TAILED HAWK BIOLOGY AND POPULATION IMPACT ANALYSIS

The Red-tailed Hawk is one of the most widely distributed raptor species in North America with a breeding range extending from northern Canada and Alaska southward to northern and central Mexico (Preston and Beane 2009). Red-tailed Hawks are capable of exploiting a broad range of habitats with the availability of structures for perching or nesting and the availability of prey items being the key factors. Red-tailed Hawks are most commonly found in open areas interspersed with patches of trees or other similar structures. They have a wide distribution and are considered a resident species of Tennessee.

In the northern portion of their range, including most of Canada and Alaska, the Red-tailed Hawk is a common summer resident migrating southward during the fall and winter migration periods. In the conterminous United States, the Red-tailed Hawk can be found throughout the year, including Tennessee (Preston and Beane 2009). Migration movements are primarily dependent on snow cover and the availability of prey items with most migratory movements being less than 1,500 kilometers (Preston and Beane 2009).

Populations of Red-tailed Hawks in North America showed increasing trends during the mid to late 1900s. Those increases were likely caused by the conversion of forested areas to more open environments for agricultural production (Preston and Beane 2009). Since 1966, the number of Red-tailed Hawks observed along routes surveyed during the BBS has shown an increasing trend estimated at 1.9% annually across all routes surveyed in the United States (Sauer et al. 2014). In Tennessee, Red-tailed Hawk populations are showing an increasing trend estimated at 3% annually since 1966 (Sauer et al. 2014). The breeding population in Tennessee has been estimated at 13,000 birds based on BBS data (Partners in Flight Science Committee 2013). Red-tailed Hawks observed in areas surveyed during the CBC has also shown an increasing trend since 1966 (National Audubon Society 2010).

The open grassland habitats and the availability of perching structures often attract Red-tailed Hawks to airports where those birds pose a strike risk with aircraft. Most requests for assistance received by WS in Tennessee are associated with threats those hawks pose to aircraft; however, WS does occasional receive requests associated with Red-tailed Hawks where damages or threats of damages to agricultural resources are occurring. For example, Red-tailed Hawks are known to capture and feed on free-ranging chickens. Occasionally, Red-tailed Hawks build nests on transmission towers and lines, potentially disrupting electrical service or making regular maintenance of lines more difficult.

WS has addressed previous requests for assistance associated with Red-tailed Hawks using both non-lethal dispersal methods and lethal removal. From FY 2009 through FY 2013, 808 Red-tailed Hawks were dispersed or live-captured and relocated while 541 Red-tailed Hawks were lethally taken by WS to alleviate damage pursuant to depredation permits (see Table 4.8). Most requests for assistance involving Red-tailed Hawks occur during the migration periods, when the number of Red-tailed Hawks in the State likely increases.

Table 4.8 – Red-tailed Hawks addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed/Relocated
2009	82	89
2010	67	108
2011	106	148
2012	251	314
2013	35	149
TOTAL	**541**	**808**

In 2012, there was an influx of Red-tailed Hawks at airports across Tennessee in which the number of hawks that WS addressed during FY 2012 more than doubled (see Table 4.8); therefore, based on trend data and previous requests for assistance, WS anticipates an annual take of up to 300 Red-tailed Hawks to address requests for assistance. In addition, WS could destroy up to 50 Red-tailed Hawk nests annually, including the eggs contained in the nests.

Based on trending data from the BBS and the CBC, the number of Red-tailed Hawks present in the State continues to increase annually. Based on current population trends for Red-tailed Hawks in the State, the number of requests for assistance with managing damage and the number of hawks that will be addressed to meet those requests is likely to increase. With a stable breeding population, the take of 300 Red-tailed Hawks a year would represent 2.3% of the estimated breeding population in Tennessee. Permitting the take by the USFWS pursuant to the MBTA ensures that take occurs within allowable take levels to achieve the desired population objectives for Red-tailed Hawks in the State.

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). The Golden Eagle nesting season can extend more than 6 months from the time the eggs are laid until the young are independent (Kochert et al. 2002). Typically, only an average of one young per breeding pair is raised in a year, with up to 15 young over a lifetime (Kochert et al. 2002). This number varies depending on a combination of weather and food availability (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 (Olendorff 1976, Kochert et al. 2002). Eagles will occasionally prey upon livestock, including sheep and goats (Olendorff 1976, 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. Between 1990 and 2012, there have been 13 civil aircraft strike reports involving Golden Eagles in the United States causing nearly 3,700 hours of aircraft downtime and nearly $940,000 in damages to aircraft (Dolbeer et al. 2013). Two of those aircraft strikes resulted in injuries to four people (Dolbeer et al. 2013). 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 Tennessee 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.

Under 50 CFR 22.26, 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. Under this proposed action 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 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 where WS would work as a subpermittee under the permit issued to the airport. No lethal take of Golden Eagles would occur under this proposed action alternative. 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.

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.

Distinguishing characteristics include a dark, double-banded breast, with the top band completely encircling the upper body/breast. Another band is located at the head, resembling a mask absent of the facial portion. The band is continuous, thinning while going across the face along the forehead region and above the bill, thickening at the supercilium, and extending around the eye and onward around the back of the head. Plumage is relatively absent of complexity with the exception of a vividly colored, reddish-orange rump that is visible during flight and behavioral displays. The rest of the body consists of a grayish-brown coloration along the dorsal side, crown, and nape, while the ventral region is white. Sex characteristics are difficult to determine since Killdeer are essentially monomorphic. The clutch of up to four eggs is laid in a ground scrape in open habitats (Leck 1984).

Breeding populations of Killdeer occur in the State with birds migrating through Tennessee during the annual migration periods (Jackson and Jackson 2000). Since 1966, the number of Killdeer observed during the breeding season in the State has shown an annual increasing trend estimated at 1.3%, with a 0.7% annual increase estimated between 2002 and 2012 (Sauer et al. 2014). Across all BBS routes in the United States, the number of Killdeer observed has also shown a declining trend estimated at -0.5% annually since 1966 (Sauer et al. 2014). The number of Killdeer observed during the CBC in those areas surveyed in the State has shown a variable, but general increasing trend since 1966 (National Audubon

Society 2010). A population estimate from the Partners in Flight landbird database is not available for Tennessee (Partners in Flight Science Committee 2013). With a relative abundance of 4.3 Killdeer observed per route during the BBS conducted in the State, a population estimate for Killdeer in Tennessee could be estimated at 18,000 killdeer based on the land area of the State. 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. From FY 2009 through FY 2013, the WS program in Tennessee has lethally removed 280 Killdeer at airports to reduce damages and threats associated with aircraft striking Killdeer (see Table 4.9). The highest level of Killdeer take by WS occurred in FY 2013 when WS removed 131 Killdeer to alleviate threats of damage. In addition, WS has employed non-lethal methods at airports in the State to harass 1,203 Killdeer from FY 2009 through FY 2013.

As the number of airports requesting assistance from WS to manage damage and threats associated with Killdeer increases, the number of Killdeer lethally removed annually is also likely to increase when WS' employees deem lethal methods appropriate for use to resolve damage and threats. To address an increasing number of requests for assistance, up to 300 Killdeer could be lethally taken and up to 100 nests destroyed by WS annually under the proposed action.

Table 4.9 – Killdeer addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed
2009	0	53
2010	67	303
2011	31	106
2012	51	262
2013	131	479
TOTAL	**280**	**1,203**

With a population estimated at nearly 18,000 Killdeer, the annual take of up to 300 Killdeer by WS would represent 1.7% of the estimated statewide population. The destruction of a limited number of nests is generally regarded as having 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.

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 southern coastal beaches during the winter. Ring-billed Gulls are considered opportunistic feeders that feed primarily on fish, insects, earthworms, rodents, and grains (Pollet et al. 2012).

The breeding population of Ring-billed Gulls is divided into the western population and the eastern population. The eastern breeding population of the United States includes 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, breakwalls, 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. No breeding populations of Ring-billed Gulls are known to occur in Tennessee. The number of gulls present in the State increases during the migration periods and during the winter.

Across all BBS routes in the United States, the number of Ring-billed Gulls observed has shown an increasing trend estimated at 1.5% since 1966 (Sauer et al. 2014). Between 2002 and 2012, the number of gulls observed across all routes surveyed in the United States has shown an increasing trend estimated at 6.2% annually (Sauer et al. 2014). In the eastern BBS region, the number of Ring-billed Gulls observed has increased 4.4% annually since 1966, with an 8.2% annual increase occurring from 2002 through 2012 (Sauer et al. 2014). The number of Ring-billed Gulls observed in areas surveyed during the CBC showed a cyclical, but increasing trend in Tennessee (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 Tennessee 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 these periods.

Between FY 2009 and FY 2013, the WS program in Tennessee employed non-lethal methods to disperse 100 Ring-billed Gulls and lethal methods to remove two Ring-billed Gulls to alleviate damage or threats of damage. 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. During 2013, the USFWS authorized entities other than WS to lethally remove 150 Ring-billed Gulls in the State to alleviate damage.

An estimate of the number of Ring-billed Gulls present in the State during the migration periods is currently unavailable. The only information currently available to evaluate the magnitude of WS' proposed take of up to 250 Ring-billed Gulls annually in the State is the number of Ring-billed Gulls observed in areas of the State surveyed during the CBC. 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.

On average, observers involved with the CBC have recorded 30,189 Ring-billed Gulls in areas of the State surveyed between 2004 and 2013 (National Audubon Society 2010). If WS removed 250 Ring-billed Gulls, WS' take would represent 0.8% of the average number of Ring-billed Gulls observed in the State between 2004 and 2013 during the CBC. As stated previously, the USFWS authorized other entities in the State to remove 150 Ring-billed Gulls lethally during 2013. If other entities in the State remove 150 Ring-billed Gulls and the take by WS reached 250 gulls, the cumulative take would represent 1.3% of the average number of Ring-billed Gulls observed in areas of the State surveyed during the CBC.

WS' lethal take of gulls would occur under permits issued to WS by the USFWS or under permits issued to cooperators where WS was acting as an agent on the permit. The permitting of take by the USFWS 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 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.

Herring Gulls are most commonly observed wintering in central and western Tennessee (Pierotti and Good 1994) as large numbers of Herring Gulls migrate south through the Mississippi Flyway. Data gathered in Tennessee during the CBC indicates the number of Herring Gulls observed during the survey has shown a very cyclical, but stable trend in the State (National Audubon Society 2010). The number of Herring Gulls observed in areas surveyed during the BBS in the Southeastern Coastal Plain and the Appalachian Mountain Region has shown an annual increasing trend estimated at 1.1% and 1.3% since 1966, with increasing annual trends from 2002 through 2012 of 2.1% and 0.9%, respectively (Sauer et al. 2014). Across all BBS routes surveyed in the United States, Herring Gulls are showing a declining trend estimated at -3.6% annually since 1966, with a -1.1% annual decline occurring from 2002 through 2012 (Sauer et al. 2014). No current population estimates are available for the number of Herring Gulls residing in the State. Hunter et al. (2006) recommended reducing the number of nesting Herring Gulls in the southeastern United States to minimize competition for nest sites between Herring Gulls and other higher priority waterbirds. Herring Gulls are predatory, feeding on eggs and nestlings of other waterbird species, including terns and plovers (Hunter et al. 2006).

The WS program in Tennessee has not previously received requests for direct operational assistance associated with Herring Gulls. However, the increasing population trends observed in the southeastern United States and the flocking behavior of gulls are likely to result in future requests for assistance. WS anticipates addressing more Herring Gulls at airports within the State where the presence of Herring Gulls could pose aircraft strike hazards. In anticipation of WS receiving requests to provide direct operational assistance in the future, WS could lethally remove up to 250 Herring Gulls annually within the State. The USFWS authorized other entities in the State to remove 75 Herring Gulls lethally during 2013 to alleviate damage or threats of damage.

The North American Waterbird Conservation Plan ranked the Herring Gull as a species of "*low concern*" in North America (Kushlan et al. 2002). The take of Herring Gulls by WS in Tennessee would only occur after the USFWS issued a depredation permit and only at levels permitted; therefore, the USFWS would determine the appropriate cumulative take level for Herring Gulls and would adjust management practices, including adjusting take through depredation permits, to achieve population objectives.

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 (USFWS 1981). Many of those birds escaped and eventually formed the feral pigeon populations that now occur throughout the United States, southern Canada, and Mexico (Williams and Corrigan 1994). 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 man-made structures and activities provide them with food and sites for roosting, loafing, and nesting (Williams and Corrigan 1994, Lowther and Johnston 2014). Thus, pigeons commonly occur around city buildings, bridges, parks, farmyards, grain elevators, feed mills, and other manmade structures (Williams and Corrigan 1994). 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). Pigeons occur throughout the year in all 50 states, including Tennessee (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 -1.5% annually, with a -1.6% annual decrease from 2002 through 2012 (Sauer et al. 2014). Since 1966, the number of pigeons observed along routes surveyed during the BBS across all BCRs in the State has shown a declining trend (Central Hardwoods = -2.4%; Southeastern Coastal Plain = -1.5%; Mississippi Alluvial Valley = -3.7%; Appalachian Mountains = -0.7%) (Sauer et al. 2014). Based on data from the BBS, the Partners in Flight Science Committee (2013) estimated the statewide population at 130,000 pigeons. The number of pigeons observed in areas surveyed during the CBC is showing a stable trend in the State (National Audubon Society 2010).

Since 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; therefore, take by other entities in Tennessee is unknown. Since pigeons are a non-native species that often competes with native wildlife species for food and habitat, any take could be viewed as providing some benefit to the native environment in the State. Between FY 2009 and FY 2013, WS employed non-lethal harassment methods to disperse 3,304 Rock Pigeons to alleviate damage or threats of damage and employed methods to lethally remove 17,226 pigeons (see Table 4.10). 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 power plant or other industrial facility.

Table 4.10 – Rock Pigeons addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed
2009	3,874	85
2010	2,607	251
2011	3,046	596
2012	3,972	1,645
2013	3,727	727
TOTAL	**17,226**	**3,304**

Based on the estimated population and previous requests for assistance, WS anticipates taking up to 5,000 Rock Pigeons and up to 100 nests annually to alleviate damage or threats throughout the State. The take of 5,000 pigeons would represent 3.9% of the estimated population in Tennessee. 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.

EURASIAN COLLARED-DOVE BIOLOGY AND POPULATION IMPACT ANALYSIS

The Eurasian Collared-Dove was first introduced to North America when several were released in the Bahamas in the mid-1970s and have quickly expanded their range with established populations in the southeastern United States and localized populations elsewhere (Romagosa 2012). Since collared-doves are an introduced, non-native species in the United States, the MBTA does not protect collared-doves from take and take can occur at any time (see 70 FR 12710-12716). Collared-doves occur statewide in Tennessee and are present in the State throughout the year (Romagosa 2012).

Since 1966, data from the BBS indicates Eurasian Collared-Dove populations have increased annually in Tennessee at an estimated rate of 28.7%, with an annual increase of 19.8% occurring from 2002 through 2012 (Sauer et al. 2014). Data from the CBC also indicates a general increasing annual trend in the State (National Audubon Society 2010). The current population in the State is unknown and no population estimates are available from the Partners in Flight landbird population database (Partners in Flight Science Committee 2013). The Partners in Flight Science Committee (2013) estimated the global breeding population to be around 8 million individuals.

Requests for assistance associated with collared-doves are likely to originate from airports where flocks of doves are posing aircraft strike hazards at airports. From FY 2009 through FY 2013, the WS program in Tennessee addressed 520 Eurasian Collared-Doves to alleviate damage or threats of damage (see Table 4.11), primarily at airports where doves can pose a threat to aircraft. Between FY 2009 and FY 2013, the WS program in Tennessee dispersed 212 collared-doves using non-lethal methods and employed lethal methods to remove 308 collared doves to alleviate damage or threats of damage.

Table 4.11 – Eurasian Collared-Doves addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed
2009	22	20
2010	71	0
2011	79	0
2012	118	27
2013	18	165
TOTAL	**308**	**212**

Since the MBTA provides collared-doves with no protections from take, the take of Eurasian Collared-Doves can occur without a depredation permit issued by the USFWS. Therefore, the take of collared-doves by entities other than WS for damage management purposes is unknown, but is likely of low magnitude since doves are not associated with causing extensive damage to resources, except to human safety by posing threats to aircraft at airports. Eurasian Collared-Doves are similar in appearance to Mourning Doves and hunters likely harvest some collared-doves during the regulated hunting season for Mourning Doves. The harvest of Mourning Doves occurs under frameworks established by the USFWS and implemented by the TWRA; however, since Eurasian Collared-Doves are a non-native species, no frameworks for the harvest of collared-doves exists. Therefore, the annual take of Eurasian Collared-Doves during the annual hunting season for Mourning Doves is not currently available.

Based on the increasing population trends of Eurasian Collared-Doves observed on BBS routes and the CBC, WS anticipates addressing additional collared-doves in the future. In anticipation of receiving additional requests for assistance, WS could lethally remove up to 500 Eurasian Collared-Doves and up to 50 nests annually in the State to alleviate damage or threats of damage. As previously stated, collared-doves are a non-native species and any removal of collared-doves could improve conditions and reduce competition for food and habitat between collared-doves and native species. Activities conducted by WS would be pursuant to Executive Order 13112 to reduce invasion of exotic species and the associated damages.

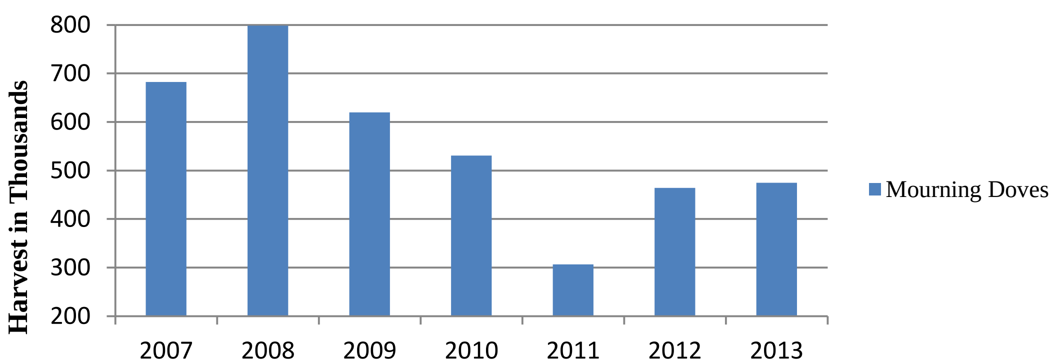
MOURNING DOVE BIOLOGY AND POPULATION IMPACT ANALYSIS

Mourning Doves are considered 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). They are a drab grayish brown with a slender, white-edged, pointed tail. Mourning Doves occur throughout the year in Tennessee (Otis et al. 2008).

According to trend data provided by Sauer et al. (2014), the number of Mourning Doves observed on routes surveyed has shown a decreasing trend in the State estimated at -0.6% annually since 1966, with an estimated annual decrease estimated at -0.9% from 2002 through 2012 (Sauer et al. 2014). Between 2003 and 2012, the number of doves heard and seen during the annual Mourning Dove Call-Count Survey has also decreased -0.6% annually in Tennessee (Seamans et al. 2013). Based on BBS data, the Partners in Flight Science Committee (2013) estimated the statewide breeding population at 1.4 million Mourning Doves. The number of Mourning Doves observed during the CBC has shown a general increasing trend in the State (National Audubon Society 2010).

Many states have regulated annual hunting seasons for doves each year with generous bag limits. Across the United States, the average harvest of Mourning Doves was 15.5 million doves with an estimated average of 385,550 doves harvested in Tennessee during the 2011 and 2012 hunting seasons (Raftovich and Wilkins 2013). Figure 4.3 shows the number of doves harvested in Tennessee during the annual hunting season from 2007 through 2013 based on data published by the USFWS (Raftovich et al. 2009, Raftovich et al. 2011, Raftovich and Wilkins 2012, Raftovich et al. 2014).

Figure 4.3 - Mourning Dove Harvest in Tennessee (2007-2013)



From FY 2009 through FY 2013, WS has addressed 23,416 doves to alleviate damage and threats (see Table 4.12). Of those doves addressed by WS from FY 2009 through FY 2013, WS used lethal methods to address 2,542 doves while 20,874 doves were addressed 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. WS could also receive requests for assistance to alleviate threats or damage to electrical utilities from roosting Mourning Doves. Migrating birds likely augment local populations of Mourning Doves in the State during the migration periods and during the winter months.

Table 4.12 – Mourning Doves addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed
2009	394	1,205
2010	796	6,352
2011	416	2,399
2012	537	9,282
2013	399	1,636
TOTAL	**2,542**	**20,874**

The USFWS publishes a report on the population status of Mourning Doves annually based upon call count survey data, breeding bird survey data, estimated hunter, and banding studies conducted annually. The USFWS reported an estimated population of 84 million to 131 million Mourning Doves in the Eastern Management Unit over the past ten years, and there was no evidence of change in dove abundance in the Unit in either the hunt or non-hunt states (Seamans et al. 2013). All estimates from the surveys seem to reveal a stable Mourning Dove population throughout the eastern United States.

Based upon an anticipated increase in requests for assistance, WS could lethally remove up to 1,500 Mourning Doves annually in Tennessee to protect property and reduce threats to human safety associated with large flocks of Mourning Doves at airports and electrical facilities. In addition, WS could destroy up to 50 Mourning Dove nests annually to alleviate damage or threats of damage.

The take of 1,500 Mourning Doves by WS would represent 0.1% of the estimated breeding population in Tennessee and 0.3% of the 474,500 doves that hunters harvested in the State during the 2013 hunting season. Like other native 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. Therefore, the take of Mourning Doves by WS would only occur at levels authorized by USFWS, which ensures the USFWS has the opportunity to consider WS' take and take by all entities, including hunter harvest, to achieve the desired population management levels of doves in Tennessee.

SNOWY OWL BIOLOGY AND POPULATION IMPACT ANALYSIS

Snowy Owls breed in open terrain of the artic barrens from the Aleutian Islands along the northern edge of Alaska, throughout the Canadian Arctic Islands and from northern Yukon, northeastern Manitoba, northern Quebec, and northern Labrador (Parmalee 1992). Snowy Owls occur in similar open habitats during their winter migrations. During the winter migrations, Snowy Owls occur across Canada, Alaska, and the northern edge of the United States; however, during years with severe winters or limited available food, Snowy Owls can occur as far south as Texas and Florida (Parmalee 1992). Snowy Owls are a nomadic species with unpredictable migrations (Parmalee 1992). A major component of the Snowy Owl's diet is lemmings, a small, vole-like mammal native to the tundra region of North America (Burt and Grossenheider 1964, Parmalee 1992). Collins, Jr. (1959) indicates that the Snowy Owls occasional southern forays are due to cycles of lemming die-offs, forcing starving owls south in search of alternative food options when lemming populations are low. While lemmings make up the majority of the diet, Snowy Owls will also feed on a variety of mammals and other bird species (ranging in size from small passerines to large hares or small geese), as well as fish and other aquatic animals (Parmalee 1992).

Snowy Owls usually perch on the ground or on slight rises, preferring open habitat for better visibility (Parmalee 1992). Therefore, the open habitats of airports provide ideal wintering areas for Snowy Owls. The number of Snowy Owls observed during the CBC across all areas surveyed in the United States has shown a variable trend over the past 20 years (National Audubon Society 2010). There are no breeding or year-round populations of Snowy Owls within Tennessee (Parmalee 1992). Population and trend data for Snowy Owls is limited and long-term data is lacking (Parmalee 1992). The Partners in Flight Science Committee (2013) estimated the breeding population in North America at 100,000 Snowy Owls.

Requests for assistance associated with Snowy Owls are likely to occur at airports where owls can pose a strike risk to aircraft. For example, during the winter of 2013, unusually large numbers of Snowy Owls appeared at several major airports across the northern United States where they posed strike hazards to aircraft. Planes struck five Snowy Owls at three different airports in the New York City area within a period of two weeks (see Fitzsimmons 2013, Tunison 2014). Between FY 2009 and FY 2013, the WS program in Tennessee did not receive requests for assistance associated with Snowy Owls. Requests for assistance in Tennessee are likely to occur infrequently, since Snowy Owls do not often migrate as far south as Tennessee. However, Snowy Owls will sometimes travel further outside their typical winter range, and while observing Snowy Owls in Tennessee is rare, they have occurred within the State (see Overton 2009).

WS would address Snowy Owls at airports primarily using non-lethal dispersal methods. Non-lethal efforts can be successful at dispersing owls from airports, including the incorporation of trap and relocation programs (see Fitzsimmons 2013, Tunison 2014). However, WS could receive requests to remove Snowy Owls lethally that pose a direct threat to aviation safety or when those owls consistently use areas of the airport where live-trapping or persistent harassment would not be practical, such as near high-use runways. In those situations, the airport could be required to close those runways or taxiways during trapping activities or harassment activities due to the safety of employees working in close proximity to active aircraft and for the safety of aircraft and passengers. In many situations, closing runways or taxiways would not be practical due to major delays in air traffic that could result from those closures. In those situations where the lethal removal of owls was necessary to alleviate immediate risks to aviation safety, WS anticipates removing up to two owls annually. However, the lethal take of Snowy Owls to alleviate aircraft strike hazards is not likely to occur frequently in the State. The lethal removal of two Snowy Owls, when necessary, would represent 0.002% of the estimated breeding population in North America.

The take of Snowy Owls could only occur when permitted by the USFWS through the issuance of depredation permits. Therefore, all take, including take by WS, would be authorized by the USFWS and would occur at the discretion of the USFWS. The take of Snowy Owls would only occur at levels authorized by the USFWS, which ensures the USFWS would have the opportunity to evaluate the cumulative take as part of population management objectives.

COMMON NIGHTHAWK BIOLOGY AND POPULATION IMPACT ANALYSIS

The Common Nighthawk can be found breeding throughout most of North America, except for the far northern arctic region and parts of the southwestern United States, wintering in South America (Brigham et al. 2011). Nighthawks are most active at dawn and dusk as they forage on flying insects and are commonly recognized by their calls (Brigham et al. 2011). Common Nighthawks nest on the open ground, gravel beaches, rocky outcrops, slashburned forests, and flat gravel rooftops in urban areas

(Brigham et al. 2011). In Tennessee, the nighthawk is a common summer resident throughout the State and can be found foraging over pastures, cultivated fields, and water surfaces.

Eggs of nighthawks are generally laid in April and May, with some reports of eggs occurring as late as August (Brigham et al. 2011). Spring migration dates generally occur in late March and early April with the fall migration occurring as early as July but is most common from August through September. Some flocks of nighthawks during the fall migration can be quite large (Brigham et al. 2011).

Populations of nighthawks are generally showing declining trends across their breeding range, likely due to loss of breeding habitat, declining insect populations from the use of pesticides, and/or predation (Bingham et al. 2011). In areas surveyed across the United States during the BBS, the number of nighthawks observed has shown an annual declining trend estimated at -1.9% since 1966, with a -1.0% annual trend occurring from 2002 through 2012 (Sauer et al. 2014). Across all BBS routes in Tennessee, the number of nighthawks observed has shown a declining trend estimated at -3.6% annually since 1966, with an estimated annual decrease of -3.3% occurring from 2002 through 2012 (Sauer et al. 2014). The Partners in Flight Science Committee (2013) estimated the breeding population of nighthawks in Tennessee at 11,000 individuals using BBS data. Because they winter in South America, Common Nighthawks are not commonly observed during the CBC (National Audubon Society 2010). Survey data relative to Common Nighthawk numbers should be interpreted with caution, as it is difficult to obtain reliable counts during the BBS and the CBC when the species is active close to dark and at night.

Most requests for assistance received by WS concerning nighthawks are associated with airports and the aircraft strike risks associated with nighthawks foraging over runways and taxiways. The open habitat environment of most airports provides ideal foraging areas for nighthawks. In addition, large flocks of nighthawks that can occur during the migration periods can also increase strike risks at airports. Between FY 2009 and FY 2013, the WS program in Tennessee employed non-lethal methods to disperse one nighthawk and employed lethal methods to remove 17 nighthawks to reduce aircraft strike risks at airports. The highest annual take by WS occurred during FY 2010 when WS removed nine nighthawks to alleviate risks.

Based on previous requests for assistance and in anticipation of addressing additional nighthawks, the WS program in Tennessee could lethally remove up to 25 Common Nighthawks annually to alleviate damage risks. WS would continue to address most requests for assistance with non-lethal dispersal methods. Based on population estimates for the State, the take of 25 nighthawks by WS would represent 0.2% of the estimated statewide breeding population. The take of Common Nighthawks by WS to alleviate damage risks would only occur when authorized by the USFWS and only at levels authorized. Most requests for assistance would be associated with nighthawks during the migration periods when large numbers of nighthawks can occur. Although current surveys for the Common Nighthawk indicate a declining trend, the International Union for Conservation of Nature lists the Common Nighthawk population in a category of "*least concern*" 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 2012*a*).

AMERICAN KESTREL BIOLOGY AND POPULATION IMPACT ANALYSIS

American Kestrels are the smallest and most common North American falcon. Their range includes most of North America, except the far northern portions of Alaska and Canada (Smallwood and Bird 2002). Kestrels are commonly found inhabiting open areas with short ground vegetation where kestrels search for prey from elevated perches and by hovering above the ground. Prey consists of arthropods and small vertebrates (Smallwood and Bird 2002). Kestrels are often attracted to areas of human activity because of the open areas created and the numerous perching sites (Smallwood and Bird 2002). Kestrels are cavity nesters, using the excavated holes of woodpeckers and other natural cavities in trees (Smallwood and Bird 2002). The availability of suitable cavities is often a limiting factor in parts of the breeding range of the kestrel (Smallwood and Bird 2002).

American Kestrels observed in areas during the BBS are showing an increasing trend in Tennessee estimated at 1.7% annually since 1966, with a 0.3% annual increase from 2002 through 2012 (Sauer et al. 2014). Kestrels are also showing increasing trends in the Central Hardwoods region and Mississippi Alluvial Valley region estimated at 0.05% and 2.5% since 1966, respectively (Sauer et al. 2014). The breeding population of kestrels in Tennessee has been estimated at 20,000 birds with the population across the United States estimated at nearly 1.7 million individuals (Partners in Flight Science Committee 2013). Trend data available from the CBC indicates a stable to increasing trend in kestrel populations in Tennessee (National Audubon Society 2010).

Most requests for assistance associated with kestrels occur at airports where kestrels pose a strike risk to aircraft. As shown in Table 4.13, WS has addressed 139 kestrels between FY 2009 and FY 2013 using non-lethal dispersal methods. WS has also addressed kestrels using lethal methods to alleviate damage, removing 62 kestrels between FY 2009 and FY 2013.

Table 4.13 – American Kestrels addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed
2009	16	17
2010	14	30
2011	8	25
2012	13	20
2013	11	47
TOTAL	**62**	**139**

WS anticipates the number of airports requesting assistance with managing damage and threats associated with American Kestrels to increase. To address those requests for assistance, WS could lethally remove up to 50 American Kestrels and destroy up to 25 nests annually under the proposed action alternative to alleviate damage and threats. The take of up to 50 American Kestrels annually by WS under the proposed action alternative would represent 0.3% of the estimated population of American Kestrels in the State.

Given the limited magnitude of take proposed by WS when compared to the estimated population, the magnitude of WS' take could be considered low. The take of American Kestrels could only occur when permitted by the USFWS through the issuance of depredation permits. Therefore, all take, including take by WS, would be authorized by the USFWS and would occur at the discretion of the USFWS. The take of American Kestrels would only occur at levels authorized by the USFWS, which ensures cumulative take would be considered as part of population management objectives for kestrels. The take of up to 25 American Kestrel nests to alleviate damage or threats of damage would not be expected to adversely affect the population of kestrels based on previous discussions.

PEREGRINE FALCON BIOLOGY AND POPULATION IMPACT ANALYSIS

As one of the most widespread bird species, the Peregrine Falcon can be found in a variety of habitats from the Tundra to the Tropics (White et al. 2002). Peregrine Falcons are medium to large birds distinguished by a dark facial stripe of variable width that extends from the eye and down the cheek, light coloring underneath, and barring under tail and wing (White et al. 2002). They are mostly a monogamous species that nest as early as late February through late June, with replacement clutches as late as

September, depending on the location (White et al. 2002). Peregrines traditionally nest on cliffs, but will also utilize buildings, bridges, or other man-made structures in urban areas, artificial nest boxes, and abandoned nests of ravens, eagles, or cormorants (White et al. 2002).

The falcon's diet consists primarily of other bird species (*i.e.*, passerines to small geese), but will also consume small mammals (*e.g.*, bats, squirrels, and rodents), amphibians, fish, and insects (White et al. 2002). Most prey is captured in the air while in flight, but it is not unusual for a Peregrine to walk on the ground in search of ground nests or rodents (White et al. 2002). Peregrines are also known to cache surplus prey, especially during the breeding season, often in a crevice or hole on a cliff face, under dense bushes or clumps of grass on a cliff edge, in tree cavities, at the base of fence posts, or on building ledges, under bridges, or behind billboards in urban areas (White et al. 2002).

During the 1950s, populations of Peregrine Falcons in North America began to experience sharp declines, primarily attributed to secondary hazards associated with pesticide use. The population declines became so severe that the Peregrine Falcon was listed as an endangered species under the ESA in 1970. Due to a remarkable recovery effort, the Peregrine Falcon was removed from the endangered species list in 1999 (Green et al. 2006). Monitoring efforts continue to show increasing populations in their historical ranges (White et al. 2002, Green et al. 2006). The number of Peregrine Falcons observed in all areas surveyed across the United States during the BBS has shown an increasing trend since 1966 estimated at 1.9% annually, with a 6.8% annual increase occurring from 2002 through 2012 (Sauer et al. 2014). In Tennessee, Peregrine Falcons have been observed breeding in the eastern part of the state (the Appalachian Mountain region), but are also present throughout the State during migration periods as birds move between breeding areas further north and their wintering areas in Central and South America (Sibley 2003). The number of Peregrine Falcons observed in areas surveyed during the CBC has shown a cyclical trend since 1966 (National Audubon Society 2010).

Requests for assistance associated with Peregrine Falcons are most likely to occur at airports where falcons pose a direct strike risk to aircraft and a threat to human safety, especially during the migration periods. Between 1990 and 2012, Dolbeer et al. (2013) reported that 224 civil aircraft strikes have occurred in the United States involving peregrine falcons, resulting in 187 hours of aircraft downtime and nearly $545,000 in damages to aircraft. Between FY 2009 and FY 2013, the WS program in Tennessee used non-lethal methods to disperse one Peregrine Falcon from an airport.

To reduce aircraft strike hazards at airports, WS would employ non-lethal harassment methods to disperse Peregrine Falcons. As discussed previously, the use of non-lethal harassment methods would not occur at a magnitude that would prevent access to necessary resources (*e.g*., nesting areas, feeding areas) to the extent the harassment would have any effect on a population. Harassment would involve only a few falcons, would occur for a short duration, and activities would occur in localized area.

If populations of Peregrine Falcons continue to increase and aircraft strike hazards associated with falcons continue to occur, WS could receive requests to lethally remove falcons to prevent aircraft strikes when non-lethal methods were ineffective at dispersing falcons. In most cases, non-lethal harassment methods or live-capture and translocation are effective at dispersing falcons from areas where aircraft strikes could occur; therefore, WS anticipates the need to lethally remove falcons to reduce aircraft strike risks would occur infrequently. In those situations where the lethal removal of falcons was necessary to alleviate immediate risks to aviation safety, WS anticipates that one falcon could be lethally removed over a five-year period to alleviate strike risks. Lethal removal of one falcon per five-year period would only occur if authorized by the USFWS through the issuance of a depredation permit.

The potential lethal removal of one Peregrine Falcon every five years would not reach a magnitude where adverse effects would occur to the species' population. WS would continue to address Peregrine Falcons using non-lethal methods and would only use lethal methods if non-lethal methods were ineffective at reducing strike risks. As stated in Chapter 1, if this alternative was selected, WS would monitor activities to ensure those activities occurred within the parameters evaluated in the EA. If the need to lethally remove Peregrine Falcons became more frequent or involved more than one individual every five years, WS would re-evaluate activities associated with falcons through a review of the EA and would conduct the appropriate analysis pursuant to the NEPA. In addition, the permitting of the lethal removal by the USFWS would also ensure any lethal removal conducted by WS occurred within allowable limits to meet population objectives for the species.

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 are found throughout the year in Tennessee (Verbeek and Caffrey 2002).

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 American Crow population in Tennessee has been estimated at 480,000 crows based on BBS data (Partners in Flight Science Committee 2013). From 1966 through 2012, trend data from the BBS indicates the number of crows observed in the State during the survey has increased at an annual rate of 0.6%, with a 0.5% annual increase occurring from 2002 through 2012 (Sauer et al. 2014). The number of crows observed throughout Tennessee in areas surveyed during the CBC has shown a stable trend since 1966, with an influx of sightings in the 1980s and 1990s (National Audubon Society 2010).

As discussed previously, blackbirds, including crows, can be taken without a depredation permit issued by the USFWS when committing or about to commit damage or posing a threat to human safety under a blackbird depredation order (see 50 CFR 21.43). In addition, crows can be harvested in the State during a regulated season that allows an unlimited number of crows to be harvested. Since the take of crows can occur without a permit from the USFWS under the blackbird depredation order, there have been no reporting requirements for the take of crows to reduce damage or reduce threats until recently. Therefore, the number of crows taken in the State under the depredation order to alleviate damage or reduce threats has been unknown until recently. Similarly, hunters harvesting crows during the regulated hunting season are not required to report their take to the USFWS or the TWRA. In Tennessee, WS provides assistance with damage or threats of damage related to American Crows primarily at airports and landfills.

From FY 2009 through FY 2013, WS dispersed 97 American Crows and killed 35 crows in Tennessee to manage damage or reduce threats. Based on previous requests for assistance and increasing population trends, WS anticipates taking up to 500 American Crows annually. The take of 500 crows represents only 0.1% of the estimated breeding population within Tennessee. As was stated previously, the take of crows by other entities either to alleviate damage or during the annual hunting seasons is currently unknown. Given the relative abundance of American Crows in the State, the take of crows under the depredation order by other entities is likely to occur, but to be a small contributor to the cumulative take of crows annually and not expected to reach a high magnitude. Similarly, the take of crows during the annual hunting season is likely of low magnitude when compared to the statewide population.

CLIFF SWALLOW BIOLOGY AND POPULATION IMPACT ANALYSIS

The Cliff Swallow is one of the most social birds of North America, nesting in large colonies with densities up to 50 nests/m^2 in a single site (Stoddard and Beecher 1983, Brown and Brown 1995). Cliff Swallows are historically a western species, but with the construction of highway culverts, bridges, and buildings providing an abundance of nesting sites, these birds have expanded their range across the Great Plains and into the East over the last century (Brown and Brown 1995). These birds are also well-known brood-parasites, often laying or moving their own eggs into neighboring nests (Brown and Brown 1995).

In Tennessee, BBS data has shown an increasing trend estimated at 8.7% annually since 1966 with an increasing trend of 17.5% between 2002 and 2012 (Sauer et al. 2014). The Cliff Swallow has shown an annual increasing trend estimated at 1.3% since 1966 and 5.1% between 2002 and 2012 across all areas surveyed in the United States (Sauer et al. 2014). Based on data from the annual BBS, the Partners in Flight Science Committee (2013) estimated the statewide breeding population at 130,000 individuals. Cliff Swallows migrate further south after the breeding season and have not been observed in areas surveyed in the State during the CBC.

Between FY 2009 and FY 2013, the WS program euthanized one Cliff Swallow in the State as part of management activities to alleviate damage. Due to the increased presence of Cliff Swallows in Tennessee and trend data provided by the BBS, along with the social nesting behavior of Cliff Swallows, WS expects to address increasing conflicts associated with this species in the future. To address future requests for assistance, WS anticipates taking up to 300 Cliff Swallows and up to 500 nests annually to alleviate damage or threats. Requests for assistance associated with Cliff Swallows are likely to be associated with airports where the gregarious behavior of swallows can pose an aircraft strike hazard. Colonial nesting birds can also create a health hazard, unsightly conditions, and kill off plant species with accumulated droppings under nest areas.

The take of up to 300 Cliff Swallows annually would represent 0.2% of the breeding population in Tennessee. Nest and egg destruction methods are considered non-lethal when conducted before the development of an embryo and are expected to have little effect on Cliff Swallow populations in Tennessee. Like many other bird species, the take of Cliff Swallows by WS to alleviate damage would only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits and only at levels permitted. Therefore, the take of Cliff Swallows by WS would only occur at levels authorized by the USFWS, which would ensure WS' take was considered to achieve the desired population objectives for swallows in the State.

BARN SWALLOW BIOLOGY AND POPULATION IMPACT ANALYSIS

Barn Swallows are considered one of the most abundant and widespread of the swallow species. Breeding populations are known to 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). In Tennessee, Barn Swallows are common throughout the State in the breeding season (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).

According to BBS trend data, Barn Swallow populations have decreased at an annual rate of -0.8% in Tennessee since 1966 (Sauer et al. 2014). The number of Barn Swallows observed along routes surveyed in the Central Hardwoods and the Appalachian Mountains have also shown decreases estimated at -1% and -0.2%, respectively, since 1966; however, populations in the Mississippi Alluvial Plain and the Southeastern Coastal Plain have shown annual increasing trends estimated at 3.6% and 2.7%, respectively, since 1966 (Sauer et al. 2014). Across all BBS routes in the United States, Barn Swallows have exhibited an annual decline estimated at -0.3% since 1966 (Sauer et al. 2014). The Partners in Flight Science Committee (2013) estimated the breeding population in the State to be 890,000 Barn Swallows using data from the BBS. Barn Swallows migrate further south after the breeding season and are not observed in those areas surveyed in the State during the CBC.

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. To discourage nesting, WS may also remove and destroy nests and eggs. During this time, WS has employed both lethal and non-lethal methods to alleviate nuisance birds and potentially damaging situations relating to aviation safety. From FY 2009 through FY 2013, 190 Barn Swallows were dispersed by WS and 67 Barn Swallows were lethally removed by WS to alleviate damage pursuant to depredation permits (see Table 4.14). Based on population estimates for Tennessee and previous requests for assistance, WS anticipates the possibility of taking up to 300 Barn Swallows and up to 500 nests annually.

Table 4.14 – Barn Swallows addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed	Nests Removed
2009	4	0	93
2010	48	0	82
2011	11	0	114
2012	1	100	39
2013	3	90	0
TOTAL	**67**	**190**	**328**

The take of up to 300 Barn Swallows each year would represent 0.03% of the estimated breeding population in Tennessee. Impacts due to nest and egg destruction are expected to have little adverse effect on the Barn Swallow population in Tennessee. Nest and egg destruction methods are considered non-lethal when conducted before the development of an embryo.

Like many other bird species, the take of Barn Swallows by WS to alleviate damage would only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits and only at levels permitted. Therefore, the take of Barn Swallows by WS would only occur at levels authorized by the USFWS, which would ensure WS' take was considered to achieve the desired population objectives for swallows in the State.

AMERICAN ROBIN BIOLOGY AND POPULATION IMPACT ANALYSIS

The American Robin is the largest, most abundant, and most widespread North American thrush (Vanderhoff et al. 2014). The conspicuous nature of the American Robin and the close association with human habitation, make the robin one of the most recognizable birds in the United States (Vanderhoff et al. 2014). Robins are often the harbinger of spring in many parts of the northern latitudes of North America, but can be found throughout the year in Tennessee (Vanderhoff et al. 2014). Robins primarily feed on invertebrates and fruit, varying seasonally (Vanderhoff et al. 2014). During the migration periods, robins often form large flocks, which can increase aircraft strike hazards at airports.

Across all BBS routes in the United States, the number of robins observed since 1966 have shown an increasing trend estimated at 0.3% annually (Sauer et al. 2014). In Tennessee, the number of robins observed during the BBS has shown an increasing trend estimated at 1.8% annually since 1966, with a 0.7% annual increase occurring from 2002 through 2012 (Sauer et al. 2014). The Partners in Flight Science Committee (2013) estimated the breeding population in Tennessee to be 2.4 million robins based on BBS data. The number of robins observed in areas surveyed during the CBC in the State has shown a cyclical pattern, but overall stable trend (National Audubon Society 2010). Between 2004 and 2013, 37,200 robins have been observed on average per year in areas surveyed during the CBC in the State (National Audubon Society 2010). The range of robins observed in the State during the CBC conducted from 2004 through 2013 has been a low of 7,303 robins to a high of 105,385 robins, which demonstrates the cyclical pattern observed from 1966 through 2013.

American Robins are present in the State all year, but may aggregate during the migration periods in large flocks. WS could addresses robins in the State to alleviate damage or threats of damage, primarily at airports in the spring where robins pose a strike risk to aircraft when they aggregate in large flocks. Between FY 2009 and FY 2013, the WS program in Tennessee lethally removed 24 robins and used non-lethal harassment methods to disperse 168 robins.

Based on requests for assistance previously received, WS could lethally remove up to 300 robins annually to alleviate damage or reduce threats in the State. As stated previously, large flocks of American Robins are present in the State during the winter, as well as, during the migration periods and most requests for assistance are associated with large groups of robins at airports. Based on the average number of robins observed in areas surveyed during the CBC from 2004 through 2013, the annual take of 300 American Robins by WS would present 0.8% of the average. If WS had lethally removed 300 robins annually from 2002 through 2011, the annual take would have ranged from 0.3% to 4.1% of the number of robins observed annually from 2004 through 2013 during the CBC. Although robins could be addressed during the breeding season, most activities would occur during the migration periods when robins occur in large flocks.

All take of robins by WS would occur only after a depredation permit has been issued by USFWS and only at levels allowed under the permit; therefore, the cumulative take of robins in the State would occur at the discretion of the USFWS to meet desired population objectives for robins. Any take by WS pursuant to depredation permits would occur within take limits to ensure the take of robins occurs within the allowable limits.

EUROPEAN STARLINGS BIOLOGY AND POPULATION IMPACT ANALYSIS

Colonization of North America by the European Starling began on March 6, 1890 when a member of the Acclimatization Society released 80 starlings into New York City's Central Park. The released birds were able to exploit the resources in the area and become established. 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 and starlings were known to occur and breed 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). In Tennessee, starlings can be found throughout the year. Flocks of many thousands of birds are frequently observed during the winter consisting of starlings, Common Grackles, Red-winged Blackbirds, and Brown-headed Cowbirds (Cabe 1993). American Robins, Rock Pigeons, and crows are also known to feed with starlings (Cabe 1993).

From 1966 through 2012, the number of starlings observed along routes surveyed during the BBS has shown a slightly decreasing trend in the State estimated at -0.02% annually, with a -0.1% decrease annually from 2002 through 2012 (Sauer et al. 2014). Across all routes surveyed in the United States during the BBS, starling populations are also showing a declining trend estimated at a rate of -0.9% annually from 1966 through 2012 (Sauer et al. 2014). Using data from the BBS, the Partners in Flight Science Committee (2013) estimated the statewide breeding population of starlings at 1.4 million birds. The number of starlings observed in those areas surveyed during the CBC in the State is showing a general stable 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 dairy workers and livestock, starlings will also consume all or most of the valuable nutrients in livestock feed, resulting in reduced milk production. From FY 2009 through FY 2013, over 81,000 European Starlings were dispersed by WS and 2,655 starlings were lethally taken to alleviate damage in Tennessee (see Table 4.15).

Table 4.15 – European Starlings addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed
2009	449	4,180
2010	454	10,620
2011	558	10,857
2012	514	20,078
2013	680	35,758
TOTAL	**2,655**	**81,493**

Based on population estimates and the expectation of receiving more requests for assistance, WS could take up to 10,000 European Starlings and up to 200 nests annually. The take of 10,000 starlings would represent less than 0.7% of the estimated breeding population in the State. Starlings are not native to North America and any removal of starlings could improve conditions and reduce competition of food and habitat for native species. Furthermore, starlings are afforded no protection under the MBTA or any State law and a depredation permit from the USFWS is not required to lethally take starlings to alleviate damage or threats of damage. Since the take of starlings is not reported to the USFWS, 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.

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 can be found 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 Tennessee, Red-winged Blackbirds are considered year-round residents of the State (Yasukawa and Searcy 1995) with a breeding population estimated at 700,000 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% annually (Sauer et al. 2014). More recent trend data from 2002 through 2012 also indicates a downward trend estimated at -2.2% annually (Sauer et al. 2014). The number of Red-winged Blackbirds observed during the CBC in the State has shown a cyclical pattern, but overall stable trend since 1984 (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 Tennessee (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.

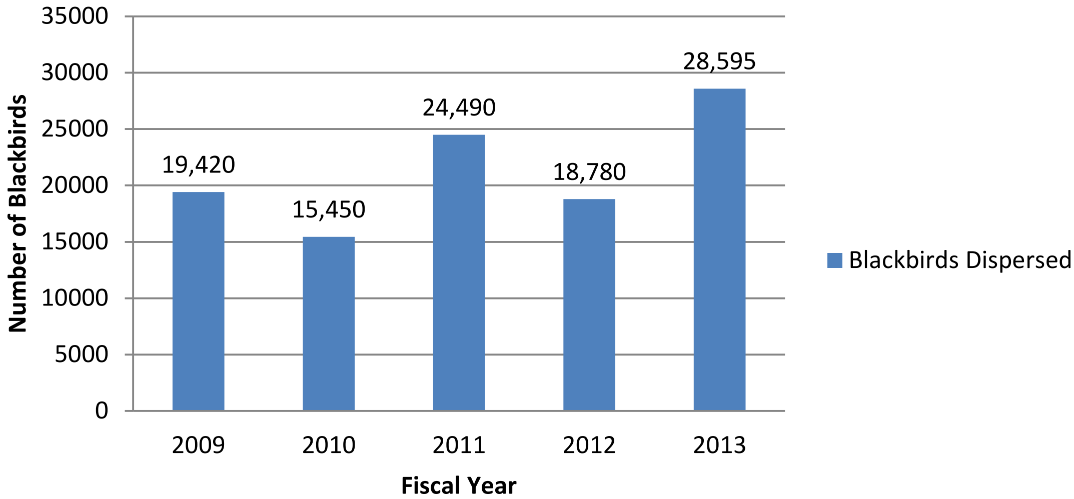
Table 4.16 shows the number of Red-winged Blackbirds addressed by WS from FY 2009 through FY 2013. Over 91% of the Red-winged Blackbirds addressed by WS from FY 2009 through FY 2013 were dispersed using non-lethal harassment methods (*e.g.*, pyrotechnics, noise associated with the discharge of a firearm). 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 4.16 –Red-winged Blackbirds addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed
2009	0	0
2010	4	36
2011	9	0
2012	4	0
2013	58	738
TOTAL	**75**	**774**

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. Figure 4.4 shows the number of blackbirds in mixed species flocks dispersed by WS in the State from FY 2009 through FY 2013.

Figure 4.4 - Number of Blackbirds Dispersed by WS in Tennessee



Based on the population data for Tennessee and previous management activity focused on relieving damage or threats from blackbirds, WS could lethally remove up to 5,000 Red-winged Blackbirds annually to alleviate damage or threats of damage. With an estimated statewide population of 700,000 birds, the take of 5,000 Red-winged Blackbirds annually would represent 0.7% of the breeding Red-winged Blackbird population in Tennessee.

The numbers of blackbirds present in the State likely increases as migratory blackbirds begin arriving in the State during the fall and winter. Between 2004 and 2013, surveyors counted an average of nearly 49,000 red-winged blackbirds per year in those areas of the State surveyed during the CBC (National Audubon Society 2010). The take of up to 5,000 red-winged blackbirds by WS would represent 10.2% of the average number of blackbirds observed in areas of the State surveyed during the CBC between 2004 and 2013. The areas surveyed during the CBC represent a small portion of the State. The number of blackbirds observed in those areas surveyed during the CBC only represent the number of blackbirds observed and does not represent statewide population estimates.

Activities to alleviate damage associated with Red-winged Blackbirds also likely occur by entities other than WS. As discussed previously, under 50 CFR 21.43, a depredation permit is not required to lethally take Red-winged Blackbirds when found committing or about to commit damage to resources or when concentrated in such numbers and in a manner as to constitute a health hazard or other nuisance. Prior to January 3, 2011, there were no reporting requirements for take under 50 CFR 21.43 (see 75 FR 75153-75156). Therefore, the number of Red-winged Blackbirds that entities other than WS lethally removes to alleviate damage or the threat of damage pursuant to 50 CFR 21.43 is unknown prior to January 3, 2011. Although private individuals are required to report the number and species of blackbirds lethally removed to the USFWS, it is unknown whether the reported take accurately reflects the actual take since it is likely that some take of blackbirds goes unreported. However, some annual take is likely to occur by private individuals. However, the take of Red-winged Blackbirds by other entities is likely to be of low magnitude.

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 can be found throughout the eastern United States but their range can be highly dependent on habitat availability. Meadowlarks can be found statewide throughout the year in Tennessee (Jaster et al. 2012).

Meadowlarks are associated with grassy fields, pastures, cultivated areas, groves, open pinewoods, and prairies (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 Tennessee. Meadowlarks found on and adjacent to airport property can pose a strike hazard, causing damage to the aircraft and threatening passenger safety.

As reported by the BBS, populations of Eastern Meadowlarks in Tennessee have decreased since 1966 at an estimated rate of -3.8% annually (Sauer et al. 2014). In the United States, meadowlarks are also showing a declining trend across all BBS survey routes estimated at -3.4% annually since 1966 (Sauer et al. 2014). The Partners in Flight Science Committee (2013) estimated the current statewide population at 640,000 individuals. CBC data shows a cyclical, but overall decreasing pattern for meadowlarks in Tennessee from since 1966 (National Audubon Society 2010).

From FY 2009 through FY 2013, the WS program in Tennessee employed lethal methods to remove 20 meadowlarks in the State and non-lethal methods to disperse 94 meadowlarks to reduce strike risk at airports in the State. WS has addressed requests associated with meadowlarks using primarily non-lethal dispersal methods. 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 up to 100 Eastern Meadowlarks could be taken annually in the State and up to 50 nests could be destroyed to alleviate the threat of damage.

Based on the estimated population, WS' take of up to 100 meadowlarks would represent 0.02% of the estimated population in Tennessee. 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). However, the International Union for Conservation of Nature and Natural Resources ranks the Eastern Meadowlark as a species of "*least concern*" (BirdLife International 2012*b*). 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 2012*b*). The permitting of the take by the USFWS through the issuance of depredation permits pursuant to the MBTA ensures that the cumulative take of meadowlarks would be considered as part of population management objectives for this species.

COMMON GRACKLE BIOLOGY AND POPULATION IMPACT ANALYSIS

Common Grackles are a semi-colonial nesting species often associated with human activities. 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 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).

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 be found in mixed species flocks of blackbirds. Common Grackles are considered a year-round, permanent resident of Tennessee and are commonly seen foraging and roosting in flocks with other blackbirds (Peer and Bollinger 1997). Large numbers of nesting grackles can be found in open woodlands, swamps, marshes, pine forests, hammocks, and suburban areas.

The breeding population of Common Grackles in the State has been estimated at 1.5 million grackles (Partners in Flight Science Committee 2013). The number of grackles observed along BBS routes surveyed in the State has shown a downward trend between 1966 and 2012 estimated at -3.1% annually (Sauer et al. 2014). Between 2002 and 2012, the number of grackles observed during the BBS has also shown a downward trend in the State estimated at -3.5% annually (Sauer et al. 2014). Downward trends have also been estimated for the number of grackles observed during the BBS conducted across all routes surveyed in the United States estimated at -1.8% annually since 1966 (Sauer et al. 2014). The number of Common Grackles observed in areas surveyed during the CBC has shown a stable trend (National Audubon Society 2010). From FY 2009 through FY 2013, WS dispersed almost 2,000 grackles and lethally removed 115 grackles to alleviate damage (see Table 4.17).

Table 4.17 – Common Grackles addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed
2009	9	0
2010	7	0
2011	62	1,500
2012	18	20
2013	19	377
TOTAL	**115**	**1,897**

Based on the estimated population and the anticipation of receiving more requests for assistance, WS could take up to 1,500 Common Grackles. Like other blackbird species, the take of Common Grackles can occur under the blackbird depredation order, which allows blackbirds, including Common Grackles, to be taken when committing damage or about to commit damage without the need for a depredation permit from the USFWS. The take of up to 1,500 Common Grackles would represent 0.1% of the estimated breeding population in Tennessee. Although private individuals are now required to report the number and species of blackbirds lethally removed to the USFWS, it is unknown whether the reported take accurately reflects the actual take since it is likely that some take of blackbirds goes unreported. However, some annual take is likely to occur by private individuals. However, the take of Common Grackles by other entities is likely to be of low magnitude. The take of Common Grackles by WS and other entities is expected to be of low magnitude when compared to the statewide estimated population for Tennessee and is not expected to have adverse impacts on the breeding population.

BROWN-HEADED COWBIRD BIOLOGY AND POPULATION IMPACT ANALYSIS

Brown-headed Cowbirds are another species commonly found in mixed-species flocks during migration periods. Brown-headed Cowbirds are considered permanent, year-round residents of Tennessee (Lowther 1993). Breeding populations in the north are migratory with cowbirds present year-round in much of the eastern United States and along the west Coast (Lowther 1993). Cowbirds expanded their breeding range as people began clearing forests for agricultural practices (Lowther 1993). Cowbirds are still commonly found in open grassland habitats but also inhabit urban and residential areas.

Unique in their breeding habits, 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, 144 species of which have actually raised cowbird young (Lowther 1993). No parental care is provided by cowbirds as the raising of cowbird young occurs by the host species. There has been some concern that the brood parasitism of cowbirds may threaten the breeding populations of vulnerable species, although the effects of parasitism on those species are unknown.

The number of cowbirds observed in areas surveyed during the BBS throughout Tennessee has shown a decreasing trend estimated at -0.6% annually since 1966, with the number of cowbirds observed in the State from 2002 to 2012 showing an estimated decreasing trend of -1% annually (Sauer et al 2014). In the Southeastern Coastal Plain and the Mississippi Alluvial Valley, cowbirds have shown a slight annual increasing trend since 1966 estimated at 0.5% and 0.2%, respectively; however, the Central Hardwoods and the Appalachian Mountains regions are also showing decreasing annual trends estimated at -1.0% and -2.2%, respectively (Sauer et al. 2014). Across all BBS routes surveyed in the United States, the number of Brown-headed Cowbirds has shown a declining trend estimated at -0.5% (Sauer et al. 2014). The number of cowbirds observed during the CBC conducted annually in the State is also showing a decreasing population trend (National Audubon Society 2010). The Partners in Flight Science Committee (2013) estimated the statewide breeding population of cowbirds at 1.1 million cowbirds based on data from the BBS.

From FY 2009 through FY 2013, WS dispersed 225 cowbirds and used lethal methods to remove 187 cowbirds (see Table 4.18). Based on the previous number of requests to manage damages and threats associated with cowbirds, and in an anticipation of an increased need to address future damages and threats in the State, up to 1,500 cowbirds could be lethally removed by WS annually in Tennessee under this alternative. If WS lethally removed up to 1,500 cowbirds annually, the take would represent 0.1% of the estimated 1.1 million cowbirds breeding within the State.

Table 4.18 – Brown-headed Cowbirds addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed
2009	0	0
2010	105	0
2011	15	0
2012	57	75
2013	10	150
TOTAL	**187**	**225**

Like other blackbird species, the take of cowbirds can occur pursuant to the blackbird depredation order without the need for a depredation permit from the USFWS. For this reason, the number of cowbirds taken annually by other entities to alleviate damage or threats of damage in the State is unknown; however, the take of cowbirds by other entities to alleviate damage or threats is likely minimal in the State. The take of Brown-headed Cowbirds by other entities is expected to be of low magnitude when compared to the estimated population of Tennessee.

HOUSE FINCH BIOLOGY AND POPULATION IMPACT ANALYSIS

Historically a hot desert species that favored open habitats of the southwest, the House Finch was introduced to eastern North America around 1940 when individuals were brought from California and released 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 can be found year-round in Tennessee (Badyaev et al. 2012).

The number of finches observed in areas surveyed during the BBS throughout Tennessee shows an increasing trend estimated at 18% annually between 1966 and 2012 (Sauer et al. 2014). The number of finches observed in the State from 2002 to 2012 has shown an estimated decreasing trend of -0.6% annually (Sauer et al 2014). All four BCRs that encompass Tennessee have shown strong increasing trends ranging from 8.3% to 16.2% since 1966 (Sauer et al. 2014). Across all BBS routes surveyed in the United States from 1966, the number of House Finches has shown a slight increasing trend estimated at 0.02% (Sauer et al. 2014). The annual CBC indicates 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 500,000 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. As prey for large raptors (*e.g.*, Cooper's Hawk, Northern Harrier, and American Kestrel), flocks of House Finches may also attract other species to further increase a safety threat near airports. 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 2009 through FY 2013, the WS program in Tennessee has lethally removed 69 House Finches to alleviate damage or threats of damage. The highest annual take occurred in FY 2012 when WS removed 45 House Finches in the State. Because of the gregarious behavior of this species and in anticipation of increasing requests for assistance, WS could take up to 150 House Finches and up to 50 nests annually to alleviate damage and associated threats.

The take of up to 150 House Finches represents 0.03% of the estimated breeding population in Tennessee. Even though the House Finch was introduced in the eastern United States, it is still a native species and protected under the MBTA. Like other native bird species, the take of House Finches by WS to alleviate damage will only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits. Therefore, take by WS would only occur at levels authorized by USFWS, which ensures that all take would be considered to achieve the desired population management levels of finches in Tennessee.

HOUSE SPARROW BIOLOGY AND POPULATION IMPACT ANALYSIS

House Sparrows were introduced to North America from England in 1850 and have since spread throughout the continent (Fitzwater 1994). House Sparrows are found 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 considered migratory in North America and are considered year-round residents wherever they occur, including those sparrows found in Tennessee (Lowther and Cink 2006). Nesting locations often occur in areas of human activities and 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 be found in the winter as birds forage and roost together.

According to BBS trend data provided by Sauer et al. (2014), the number of House Sparrows observed along all routes surveyed across the United States have shown a statistically significant downward trend estimated at -3.7% annually between 1966 and 2012. In Tennessee, the number of House Sparrows observed in areas surveyed during the BBS has also shown a downward trend estimated at -2.8% annually since 1966 (Sauer et al. 2014). More recently, the number of House Sparrows observed between 2002 and 2012 has also shown a declining trend estimated at -2.4% annually (Sauer et al. 2014). The number of House Sparrows observed in areas surveyed during the CBC annually has also shown a decreasing trend since 1966 (National Audubon Society 2010). The Partners in Flight Science Committee (2013) estimated the breeding population of House Sparrows in the State to be 500,000 birds.

Robbins (1973) suggested that declines in the sparrow population must be largely attributed to 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 20^{th} century. Ehrlich et al. (1988) suggested that House Sparrow population declines might be linked to the dramatic decrease during the 20^{th} century in the presence of horses as transport animals. Grain rich horse droppings were apparently a major food source for House Sparrows.

Between FY 2009 and FY 2013, WS has employed non-lethal methods to address 602 sparrows in the State to alleviate damage or threats of damage (see Table 4.19). In addition, WS lethally removed 283 House Sparrows in the State from FY 2009 through FY 2013. House Sparrow nests and eggs were also removed or destroyed for management purposes. Since House Sparrows are afforded no protection from take under the MBTA, no depredation permits are issued for the take of House Sparrows and there is no requirements to report take of sparrows; therefore, the number of sparrows lethally removed by other entities 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 300 House Sparrows and up to 50 nests in the State annually to alleviate damage or threats of damage.

Table 4.19 – House Sparrows addressed by WS in Tennessee from FY 2009 to FY 2013

Year	Take	Dispersed	Nests Removed
2009	69	475	19
2010	20	7	0
2011	45	50	0
2012	84	0	0
2013	65	70	0
TOTAL	**283**	**602**	**19**

If up to 300 sparrows were lethally removed by WS annually in the State, the take would represent 0.06% of the statewide breeding population in Tennessee. As stated previously, the annual take of House Sparrows by other entities is currently not known. House Sparrows are non-indigenous and often have negative effects on native birds, primarily through competition for nesting sites; therefore, sparrows are considered by many wildlife biologists and ornithologists to be an undesirable component of North American wild and native ecosystems. Any reduction in House Sparrow populations in North America could be considered as providing some benefit to native bird species. House Sparrows are afforded no protection from take under the MBTA or State laws. WS' take of House Sparrows to reduce damage and threats would comply with Executive Order 13112.

ADDITIONAL TARGET BIRD SPECIES

WS has addressed limited numbers of additional target species previously or WS anticipates addressing a limited number of additional 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 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. The target bird species that WS could address in limited numbers, after receiving a request for assistance associated with those species, would include those birds identified in Appendix E[20].

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 annually of any of those species identified in Appendix E, except for those waterfowl and game species identified in Appendix E that have annual hunting seasons. 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. In addition, to alleviate damage or discourage nesting in areas where damages were occurring, WS could destroy up to 10 nests annually of those species that nest in the State. WS does not expect the annual take of those species 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. If the USFWS did not issue a permit, no take would occur by WS. In addition, take could only occur at those levels stipulated in the 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 permitting processes. The USFWS, as the agency 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 impact on the quality of the human environment. In addition, WS would report annually to the USFWS any take of the bird species listed in Appendix E in accordance with a federal and state permit.

As part of an integrated approach to managing damage, WS could destroy up to 10 nests and the associated eggs annually of those species that nest in the State. People often consider nest and egg destruction methods as a non-lethal approach when conducted before the development of an embryo. 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 nest destruction, this activity has no long-term effect on breeding adult birds. WS would not use nest and egg removal as a population management method. WS would use nest and egg destruction to inhibit nesting in an area experiencing damage due to the nesting activity and WS would only employ nest and egg destruction at a localized level. As with the lethal removal of birds, the destruction of nests could only occur when authorized by the USFWS, when required. Therefore, the number of nests that WS would remove annually would occur at the discretion of the USFWS.

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[20] Appendix E contains a list of the common and scientific names of those bird species that WS could address infrequently and/or in low numbers.

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.[21] 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.

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

[21]Data collected by organizations/agencies conducting research and monitoring will provide a broad species and geographic surveillance effort.

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 requestor or from a site visit. In some instances, wildlife-related information provided to the requestor 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 B 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 B 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[22]. 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 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 TWRA, when required. Lethal removal of birds could continue to occur without a permit, during hunting seasons, under depredation/control orders, or through the issuance of depredation permits by the USFWS. The USFWS

[22]Pesticide applicators licenses can be obtained by people who meet TDA requirements and successfully pass testing requirements

can issue permits for those species of birds protected under the MBTA, while the TWRA may issue permits for Wild Turkeys and other 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 to bird populations in the State would not occur directly from a program implementing technical assistance only.

With the oversight of the USFWS and the TWRA, 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 TWRA, 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 TWRA, the TDA, 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 B would be available under this alternative, although not all methods would be available for direct implementation by all persons because several chemical methods are only available to those people with pesticide applicators licenses. Mesurol, alpha chloralose, and DRC-1339 are only 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. The USFWS can issue permits for those species of birds protected under the MBTA, while the TWRA may issue permits for Wild Turkeys and other bird species. 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 information were provided to the USFWS by the TWRA, the TDA, or another agency, they could review the application and make a determination as described in Alternative 1.

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 TWRA. 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 alleviate 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 Tennessee. WS' personnel use a thought process for evaluating and responding to requests for assistance detailed in the WS Decision Model (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/egg 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.

Nest destruction would not adversely affect non-target species since identification of 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 TDA 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 (Shafer 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 Tennessee. 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[23].

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 4,6-dimethyl-2-pyrimidinal (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*a*). 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

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[23]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.

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, 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 B. 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™, 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, Jr. 1972, Schafer, Jr. et al. 1977, Cunningham et al. 1979) and low toxicity to most mammals, sparrows, and finches (Schafer, Jr. and Cunningham 1967, Apostolou 1969, Schafer, Jr. 1972, Matteson 1978, 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})[24] 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).

[24]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.

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 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 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, Jr. 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 as little as 5 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 every precaution would be taken 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 Tennessee would be expected to be extremely low to non-existent. Non-targets have not been lethally removed by WS during prior activities targeting birds in the State. 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 TWRA 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 Tennessee as determined by the USFWS during the development of this EA. Appendix C 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 not likely adversely affect those species listed in the State by the USFWS or their critical habitats. As part of the development process associated with this EA, WS re-initiated consultation with the USFWS pursuant to Section 7 of the ESA. The USFWS concurred with WS' determination that activities conducted pursuant to the proposed action would not likely adversely affect those species currently listed in the State or their critical habitats (M. Jennings, USFWS, pers. comm. 2015). WS would continue to consult with the USFWS 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 State listed species designated as endangered or threatened by the TWRA and the TDEC (see Appendix D). As part of the development process associated with this EA, WS has re-initiated consultation with the TWRA and the TDEC. WS is currently seeking concurrence from the TWRA on WS' effects determination. WS would abide by the outcome associated with the consultation process. WS would continue to consult with the TWRA and the TDEC to evaluate activities to resolve bird damage to ensure the protection of threatened or endangered species in the State.

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 requestor 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/or the TWRA, 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 B 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 wildlife 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 B, would be integrated to alleviate 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 alleviate 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, 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 TWRA. 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.

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 Tennessee. 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. DRC-1339 is 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. However, DRC-1339 is not currently registered for use in Tennessee.

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).

As mentioned previously, formulations of DRC-1339 are not currently registered for use in the State, including formulations for crows. However, 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 from June 1 through February 28 (TWRA 2014*b*). 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 using acute doses ranging from 40 to 863 mg/kg. The acute lethal oral dose of DRC-1339 for Boat-tailed Grackles (*Quiscalus major*) 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 Tennessee, the number is likely very few, if any, people are likely consuming crows harvested in Tennessee 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. In addition, no formulations of DRC-1339 are currently available for use in the State; therefore, no exposure would occur at this time.

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 birds be harvested during the regulated hunting season, which is established by the TWRA 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 TWRA 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.

WS could also use paintball guns to disperse target bird species. Paintballs do not actually contain paint, but are marking capsules which 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 pig skin, 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 2009 through FY 2013. 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 alleviate 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. 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 TWRA, 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 TWRA 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 B would be available to those persons experiencing damage or threats and could be used to take birds if permitted by the USFWS and/or the TWRA. 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 taking of birds would be shooting and nest destruction. Under this alternative, shooting and nest destruction would be available to those persons experiencing damage or threats of damage when required and permitted by the USFWS and/or the TWRA. 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 alleviate 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 alleviate 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 the TWRA, 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 2009 through FY 2013 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 requestor 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 TWRA, 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 TWRA 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 TWRA, 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 TWRA.

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 TWRA, when required. The humaneness and animal welfare concerns of methods available for use in Tennessee, 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/egg 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, Jr. 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 be 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 Tennessee.

The chemical repellent under the trade name Avitrol acts as a dispersing agent when birds ingest treated bait, which causes them to become hyperactive. 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*a*). 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 B 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.

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 alleviate 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 in the proposed action alternative.

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 Tennessee. Those people experiencing damage or threats associated with birds could use those methods legally available and permitted by the USFWS, the TWRA, 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.

Issue 6 - Effects of Bird Damage Management Activities on the Regulated Harvest of Birds

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 TWRA. Those species addressed in this EA that have established hunting seasons include Snow Geese, Canada Geese, Mallards, Wild Turkeys, Eurasian Collared-Doves, Mourning Doves, Sandhill Cranes, and American Crows. In addition, the waterfowl species addressed in Appendix E along with Fish Crows can be harvested during annual hunting seasons. For many migratory bird species considered harvestable during a hunting season, the number of birds harvested during the season is reported by the USFWS and/or the TWRA in published reports.

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

The magnitude of take addressed in the proposed action would be low when compared to population data and the mortality of birds from all known sources. When WS' proposed take of those bird species considered harvestable was included as part of the known mortality of those species and compared to the estimated populations of those species, the potential effects on those species' populations was below the level of removal required to lower population levels. The USFWS and the TWRA would determine the number of birds taken annually by WS through the issuance of depredation permits and by regulating take through the depredation orders and control orders.

WS would primarily conduct activities in areas where hunting access was restricted (*e.g.*, airports) or was ineffective (*e.g.*, urban areas). The use of non-lethal or lethal methods often disperses birds from areas where damage was occurring to areas outside the damage area, which could serve to move birds from those less accessible areas to places accessible to hunters.

With oversight of bird populations by the USFWS and/or the TWRA, the number of birds that could be lethally removed by WS would not limit the ability of those people interested to harvest those bird species during the regulated season. WS would report all take to the USFWS and/or the TWRA annually to ensure take by WS was incorporated into population management objectives established for bird populations. Based on the limited take proposed by WS and the oversight by the USFWS and/or the TWRA, WS' take of birds annually under this alternative would have no effect on the ability of hunters to harvest birds during the regulated harvest season.

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

Under the technical assistance only alternative, WS would have no direct impact on bird populations in the State. If WS recommended the use of non-lethal methods and people employed those non-lethal methods, birds would likely be dispersed from the damage area to areas outside the damage area, which could serve to move those birds from those less accessible areas to places accessible to hunters. Although lethal methods could be recommended by WS under a technical assistance only alternative, the use of those methods could only occur after the property owner or manager received a depredation permit from the USFWS and/or the TWRA, under depredation/control orders, or take could occur during the regulated hunting season. WS' recommendation of lethal methods could lead to an increase in the use of those methods. However, the number of birds lethally removed under a depredation permit, under depredation/control orders, and during the regulated hunting seasons would be determined by the USFWS and/or the TWRA. Therefore, 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 TWRA determine the number of birds that may be taken during the hunting season, under depredation permits, under depredation orders, and under control orders.

Alternative 3 – No Bird Damage Management Conducted by WS

WS would have no impact on the ability to harvest birds under this alternative. WS would not be involved with any aspect of bird damage management. The USFWS and/or the TWRA would continue to regulate populations through adjustments of the allowed take during the regulated harvest season and the continued use of depredation orders, control orders, and depredation permits.

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 cormorants, Canada Geese, and blackbirds can occur under depredation/control orders without the need for a depredation permit. Muscovy Ducks can be lethally taken pursuant to a control order. European Starlings, Rock Pigeons, Eurasian Collared-Doves, House Sparrows, and feral waterfowl can be lethally taken without the need for a depredation permit since 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 TWRA, 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 1) evaluate damage occurring (including other affected elements and the dynamics of the damaging species); 2) to determine appropriate strategies to minimize effects on environmental elements; 3) applies damage management actions; and 4) 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 TWRA 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 TWRA 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 Tennessee from FY 2009 through FY 2013 was of a low magnitude when compared to the total known take and when compared to available population information. The USFWS and the TWRA 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 the TWRA. 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 the TWRA. Therefore, the cumulative take of birds annually or over time by WS would occur at the desire of the USFWS and/or the TWRA 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 Tennessee 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 (*e.g.*, 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 B 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 B. 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 TDA 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 Tennessee 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 for 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 B have a high level of selectivity and can be employed using SOPs to ensure minimal effects to non-target species. Non-targets were not taken by WS in Tennessee during activities to alleviate bird damage from FY 2009 through FY 2013. Based on the methods available to alleviate 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. WS' has reviewed the T&E species and re-initiated consultation with the TWRA, the TDEC, and the USFWS. WS would abide by the outcome associated with the consultation process. 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 B 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 TDA. 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 B. 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 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 Tennessee. 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 Tennessee, 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 Tennessee.

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.

No cumulative effects from the use of those methods discussed in Appendix B 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 the TWRA 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 the TWRA. 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 TWRA, 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.

Issue 6 - Effects of Bird Damage Management Activities on the Regulated Harvest of Birds

As discussed in this EA, the magnitude of the proposed annual take by WS on the populations of target species was low when compared to the total take of birds and when compared to the estimated populations of those species. Since all take of birds is regulated by the USFWS and/or the TWRA, the take of birds by WS that would occur annually and cumulatively would occur pursuant to bird population objectives established in the State. WS' take of birds annually to alleviate damage would be a minor component of the known annual take that occurs during the harvest seasons.

With oversight of bird take, the USFWS and/or the TWRA maintains the ability to regulate take by WS to meet management objectives for birds in the State. Therefore, the cumulative take of birds is considered as part of the USFWS and/or the TWRA objectives for bird populations in the State.

CHAPTER 5 - LIST OF PREPARERS AND/OR PERSONS CONSULTED

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APPENDIX A
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APPENDIX B

METHODS AVAILABLE FOR RESOLVING OR PREVENTING 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 Tennessee 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 Tennessee. 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 humans 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 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) and numerous individuals in New Jersey have 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. 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 management 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 Mallards with birds habituating in approximately 5 minutes and 20 minutes, respectively (Blackwell et al. 2002).

Research on this potential tool has been conducted in a replicated format for Double-crested Cormorants (Glahn et al. 2000*b*). Moving the laser light through the tree branches rather than touching birds with the laser light elicited an avoidance response from cormorants (Glahn et al. 2000*b*). During pen trials with lasers, the cormorants were inconsistent in their response with some birds showing no response to the laser (Glahn et al. 2000*b*). The lack of overt response by cormorants to lasers is not clearly understood, but suggests laser light is not a highly aversive agent (Glahn et al. 2000*b*). 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 60% 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 cormorants, 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, Jr. 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, Jr. 1991). However, a laboratory study by Schafer, Jr. 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, Jr. 1981, Holler and Schafer, Jr. 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*a*). 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[25]), nontoxic to rats in an inhalation study (LC_{50} > 2.8 mg/L[26]), 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.

[25] 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.
[26] 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.

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).

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.

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.

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, and 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, Jr. 1991). The dose used for immobilization is designed to be about 2 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 include 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.

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. Birds 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 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 site that overlooks the net, 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 require 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-capture 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 cormorants, 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 and 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.

Nest destruction is the removal of nesting materials during the construction phase of the nesting cycle. 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 because problem bird species are highly mobile and can easily return to damage sites from long distances, or because of high populations.

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. This method 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.

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 Tennessee when the target animal(s) can legally be translocated, 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 to 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 birds flying 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. Locating a release site for a large number of birds can prove to be a challenge as well. 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 the TWRA.

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 TWRA 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.

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, Jr. 1981, Schafer, Jr. 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, Jr. 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, Jr. 1984, Schafer, Jr. 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. 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 C

FEDERAL THREATENED AND ENDANGERED SPECIES IN TENNESSEE

Notes:

- This report shows the listed species associated in some way with this state.
- This list does not include experimental populations and similarity of appearance listings.

TAXA	COMMON NAME	SPECIES	STATUS
Birds	Bachman's Warbler	*Vermivora bachmanii*	E
	Least Tern	*Sterna antillarum*	E
Crustaceans	Nashville Crayfish	*Orconectes shoupi*	E
Fish	Amber Darter	*Percina antesella*	E
	Blackside Dace	*Phoxinus cumberlandensis*	T
	Blue Shiner	*Cyprinella caerulea*	T
	Bluemask Darter	*Etheostoma sp.*	E
	Boulder Darter	*Etheostoma wapiti*	E
	Chucky Madtom	*Noturus crypticus*	E
	Conasauga Logperch	*Percina jenkinsi*	E
	Cumberland Darter	*Etheostoma susanae*	E
	Duskytail Darter	*Etheostoma percnurum*	E
	Goldline Darter	*Percina aurolineata*	T
	Laurel Dace	*Chrosomus saylori*	E
	Palezone Shiner	*Notropis albizonatus*	E
	Pallid Sturgeon	*Scaphirhynchus albus*	E
	Pygmy Madtom	*Noturus stanauli*	E
	Slackwater Darter	*Etheostoma boschungi*	T
	Slender Chub	*Erimystax cahni*	T
	Smoky Madtom	*Noturus baileyi*	E
	Snail Darter	*Percina tanasi*	T
	Spotfin Chub	*Erimonax monachus*	T
	Yellowfin Madtom	*Noturus flavipinnis*	T
Insects	American Burying Beetle	*Nicrophorus americanus*	E
Mammals	Carolina Northern Flying Squirrel	*Glaucomys sabrinus coloratus*	E
	Eastern Puma	*Puma concolor couguar*	E
	Florida Panther	*Puma concolor coryi*	E
	Indiana Bat	*Myotis sodalis*	E
	Gray Bat	*Myotis grisescens*	E
	Gray Wolf	*Canis lupus*	E
Mussels	Alabama Lampmussel	*Lampsilis virescens*	E
	Appalachian Elktoe	*Alasmidonta raveneliana*	E
	Appalachian Monkeyface	*Quadrula sparsa*	E
	Birdwing Pearlymussel	*Lemiox rimosus*	E
	Clubshell	*Pleurobema clava*	E
	Coosa Moccasinshell	*Medionidus parvulus*	E

	Cracking Pearlymussel	*Hemistena lata*	E
	Cumberland Bean	*Villosa trabalis*	E
	Cumberland Elktoe	*Alasmidonta atropurpurea*	E
	Cumberland Monkeyface	*Quadrula intermedia*	E
	Cumberland Pigtoe	*Pleurobema gibberum*	E
	Cumberlandian Combshell	*Epioblasma brevidens*	E
	Dromedary Pearlymussel	*Dromus dromas*	E
	Fanshell	*Cyprogenia stegaria*	E
	Finelined Pocketbook	*Lampsilis altilis*	T
	Finerayed Pigtoe	*Fusconaia cuneolus*	E
	Fluted Kidneyshell	*Ptychobranchus subtentum*	E
	Georgia Pigtoe	*Pleurobema hanleyianum*	E
	Green Blossom	*Epioblasma torulosa gubernaculum*	E
	Littlewing Pearlymussel	*Pegias fabula*	E
	Orangefoot Pimpleback	*Plethobasus cooperianus*	E
	Ovate Clubshell	*Pleurobema perovatum*	E
	Oyster Mussel	*Epioblasma capsaeformis*	E
	Pale Lilliput	*Toxolasma cylindrellus*	E
	Pink Mucket	*Lampsilis abrupta*	E
	Pink Ring	*Obovaria retusa*	E
	Purple Bean	*Villosa perpurpurea*	E
	Purple Cat's Paw	*Epioblasma obliquata obliquata*	E
	Rabbitsfoot	*Quadrula cylindrical cylindrical*	E
	Rayed Bean	*Villosa fabalis*	E
	Rough Rabbitsfoot	*Quadrula cylindrical strigillata*	E
	Rough Pigtoe	*Pleurobema plenum*	E
	Scaleshell Mussel	*Leptodea leptodon*	E
	Sheepnose Mussel	*Plethobasus cyphyus*	E
	Shiny Pigtoe	*Fusconaia cor*	E
	Slabside Pearlymussel	*Pleuronaia dolabelloides*	E
	Snuffbox Mussel	*Epioblasma triquetra*	E
	Southern Acornshell	*Epioblasma othcaloogensis*	E
	Southern Clubshell	*Pleurobema decisum*	E
	Southern Pigtoe	*Pleurobema georgianum*	E
	Spectaclecase	*Cumberlandia monodonta*	E
	Tan Riffleshell	*Epioblasma florentina walkeri*	E
	Triangular Kidneyshell	*Ptychobranchus greenii*	E
	Tubercled Blossom	*Epioblasma torulosa torulosa*	E
	Turgid Blossom	*Epioblasma turgidula*	E
	Upland Combshell	*Epioblasma metastriata*	E
	White Wartyback	*Plethobasus cicatricosus*	E
	Winged Mapleleaf	*Quadrula fragosa*	E
	Yellow Blossom	*Epioblasma florentina florentina*	E
Snails	Anthony's Riversnail	*Athearnia anthonyi*	E
	Painted Snake-Coiled Forest Snail	*Anguispira picta*	T
	Royal Marstonia	*Pyrgulopsis ogmorhaphe*	E
Spiders	Spruce-fir Moss Spider	*Microhexura montivaga*	E

Vascular Plants	American Chaffseed	*Schwalbea americana*	E
	American Hart's-tongue Fern	*Asplenium scolopendrium americanum*	T
	Blue Ridge Goldenrod	*Solidago spithamaea*	T
	Braun's Rock-cress	*Arabis perstellata*	E
	Cumberland Rosemary	*Conradina verticillata*	T
	Cumberland Sandwort	*Arenaria cumberlandensis*	E
	Green Pitcher-plant	*Sarracenia oreophila*	E
	Guthrie's Ground-plum	*Astragalus bibullatus*	E
	Large-flowered Skullcap	*Scutellaria montana*	T
	Leafy Prairie-clover	*Dalea foliosa*	E
	Morefield's Leather Flower	*Clematis morefieldii*	E
	Price's Potato-bean	*Apios priceana*	T
	Roan Mountain Bluet	*Hedyotis purpurea montana*	E
	Rock Gnome Lichen	*Gymnoderma lineare*	E
	Ruth's Golden Aster	*Pityopsis ruthii*	E
	Small Whorled Pogonia	*Isotria medeoloides*	T
	Spreading Avens	*Geum radiatum*	E
	Spring Creek Bladderpod	*Lesquerella perforata*	E
	Tennessee Yellow-eyed Grass	*Xyris tennesseensis*	E
	Virginia Spiraea	*Spiraea virginiana*	T

APPENDIX D

STATE LISTED THREATENED AND ENDANGERED SPECIES IN TENNESSEE

TAXA	COMMON NAME	SPECIES	STATUS
Amphibians	Berry Cave Salamander	*Gyrinophilus gulolineatus*	T
	Tennessee Cave Salamander	*Gyrinophilus palleucus*	T
Birds	Bachman's Sparrow	*Aimophila aestivalis*	E
	Bewick's Wren	*Thryomanes bewickii*	E
	Common Raven	*Corvus corax*	T
	Golden Eagle	*Aquila chrysaetos*	T
	Least Tern	*Sterna antillarum athalassos*	E
	Lark Sparrow	*Chondestes grammacus*	T
	Northern Saw-whet Owl	*Aegolius acadius*	T
	Peregrine Falcon	*Falco peregrinus*	E
Crustaceans	Big South Fork Crayfish	*Cambarus bouchardi*	E
	Brawley's Fork Crayfish	*Cambarus williami*	E
	Chickamauga Crayfish	*Cambarus extraneus*	T
	Conasauga Blue Borrower	*Cambarus cymatilis*	E
	Hardin Crayfish	*Orconectes wrighti*	E
	Hatchie Burrowing Crayfish	*Fallicambarus hortoni*	E
	Nashville Crayfish	*Orconectes shoupi*	E
	Obey Crayfish	*Cambarus obeyensis*	T
	Pristine Crayfish	*Cambarus pristinus*	E
	Tennessee Cave Crayfish	*Orconectes incomptus*	E
	Valley Flame Crayfish	*Cambarus deweesae*	E
Fishes	Amber Darter	*Percina antesella*	E
	Ashy Darter	*Etheostoma cinereum*	T
	Barrens Darter	*Etheostoma forbesi*	E
	Barrens Topminnow	*Fundulus julisia*	E
	Blackside Dace	*Phoxinus cumberlandensis*	T
	Blue Shiner	*Cyprinella caerulea*	E
	Blue Sucker	*Cycleptus elongates*	T
	Bluemask Darter	*Etheostoma sp.*	E
	Boulder Darter	*Etheostoma wapiti*	E
	Chucky Madtom	*Noturus crypticus*	E
	Coldwater Darter	*Etheostoma ditrema*	T
	Conasauga Logperch	*Percina jenkinsi*	E
	Coppercheek Darter	*Etheostoma aquali*	T
	Crown Darter	*Etheostoma corona*	E
	Cumberland Darter	*Etheostoma susanae*	E
	Duskytail Darter	*Etheostoma percnurum*	E
	Egg-mimic Darter	*Etheostoma pseudovulatum*	E
	Frecklebelly Madtom	*Noturus munitus*	T
	Holiday Darter	*Etheostoma brevirostrum*	T
	Lake Sturgeon	*Acipenser fulvescens*	E
	Laurel Dace	*Phoxinus saylori*	E

	Longhead Darter	*Percina macrocephala*	T
	Palezone Shiner	*Notropis albizonatus*	E
	Pallid Sturgeon	*Scaphirhynchus albus*	E
	Pygmy Madtom	*Noturus stanauli*	E
	Saddled Madtom	*Noturus fasciatus*	T
	Sickle Darter	*Percina williamsi*	T
	Silverjaw Minnow	*Notropis buccatus*	T
	Slackwater Darter	*Etheostoma boschungi*	T
	Slender Chub	*Erimystax cahni*	T
	Smoky Madtom	*Noturus baileyi*	E
	Snail Darter	*Percina tanasi*	T
	Spotfin Chub	*Erimonax monachus*	T
	Striated Darter	*Etheostoma striatulum*	T
	Trispot Darter	*Etheostoma trisella*	T
	Tuckasegee Darter	*Etheostoma gutselli*	E
	Western Sand Darter	*Ammocrypta clara*	T
	Yellowfin Madtom	*Noturus flavipinnis*	E
Mammals	Carolina Northern Flying Squirrel	*Glaucomys sabrinus coloratus*	E
	Gray Bat	*Myotis grisescens*	T
	Indiana Bat	*Myotis sodalis*	E
Mussels	Alabama Lampmussel	*Lampsilis virescens*	E
	Alabama Moccasinshell	*Medionidus acutissimus*	T
	Appalachian Elktoe	*Alasmidonta raveneliana*	E
	Appalachian Monkeyface	*Quadrula sparsa*	E
	Birdwing Pearlymussel	*Lemiox rimosus*	E
	Clubshell	*Pleurobema clava*	E
	Coosa Moccasinshell	*Medionidus parvulus*	E
	Cracking Pearlymussel	*Hemistena lata*	E
	Cumberland Bean	*Villosa trabalis*	E
	Cumberland Elktoe	*Alasmidonta atropurpurea*	E
	Cumberland Monkeyface	*Quadrula intermedia*	E
	Cumberland Pigtoe	*Pleurobema gibberum*	E
	Cumberlandian Combshell	*Epioblasma brevidens*	E
	Dromedary Pearlymussel	*Dromus dromas*	E
	Fanshell	*Cyprogenia stegaria*	E
	Finelined Pocketbook	*Lampsilis altilis*	T
	Finerayed Pigtoe	*Fusconaia cuneolus*	E
	Littlewing Pearlymussel	*Pegias fabula*	E
	Orangefoot Pimpleback	*Plethobasus cooperianus*	E
	Ovate Clubshell	*Pleurobema perovatum*	E
	Oyster Mussel	*Epioblasma capsaeformis*	E
	Pale Lilliput	*Toxolasma cylindrellus*	E
	Pink Mucket	*Lampsilis abrupta*	E
	Pink Ring	*Obovaria retusa*	E
	Purple Bean	*Villosa perpurpurea*	E
	Purple Cat's Paw	*Epioblasma obliquata obliquata*	E
	Rough Pigtoe	*Pleurobema plenum*	E

	Rough Rabbitsfoot	*Quadrula cylindrical strigillata*	E
	Shiny Pigtoe	*Fusconaia cor*	E
	Southern Acornshell	*Epioblasma othcaloogensis*	E
	Southern Pigtoe	*Pleurobema georgianum*	E
	Tan Riffleshell	*Epioblasma florentina walkeri*	E
	Triangular Kidneyshell	*Ptychobranchus greenii*	E
	Upland Combshell	*Epioblasma metastriata*	E
	White Wartyback	*Plethobasus cicatricosus*	E
	Winged Mapleleaf	*Quadrula fragosa*	E
Non-Vascular Plants	Alternate Leaf Archidium Moss	*Archidium alternifolium*	T
	American Funaria Moss	*Funaria americana*	T
	Ammon's Tortula	*Tortula ammonsiana*	E
	Appalachian Fissidens Moss	*Fissidens appalachensis*	T
	Bazzania Nudicaulis Liverwort	*Bazzania nudicaulis*	T
	Blister Ribbon	*Preissia quadrata*	T
	Fragile Tortula	*Tortula fragilis*	E
	Funck's Rustwort	*Marsupella funckii*	E
	Grandfather Mountain Leptodontium	*Leptodontium viticulosoides sulphureum*	E
	Gymnomitrion Laceratum Liverwort	*Gymnomitrion laceratum*	T
	Hot Porella	*Porella gracillima*	E
	Lesser Copperwort	*Cephaloziella massalongi*	E
	Liverwort	*Frullania appalachiana*	E
	Lophocolea Muricata	*Lophocolea muricata*	T
	Mannia Triandra Liverwort	*Mannia triandra*	T
	Mount LeConte Moss	*Leptohymenium sharpii*	E
	Oncophorus Moss	*Oncophorus raui*	T
	Ornate Cololejeunea	*Cololejeunea ornata*	T
	Palamocladium Moss	*Palamocladium leskeoides*	T
	Peak Moss	*Brachydontium trichoides*	E
	Pearson's Sphenolobopsis	*Sphenolobopsis pearsonii*	E
	Sharp's Homaliadelphus	*Homaliadelphus sharpii*	E
	Sharp's Lejeunea	*Lejeunea sharpii*	E
	Sword Moss	*Bryoxiphium norvegicum*	T
	Watauga Porella	*Porella wataugensis*	T
	Wedge Flapwort	*Leptoscyphus cuneifolius*	E
Reptiles	Bog Turtle	*Glyptemys muhlenbergii*	T
	Northern Pinesnake	*Pituophis melanoleucus melanoleucus*	T
	Western Pygmy Rattlesnake	*Sistrurus miliarius streckeri*	T
Snails	Anthony's Riversnail	*Athearnia anthonyi*	E
	Painted Tigersnail	*Anguispira picta*	E
	Royal Springsnail	*Pyrgulopsis ogmorhaphe*	E
Vascular	Alabama Grapefern	*Botrychium jenmanii*	T

Plants	Alabama Snow-wreath	*Neviusia alabamensis*	T
	Alderleaf Buckthorn	*Rhamnus alnifolia*	E
	American Fly-honeysuckle	*Lonicera canadensis*	T
	American Water-pennywort	*Hydrocotyle americana*	E
	American Wintergreen	*Pyrola americana*	E
	American Yew	*Taxus canadensis*	E
	Appalachian Fir Clubmoss	*Huperzia appalachiana*	T
	Appalachian Quillwort	*Isoetes appalachiana*	E
	Appalachian Waterleaf	*Hydrophyllum virginianum*	T
	Ash-leaved Bush-pea	*Thermopsis fraxinifolia*	T
	Barratt's Sedge	*Carex barrattii*	E
	Barrens Silky Aster	*Symphyotrichium pretense*	E
	Beadle's Mountain-mint	*Pycnanthemum beadlei*	E
	Bent Avens	*Geum geniculatum*	E
	Blackfoot Quillwort	*Isoetes melanopoda*	E
	Blue Mud-plantain	*Heteranthera limosa*	T
	Blue Ridge Broomsedge	*Carex bromoides montana*	T
	Blue Ridge Goldenrod	*Solidago spithamaea*	E
	Blue Ridge St. John's-wort	*Hypericum mitchellianum*	T
	Blue-flower Coyote-thistle	*Eryngium integrifolium*	T
	Boykin's Milkwort	*Polygala boykinii*	T
	Branched Three-awn Grass	*Aristida ramosissima*	E
	Branching Bur-reed	*Sparganium androcladum*	E
	Braun's Rockcress	*Arabis perstellata*	E
	Bristle-fern	*Trichomanes boschianum*	T
	Bristly Sedge	*Carex comosa*	T
	Broadleaf Bunchflower	*Melanthium latifolium*	E
	Broadleaf Goldenrod	*Solidago lancifolia*	E
	Broad-leaved Barbara's-buttons	*Marshallia trinervia*	T
	Broad-leaved Tickseed	*Coreopsis latifolia*	E
	Brown Bog Sedge	*Carex buxbaumii*	E
	Buffalo Clover	*Trifolium reflexum*	E
	Buffalo Currant	*Ribes odoratum*	T
	Butternut	*Juglans cinerea*	T
	Cain's Reedgrass	*Calamagrostis cainii*	E
	Canada Burnet	*Sangisorba canadensis*	E
	Canby's Lobelia	*Lobelia canbyi*	T
	Canby's Mountain-lover	*Paxistima canbyi*	E
	Capillary Hairsedge	*Bulbostylis ciliatifolia coarctata*	E
	Carolina Anemone	*Anemone caroliniana*	E
	Carolina Hemlock	*Tsuga caroliniana*	T
	Carolina Pink	*Silene caroliniana pensylvanica*	T
	Carolina Redroot	*Lachnanthes caroliniana*	E
	Carolina Saxifrage	*Saxifraga caroliniana*	E
	Chapman's Redtop	*Tridens flavus var. chapmanii*	E
	Climbing Fumitory	*Adlumia fungosa*	T
	Clingman's Hedge-nettle	*Stachys clingmanii*	T
	Coastal False-asphodel	*Triantha racemosa*	E

Coastal Plain		
Yellow-eyed Grass	*Xyris ambigua*	E
Coastal Sweet Pepper-bush	*Clethra alnifolia*	E
Compass Plant	*Silphium laciniatum*	T
Copper Iris	*Iris fulva*	T
Cranberry	*Vaccinium macrocarpon*	T
Creamflower Tick-trefoil	*Desmodium ochroleucum*	E
Creeping St. John's-wort	*Hypericum adpressum*	E
Crested Shield-fern	*Dryopteris cristata*	T
Cumberland Sandwort	*Minuartia cumberlandensis*	E
Cumberland Featherbells	*Stenanthium diffusum*	E
Cumberland Rose Gentian	*Sabatia capitata*	E
Cumberland Rosemary	*Conradina verticillata*	T
Cumberland Rosinweed	*Silphium brachiatum*	E
Cumberland Sandgrass	*Calamovilfa arcuata*	T
Cutleaf Meadow-parsnip	*Thaspium pinnatifidum*	E
Cutleaf Water-milfoil	*Myriophyllum pinnatum*	E
Death Camas	*Zigadenus leimanthoides*	T
Downy Gentian	*Gentiana puberulenta*	E
Drooping Bluegrass	*Poa saltuensis*	T
Dwarf Filmy-fern	*Trichomanes petersii*	T
Dwarf Huckleberry	*Gaylussacia dumosa*	T
Dwarf Milkwort	*Polygala nana*	E
Dwarf Sundew	*Drosera brevifolia*	T
Earleaved False-foxglove	*Agalinis auriculata*	E
Eastern Turkeybeard	*Xerophyllum asphodeloides*	T
Eastern Yampah	*Perideridia americana*	E
Eaton's Witchgrass	*Dichanthelium acumenatum spretum*	E
Elliptic Spike Rush	*Eleocharis elliptica*	E
False Dandelion	*Krigia montana*	T
Fen Indian-plantain	*Arnoglossum plantagineum*	T
Fen Orchis	*Liparis loeselii*	T
Fetter-bush	*Leucothoe racemosa*	T
Few-flowered Beak-rush	*Rhynchospora rariflora*	E
Fireweed	*Epilobium angustifolium*	T
Florida Hedge-hyssop	*Gratiola floridana*	E
Four-flowered Loosestrife	*Lysimachia quadriflora*	E
Fowl Bluegrass	*Poa palustris*	E
Foxtail Clubmoss	*Lycopodiella alopecuroides*	T
Fraser Fir	*Abies fraseri*	T
Fraser's Loosestrife	*Lysimachia fraseri*	E
Fremont’s Virgin’s-bower	*Clematis fremontii*	E
Fringed Black Bindweed	*Polygonum cilinode*	T
Fringed Yellow-eyed Grass	*Xyris fimbriata*	E
Gattinger's Goldenrod	*Solidago gattingeri*	E
Giant Blue Cohosh	*Caulophyllum giganteum*	T
Glade Cleft Phlox	*Phlox bifida ssp. stellaria*	T
Glade Onion	*Allium stellatum*	E
Globe-fruited False Loosestrife	*Ludwigia sphaerocarpa*	T
Godfrey's Stitchwort	*Minuartia godfreyi*	E
Gorge Goldenrod	*Solidago faucibus*	T

Granite Gooseberry	*Ribes curvatum*	T
Grape Honeysuckle	*Lonicera prolifera*	E
Grassleaf Arrowhead	*Sagittaria graminea*	T
Gray's Lily	*Lilium grayi*	E
Great Plains Goldentop	*Euthamia gymnospermoides*	E
Great Plains Ladies'-tresses	*Spiranthes magnicamporum*	E
Green-and-gold	*Chrysogonum virginianum*	T
Hairy Fimbristylis	*Fimbristylis puberula*	T
Hairy Skullcap	*Scutellaria arguta*	E
Hairy Willow-herb	*Epilobium ciliatum*	T
Halberd-leaf Tearthumb	*Polygonum arifolium*	T
Harbison's Hawthorn	*Crataegus harbisonii*	E
Harper's Fimbristylis	*Fimbristylis perpusilla*	E
Harper's Umbrella-plant	*Eriogonum longifolium harperi*	E
Hart's-tongue Fern	*Asplenium scolopenderium americanum*	E
Harvey's Beakrush	*Rhynchospora harveyi*	T
Hay Sedge	*Carex argyrantha*	T
Heartleaf Meehania	*Meehania cordata*	T
Heart-leaved Paper Birch	*Betula papyrifera cordifolia*	E
Heart-leaved Plantain	*Plantago cordata*	E
Hitchcock's Sedge	*Carex hitchcockiana*	T
Hiwassee Quillwort	*Isoetes tennesseensis*	E
Horned Beak-rush	*Rhynchospora capillacea*	E
Horned Bladderwort	*Utricularia cornuta*	E
Horse-tail Spike-rush	*Eleocharis equisetoides*	E
John Beck's Leafcup	*Polymnia johnbeckii*	E
Lake-bank Sedge	*Carex lacustris*	T
Lamance Iris	*Iris brevicaulis*	E
Large Purple Fringed Orchid	*Platanthera grandiflora*	E
Large-flowered Skullcap	*Scutellaria montana*	T
Large-flowering Barbara's-buttons	*Marshallia grandiflora*	E
Large-leaf Pondweed	*Potamogeton amplifolius*	T
Larkspur-leaved Coreopsis	*Coreopsis delphiniifolia*	E
Leafy Prairie-clover	*Dalea foliosa*	E
Least Grape-fern	*Botrychium simplex*	E
Least Trillium	*Trillium pusillum*	E
Leggett's Pinweed	*Lechea pulchella*	E
Limerock Arrow-wood	*Viburnum bracteatum*	E
Linear-leaved Willow-herb	*Epilobium leptophyllum*	T
Long-bracted Green orchis	*Coeloglossum viride virescens*	E
Longleaf Stitchwort	*Stellaria longifolia*	E
Loose-headed Beak-rush	*Rhynchospora chalarocephala*	T
Low Frostweed	*Helianthum propinquum*	E
Lucy Braun's White Snakeroot	*Ageratina luciae-brauniae*	T
Manhart's Sedge	*Carex manhartii*	E
Marsh Marigold	*Caltha palustris*	E
Marsh Speedwell	*Veronica scutellata*	E
Matted Spike-rush	*Eleocharis intermedia*	E
Mayberry	*Vaccinium elliottit*	E

Menge's Fame-flower	*Phemeranthus mengesii*	T
Missouri Primrose	*Oenothera macrocarpa*	T
Morefield's Leather-flower	*Clematis morefieldii*	E
Moss Phlox	*Phlox subulata*	T
Mountain Bittercress	*Cardamine clematitis*	T
Mountain Bush-honeysuckle	*Diervilla sessifolia rivularis*	T
Mountain Fetter-bush	*Pieris floribunda*	T
Mountain Ricegrass	*Patis racemosa*	E
Mountain Sandwort	*Minuartia groenlandica*	E
Mountain St. John's-wort	*Hypericum graveolens*	E
Mountain Witch-alder	*Fothergilla major*	T
Muhlenberg’s Nutrush	*Scleria muehlenbergii*	T
Muskingum Sedge	*Carex muskingumensis*	E
Narrowleaf Bushclover	*Lespedeza angustifolia*	T
Narrow-leaf Ramps	*Allium burdickii*	T
Narrow-leaved Gentian	*Gentiana linearis*	T
Narrow-leaved Meadow-sweet	*Spiraea alba*	E
Narrow-leaved Trillium	*Trillium lancifolium*	E
Nestronia	*Nestronia umbellula*	E
Nevius's Stonecrop	*Sedum nevii*	E
Northern Beechfern	*Phegopteris connectilis*	E
Northern Bush-honeysuckle	*Diervilla lonicera*	T
Northern Dropseed	*Sporobolus heterolepis*	T
Northern Long Sedge	*Carex folliculata*	T
Northern Mannagrass	*Glyceria laxa*	E
Northern Starflower	*Trientalis borealis*	T
Nuttall's Milkwort	*Polygala nuttallii*	E
Obscure Beak-rush	*Rhynchospora perplexa*	T
Ovate Catchfly	*Silene ovata*	E
Ozark Bunchflower	*Melanthium woodii*	E
Pale Corydalis	*Corydalis sempervirens*	E
Pale False-foxglove	*Agalinis skinneriana*	T
Pale St. John's-wort	*Hypericum ellipticum*	E
Pale Umbrella-wort	*Mirabilis albida*	T
Pale-purple Coneflower	*Echinacea pallida*	E
Piedmont Barbara's-buttons	*Marshallia obovata*	E
Pinelands Dropseed	*Sporobolus junceus*	E
Pink Sundew	*Drosera capillaris*	T
Pinnate-lobed Black-eyed Susan	*Rudbeckia triloba pinnatiloba*	E
Piratebush	*Buckleya distichophylla*	T
Plains Muhly	*Muhlenbergia cuspidata*	E
Pope's Sand-parsley	*Ammoselinum popei*	T
Porter’s Goldenrod	*Solidago porteri*	E
Porter's Reedgrass	*Calamagrostis porteri*	E
Prairie False-foxglove	*Agalinis heterophylla*	E
Prairie Goldenrod	*Solidago ptarmicoides*	E
Prairie Parsley	*Polytaenia nuttallii*	T
Pretty Sedge	*Carex woodii*	E
Price's Potato-bean	*Apios priceana*	E
Purple Gerardia	*Agalinis plukenetii*	E

Purple Giant Hyssop	*Agastache scrophulariifolia*	T
Purple Prairie-clover	*Dalea purpurea*	E
Pyne's Ground-plum	*Astragalus bibullatus*	E
Red Starvine	*Schisandra glabra*	T
Ridge-stem False-foxglove	*Agalinis oligophylla*	E
Rigid Sedge	*Carex tetanica*	E
Roan Mountain Bluet	*Hedyotis purpurea montana*	E
Rock Goldenrod	*Solidago rupestris*	E
Rockcastle Aster	*Eurybia saxicastellii*	E
Rose Pogonia	*Pogonia ophioglossoides*	E
Rough Rattlesnake-root	*Prenanthes aspera*	T
Roundleaf Fame-flower	*Phemeranthus teretifolium*	T
Roundleaf Shadbush	*Amelanchier sanguinea*	T
Roundleaf Sundew	*Drosera rotundifolia*	T
Rugel's Ragwort	*Rugelia nudicaulis*	E
Running Bittercress	*Cardamine flagellifera*	T
Running Glade Clover	*Trifolium calcaricum*	E
Ruth's Golden-aster	*Pityopsis ruthii*	E
Ruth's Sedge	*Carex ruthii*	T
Sand Cherry	*Prunus pumila*	E
Sand Grape	*Vitis rupestris*	E
Savannah Beaksedge	*Rhynchospora debilis*	E
Schweinitz's Ragwort	*Packera schweinitziana*	T
Sessile Water Speedwell	*Veronica catenata*	E
Sessile-fruited Arrowhead	*Sagittaria rigida*	E
Shadow-witch	*Ponthieva racemosa*	E
Shaggy False Gromwell	*Onosmodium hispidissimum*	E
Shining Ladies-tresses	*Spiranthes lucida*	T
Short-beaked Arrowhead	*Sagittaria brevirostra*	T
Shortleaf Sneezeweed	*Helenium brevifolium*	E
Short-leaved Panicgrass	*Dichanthelium ensifolium curtifolium*	E
Short's Bladderpod	*Physaria globosa*	E
Showy Lady's-slipper	*Cypripedium reginae*	E
Silverling	*Paronychia argyrocoma*	T
Silvery Sedge	*Carex canescens disjuncta*	E
Skunk-cabbage	*Symplocarpus foetidus*	E
Slender Blazing-star	*Liatris cylindracea*	T
Slender Blue Flag	*Iris prismatica*	T
Small Whorled Pogonia	*Isotria medeoloides*	E
Small's Stonecrop	*Diamorpha smallii*	E
Smoky Mountain's Mannagrass	*Glyceria nubigena*	T
Smoky Mountain Sedge	*Carex fumosimontana*	E
Smooth False Gromwell	*Onosmodium molle subsetum*	E
Snowy Orchid	*Platanthera nivea*	E
Softleaf Arrow-wood	*Viburnum molle*	E
Southern Jointweed	*Polygonella americana*	E
Southern Lady's-slipper	*Cypripedium kentuckiense*	E
Southern Lobelia	*Lobelia amoena*	T
Southern Long Sedge	*Carex lonchocarpa*	E
Southern Morning-glory	*Stylisma humistrata*	T

Southern Nodding Trillium	*Trillium rugelii*	E
Southern Prairie-dock	*Silphium pinnatifidum*	T
Southern Twayblade	*Listera australis*	E
Spinulose Shield-fern	*Dryopteris carthusiana*	T
Spotted Coralroot	*Corallorhiza maculata*	T
Spreading Avens	*Geum radiatum*	E
Spreading Rockcress	*Boechera patens*	E
Spring Blue-eyed Mary	*Collinsia verna*	E
Spring Creek Bladderpod	*Lesquerella perforata*	E
Starflower False Solomon's Seal	*Maianthemum stellatum*	E
Sticky Bog-asphodel	*Triantha glutinosa*	E
Stones River Bladderpod	*Paysonia stonensis*	E
Sullivantia	*Sullivantia sullivantii*	E
Svenson's Wild-rye	*Elymus svensonii*	T
Swamp Loosestrife	*Lysimachia terrestris*	E
Swamp Saxifrage	*Saxifraga pensylvanica*	E
Sweet Coneflower	*Rudbeckia subtomentosa*	T
Sweet Pinesap	*Monotropsis odorata*	T
Sweetbay Magnolia	*Magnolia virginiana*	T
Sweet-fern	*Comptonia peregrina*	E
Sweetscent Ladies-tresses	*Spiranthes odorata*	E
Tall Larkspur	*Delphinium exaltatum*	E
Tawny Cotton-grass	*Eriophorum virginicum*	E
Ten-angle Pipewort	*Eriocaulon decangulare*	E
Tennessee Coneflower	*Echinacea tennesseensis*	T
Tennessee Pondweed	*Potamogeton tennesseensis*	T
Tennessee Yellow-eyed Grass	*Xyris tennesseensis*	E
Three-toothed Cinquefoil	*Potentilla tridentata*	T
Torrey's Dropseed	*Muhlenbergia torreyana*	E
Trailing Stitchwort	*Stellaria alsine*	E
Trailing Trillium	*Trillium decumbens*	E
Trailing Wolfsbane	*Aconitum reclinatum*	E
Tubercled Rein-orchid	*Platanthera flava var. herbiola*	T
Tufted Club-rush	*Trichophorum cespitosum*	E
Velvety Cerastium	*Cerastium velutinum velutinum*	E
Virginia Bunchflower	*Melanthium virginicum*	E
Virginia Spiraea	*Spiraea virginiana*	E
Water-purslane	*Didiplis diandra*	T
Wavy-leaf Purple Coneflower	*Echinacea simulata*	T
Western False Gromwell	*Onosmodium molle occidentale*	T
Western Hairy Rockcress	*Arabis hirsuta*	T
Western Wallflower	*Erysimum capitatum*	E
White Beak-rush	*Rhynchospora alba*	E
White Camas	*Zigadenus glaucus*	E
White Fringeless Orchid	*Platanthera integrilabia*	E
White Heather Aster	*Symphyotrichium ericoides ericoides*	E
White Mandarin	*Steptopus amplexifolius*	T
White Water-buttercup	*Ranunculus aquatilis diffusus*	E
White-bracted Thoroughwort	*Eupatorium leucolepis*	E
White-leaved Leather-flower	*Clematis glaucophylla*	E

White-leaved Sunflower	*Helianthus glaucophyllus*	T
White Prairie-clover	*Dalea candida*	T
Whorled Mountain-mint	*Pycnanthemum verticillatum*	E
Whorled Sunflower	*Helianthus verticillatus*	E
Wide-leaved Yellow-eyed Grass	*Xyris laxifolia var. iridifolia*	T
Willow Aster	*Symphyotrichium praealtum*	E
Wolf Spike-rush	*Eleocharis wolfii*	E
Wood Lily	*Lilium philadelphicum*	E
Woolly Sedge	*Carex pellita*	E
Wooly Sandwort	*Arenaria lanuginosa*	E
Wretched Sedge	*Carex misera*	T
Wrinkled Jointgrass	*Coelarachis rugosa*	T
Yellow Avens	*Geum aleppicum*	E
Yellow Fringeless Orchid	*Platanthera integra*	E
Yellow Honeysuckle	*Lonicera flava*	T
Yellow Nodding Ladies-tresses	*Spiranthes ochroleuca*	E
Yellow Sunnybell	*Schoenolirion croceum*	T
Yellow Water-crowfoot	*Ranunculus flabellaris*	T
Zigzag Bladderwort	*Utricularia subulata*	T

APPENDIX E
ADDITIONAL TARGET 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 occur infrequently or the requests 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 the Black-bellied Whistling Duck (*Dendrocygna autumnalis*), Fulvous Whistling Duck (*Dendrocygna bicolor*), Greater White-fronted Goose (*Anser albifrons*), Wood Duck (*Aix sponsa*), Gadwall (*Anas strepera*), American Wigeon (*Anas americana*), American Black Duck (*Anas rubripes*), Blue-winged Teal (*Anas discors*), Northern Shoveler (*Anas clypeata*), Northern Pintail (*Anas acuta*), Green-winged Teal (*Anas crecca*), Canvasback (*Aythya valisineria*), Redhead (*Aythya americana*), Ring-necked Duck (*Aythya collaris*), Greater Scaup (*Aythya marila*), Lesser Scaup (*Aythya affinis*), Bufflehead (*Bucephala albeola*), Common Goldeneye (*Bucephala clangula*), Hooded Merganser (*Lophodytes cucullatus*), Common Merganser (*Mergus merganser*), Red-breasted Merganser (*Mergus serrator*), Common Loon (*Gavia immer*), Pied-billed Grebe (*Podilymbus podiceps*), Horned Grebe (*Podiceps auritus*), Anhinga (*Anhingas anhingas*), American White Pelican (*Pelecanus erythrorhynchos*), American Bittern (*Botaurus lentiginosus*), Little Blue Heron (*Egretta caerulea*), Green Heron (*Butorides virescens*), Yellow-crowned Night-Heron (*Nyctanassa violacea*), Northern Harrier (*Circus cyaneus*), Red-shouldered Hawk (*Buteo lineatus*), Broad-winged Hawk (*Buteo platypterus*), Rough-legged Hawk (*Buteo lagopus*), Common Gallinule (*Gallinula galeata*), American Coot (*Fulica americana*), Sandhill Crane (*Grus canadensis*), Black-necked Stilt (*Himantopus mexicanus*), American Avocet (*Recurvirostra americana*), Black-bellied Plover (*Pluvialis squatarola*), Semipalmated Plover (*Charadrius semipalmatus*), Spotted Sandpiper (*Actitis macularia*), Solitary Sandpiper (*Tringa solitaria*), Greater Yellowleg (*Tringa melanoleuca*), Willet (*Catoptrophorus semipalmatu*), Lesser Yellowleg (*Tringa flavipes*), Upland Sandpiper (*Bartramia longicauda*), Stilt Sandpiper (*Calidris himantopus*), Sanderling (*Calidris alba*), Dunlin (*Calidris alpina*), Least Sandpiper (*Calidris minutilla*), White-rumped Sandpiper (*Calidris fuscicollis*), Pectoral Sandpiper (*Calidris melanotos*), Semipalmated Sandpiper (*Calidris pusilla*), Wilson's Snipe (*Gallinago delicata*), American Woodcock (*Scolopax minor*), Wilson's Phalarope (*Phalaropus tricolor*), Bonaparte's Gull (*Chroicocephalus philadelphia*), Caspian Tern (*Hydroprogne caspia*), Common Tern (*Sterna hirundo*), Forster's Tern (*Sterna forsteri*), Common Ground-Dove (*Columbina passerine*), Barn Owl (*Tyto alba*), Eastern Screech-Owl (*Megascops asio*), Great Horned Owl (*Bubo virginianus*), Barred Owl (*Strix varia*), Long-eared Owl (*Asio otus*), Short-eared Owl (*Asio flammeus*), Chuck-will's-widow (*Antrostomus carolinensis*), Eastern Whip-poor-will (*Antrostomus vociferous*), Chimney Swift (*Chaetura pelagica*), Belted Kingfisher (*Megaceryle alcyon*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), Red-bellied Woodpecker (*Melanerpes carolinus*), Yellow-bellied Sapsucker (*Sphyrapicus varius*), Downy Woodpecker (*Picoides pubescens*), Hairy Woodpecker (*Picoides villosus*), Northern Flicker (*Colaptes auratus*), Pileated Woodpecker (*Dryocopus pileatus*), Merlin (*Falco columbarius*), Loggerhead Shrike (*Lanius ludovicianus*), Eastern Phoebe (*Sayornis phoebe*), Blue Jay (*Cyanocitta cristata*), Fish Crow (*Corvus ossifragus*), Horned Lark (*Eremophila alpestris*), Purple Martin (*Progne subis*), Tree Swallow (*Tachycineta bicolor*), Northern Rough-winged Swallow (*Stelgidopteryx serripennis*), Bank Swallow (*Riparia riparia*),Gray Catbird (*Dumetella carolinensis*), Brown Thrasher (*Toxostoma rufum*), Northern Mockingbird (*Mimus polyglottos*), Cedar Waxwing (*Bombycilla cedrorum*), Grasshopper Sparrow (*Ammodramus savannarum*), Northern Cardinal (*Cardinalis cardinalis*), Bobolink (*Dolichonyx oryzivorus*), Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*), Brewer's Blackbird (*Euphagus cyanocephalus*), and Purple Finch (*Haemorhous purpureus*).

Many of those 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 Tennessee occur in Table E-1.

Table E-1. Additional bird species that WS could address in Tennessee and the resource types damaged by those species

Species	Resource*				Species	Resource*			
	A	N	P	H		A	N	P	H
Black-bellied Whistling Duck			X	X	Least Sandpiper			X	X
Fulvous Whistling Duck			X	X	White-rumped Sandpiper			X	X
Greater White-fronted Goose			X	X	Pectoral Sandpiper			X	X
Wood Duck			X	X	Semipalmated Sandpiper			X	X
Gadwall			X	X	Wilson's Snipe			X	X
American Wigeon			X	X	American Woodcock			X	X
American Black Duck			X	X	Wilson's Phalarope			X	X
Blue-winged Teal			X	X	Bonaparte's Gull			X	X
Northern Shoveler			X	X	Caspian Tern			X	X
Northern Pintail			X	X	Common Tern			X	X
Green-winged Teal			X	X	Forster's Tern			X	X
Canvasback			X	X	Common Ground-Dove			X	X
Redhead			X	X	Barn Owl	X	X	X	X
Ring-necked Duck			X	X	Eastern Screech-Owl			X	X
Greater Scaup			X	X	Great Horned Owl	X	X	X	X
Lesser Scaup			X	X	Barred Owl	X	X	X	X
Bufflehead			X	X	Long-eared Owl			X	X
Common Goldeneye			X	X	Short-eared Owl			X	X
Hood Merganser	X		X	X	Chuck-will's-widow			X	X
Common Merganser	X		X	X	Eastern Whip-poor-will			X	X
Red-breasted Merganser	X		X	X	Chimney Swift			X	X
Common Loon			X	X	Belted Kingfisher	X	X	X	X
Pied-billed Grebe	X		X	X	Red-headed Woodpecker			X	X
Horned Grebe	X		X	X	Red-bellied Woodpecker			X	X
Anhinga	X	X	X	X	Yellow-bellied Sapsucker			X	X
American White Pelican	X		X	X	Downy Woodpecker			X	X
American Bittern			X	X	Hairy Woodpecker			X	X
Little Blue Heron	X		X	X	Northern Flicker			X	X
Green Heron	X		X	X	Pileated Woodpecker			X	X
Yellow-crowned Night-Heron	X		X	X	Merlin	X	X	X	X
Northern Harrier			X	X	Loggerhead Shrike			X	X
Red-shouldered Hawk			X	X	Eastern Phoebe			X	X
Broad-winged Hawk			X	X	Blue Jay			X	X
Rough-legged Hawk			X	X	Fish Crow	X	X	X	X
Common Gallinule			X	X	Horned Lark			X	X
American Coot			X	X	Purple Martin			X	X
Sandhill Crane	X		X	X	Tree Swallow			X	X

Black-necked Stilt			X	X	Northern Rough-winged Swallow			X	X
American Avocet			X	X	Bank Swallow			X	X
Black-bellied Plover			X	X	Gray Catbird			X	X
Semipalmated Plover			X	X	Brown Thrasher			X	X
Spotted Sandpiper			X	X	Northern Mockingbird			X	X
Solitary Sandpiper			X	X	Cedar Waxwing			X	X
Greater Yellowleg			X	X	Grasshopper Sparrow			X	X
Willet			X	X	Northern Cardinal			X	X
Lesser Yellowleg			X	X	Bobolink			X	X
Upland Sandpiper			X	X	Yellow-headed Blackbird	X	X	X	X
Stilt Sandpiper			X	X	Brewer's Blackbird	X	X	X	X
Sanderling			X	X	Purple Finch			X	X
Dunlin			X	X					

*A = Agriculture, N = Natural Resources, P = Property, H = Health and Safety

Table E-2 shows the number of technical assistance projects that WS conducted involving those species addressed in E-1 from FY 2009 through FY 2013. 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 annually of any of those species identified in Table E-1, except for those waterfowl and game species identified in Table E-1 that have annual hunting seasons. 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. In addition, to alleviate damage or discourage nesting in areas where damages were occurring, WS could destroy up to 10 nests annually of those species in Table E-1 that nest in the State.

Nest and egg destruction methods are often considered non-lethal when conducted before the development of an embryo. 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 nest destruction, 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 nests can only occur when authorized by the USFWS; therefore, the number of nests taken by WS annually would occur at the discretion of the USFWS.

Annual migratory bird hunting seasons allow hunters the opportunity to harvest Black-bellied Whistling Ducks, Fulvous Whistling Ducks, Greater White-fronted Geese, Wood Ducks, Gadwalls, American Wigeons, American Black Ducks, Blue-winged Teal, Northern Shovelers, Northern Pintails, Green-winged Teal, Canvasbacks, Redheads, Ring-necked Ducks, Greater Scaup, Lesser Scaup, Buffleheads, Common Goldeneyes, Hooded Mergansers, Common Mergansers, Red-breasted Mergansers, Common Gallinule, American Coot, Sandhill Crane, Wilson's Snipe, and American Woodcocks. With the exception of the Wood Duck, Hooded Merganser, and Common Gallinule, none of the above mentioned waterfowl species breed in Tennessee. As migratory species, most can be found statewide during the winter as they migrate south. Wood Ducks and Hooded Mergansers can be found statewide in Tennessee throughout the year, while Common Gallinules are only present during the breeding season (Sibley 2000, Bannor and Kiviat 2002).

The waterfowl season in Tennessee runs from the end of November through the end of January, which includes all ducks, coots, mergansers, rails, and gallinules. The early goose season is open the first two weeks of September, while the regular goose season opens concurrently with duck season, but runs through the first week in February (TWRA 2014*b*). Tennessee also has an early Wood Duck and Teal season in which Wood Ducks, Blue-winged Teal, and Green-winged Teal can be harvested for 5 days in the middle of September (TWRA 2014*a*). American Woodcocks can be harvested from late October through early December, while Wilson's Snipes can be harvested from mid-November through the end of February (TWRA 2014*a*). The TWRA is responsible for establishing limits and monitoring the take of all game species in Tennessee, including waterfowl. Each of these species is also federally protected under the MBTA and take outside of the regular hunting season is prohibited without the issuance of a depredation permit.

Table E-2. Technical assistance projects conducted by WS in Tennessee, FY 2009 - FY 2013

Species	Total	Species	Total
Bittern, American	2	Mockingbird, Northern	11
Bluebird, Eastern	3	Night-heron, Yellow-crowned	2
Cardinal, Northern	6	Owl, Barred	4
Coot, American	5	Owl, Barn	7
Crane, Sandhill	13	Owl, Eastern Screech	3
Duck, American Wigeon	2	Owl, Great Horned	23
Duck, Blue-winged Teal	2	Owl, Short-eared	2
Duck, Gadwall	2	Sandpiper, Pectoral	2
Duck, Green-winged Teal	2	Sandpiper, Semipalmated	2
Duck, Wood	1	Sandpiper, Solitary	2
Finch, Purple	1	Sandpiper, Spotted	2
Flicker, Northern	15	Shrikes (all species)	2
Fowl, Pea	3	Snipe, Wilson's	2
Goose, White-fronted	2	Stilt, Black-necked	2
Goldfinch, American	3	Swallow, Northern Rough-winged	1
Hawk, Broad-winged	12	Swan, Mute	3
Hawk, Northern Goshawk	3	Swifts (all species)	3
Hawk, Northern Harrier	4	Waxwing, Cedar	2
Hawk, Red-shouldered	21	Woodcock, American	1
Heron, Green	2	Woodpecker, Downy	10
Heron, Little Blue	2	Woodpecker, Hairy	6
Kingbird, Eastern	2	Woodpecker, Pileated	23
Loon, Common	1	Woodpecker, Red-bellied	8
Martin, Purple	3	Woodpecker, Red-headed	9

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.

WS does not expect the annual take of those species 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. If the USFWS did not issue a permit, no take would occur by WS. In addition, take could only occur at those levels stipulated in the 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 permitting processes. The USFWS, as the agency 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 E-1 in accordance with a federal permit.