ENVIRONMENTAL ASSESSMENT
(FINAL)

MAMMAL DAMAGE MANAGEMENT
IN GEORGIA

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

In cooperation with:

TENNESSEE VALLEY AUTHORITY

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ACRONYMS

AMDUCA	Animal Medicinal Drug Use Clarification Act
APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWA	Clean Water Act
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLIR	Forward Looking Infrared
FR	Federal Register
FY	Fiscal Year
GDNR	Georgia Department of Natural Resources
GnRH	Gonadotropin-releasing Hormone
IC	Intracardiac
IV	Intravenous
MOU	Memorandum of Understanding
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NRP	Natural Resources Plan
NWRC	National Wildlife Research Center
NWP	Nationwide Permit
ORV	Oral Rabies Vaccine
PEP	Post - Exposure Prophylaxis
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
TNR	Trap-Neuter-Release
TVA	Tennessee Valley Authority
USC	United States Code
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Services
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 Georgia continues to receive requests for assistance or anticipates receiving requests for assistance to resolve or prevent damage occurring to agricultural resources, natural resources, and property, including threats to human safety, associated with big brown bats (*Eptesicus fuscus*), bobcats (*Lynx rufus*), beaver (*Castor canadensis*), Brazilian free-tailed bats (*Tadarida brasiliensis*), coyotes (*Canis latrans*), eastern chipmunk (*Tamia striatus*), eastern cottontails (*Sylvilagus floridanus*), evening bats (*Nycticeius humeralis*), fallow deer (*Dama dama*), feral cats (*Felis domesticus*), feral dogs (*Canis familiaris*), feral swine (*Sus scrofa*), gray fox (*Urocyon cinereoargenteus*), gray squirrels (*Sciurus carolinensis*), little brown myotis (*Myotis lucifugus*), mink (*Neovison vison*), muskrats (*Ondatra zibethicus*), nine-banded armadillos (*Dasypus novemcinctus*), raccoons (*Procyon lotor*), Rafinesque's big-eared bats (*Corynorhinus rafinesquii*), red fox (*Vulpes vulpes*), river otters (*Lontra canadensis*), roof rats (*Rattus rattus*), silver-haired bats (*Lasionycteris noctivagans*), striped skunks (*Mephitis mephitis*), tri-colored bats (*Perimyotis subflavus*), Virginia opossum (*Didelphis virginiana*), white-tailed deer (*Odocoileus virginianus*), and woodchucks (*Marmota monax*). In addition, WS could occasionally receive requests for assistance with feral or free-ranging non-native mammals[2]. The Tennessee Valley Authority (TVA) also continues to experience damage and threats of damage associated with mammals at facilities or properties they own or manage in Georgia. The TVA could request the assistance of WS to manage damage or threats of damage at those facilities and properties.

Individual damage management projects conducted by the WS program could be categorically excluded from further analysis under the National Environmental Policy Act (NEPA), in accordance with APHIS implementing regulations for the NEPA (7 CFR 372.5(c), 60 FR 6000-6003). The purpose of this Environmental Assessment (EA) is to evaluate cumulatively the individual projects that WS could conduct to manage damage and threats to agricultural resources, property, natural resources, and threats to people caused by those mammal species identified previously, including those activities that the TVA could request of WS. This EA will assist in determining if the proposed cumulative management of mammal 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 caused by those species. Because the goal of WS would be to conduct a coordinated program to alleviate mammal damage in accordance with plans, goals, and objectives developed to reduce damage, and because the program's goals and directives[3] would be to provide assistance when requested, within the constraints of available funding and workforce, it is conceivable that additional damage management efforts could occur. 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 Georgia as part of a coordinated program. This EA analyzes the potential effects of mammal damage management when requested, as coordinated between WS, the TVA, and the Georgia Department of Natural Resources (GDNR).

WS and the TVA are preparing this EA to 1) facilitate planning; 2) promote interagency coordination; 3) streamline program management; 4) clearly communicate to the public the analysis of individual and cumulative impacts of proposed activities; and 5) evaluate and determine if there would be any potentially significant or cumulative effects from the alternative approaches developed to meet the need for action.

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[1]The WS program is authorized to protect agriculture and other resources from damage caused by wildlife through the Act of March 2, 1931 (46 Stat. 1468; 7 USC 426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 426c).

[2]See further discussion in Chapter 4, Section 4.1.

[3]At the time of preparation, WS' Directives occurred at the following web address: http://www.aphis.usda.gov/wildlife_damage/ws_directives.shtml.

The analyses contained in this EA are based on information derived from WS' Management Information System, published documents (see Appendix A), interagency consultations, and public involvement.

This EA evaluates the need for action to manage damage associated with mammals in the State, the potential issues associated with managing damage, and the environmental consequences of conducting different alternatives to meet the need for action while addressing the identified issues. WS, in cooperation with the TVA, initially developed the issues and alternatives associated with managing damage caused by mammals in consultation with the GDNR. The GDNR has regulatory authority to manage populations of wildlife in the State. To assist with identifying additional issues and alternatives to managing damage associated with mammals in Georgia, WS will make this EA available to the public for review and comment prior to the issuance of a Decision[4].

WS previously developed an EA that addressed WS' activities to manage damage associated with several species of mammals in Georgia (USDA 2008*a*). In addition, WS prepared an EA that evaluated the need to manage damage caused by white-tailed deer in the State (USDA 2002), an EA that evaluated the need to manage aquatic rodents (USDA 2004), and an EA that evaluated the need to manage damage caused by feral swine (USDA 2005). This new EA will (1) assist in determining if the proposed management of damage associated with mammals could have a significant impact on the environment for both people and other organisms; (2) analyze several alternatives to address the need for action and the identified issues; (3) coordinate efforts between WS, the TVA, the GDNR, and other entities; (4) inform the public; and (5) document the environmental consequences of the alternatives to comply with the NEPA. This new EA will re-evaluate activities conducted under the previous EAs to address a new need for action and the associated affected environment. Therefore, the analysis and the outcome of the Decision issued for this EA will supersede the previous EAs that addressed managing damage associated with white-tailed deer (USDA 2002), aquatic rodents (USDA 2004), feral swine (USDA 2005), and several other species of mammals (USDA 2008*a*).

1.2 NEED FOR ACTION

Some species of animals 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 animals. Those conflicts often lead people to request assistance with reducing damage to resources and to reduce threats to human safety.

Animals can have either positive or negative values depending on the perspectives and circumstances of individual people. In general, people regard animals as providing economic, recreational, and aesthetic benefits. Knowing that animals exist in the natural environment provides a positive benefit to some people. However, activities associated with animals 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 animals. When addressing damage or threats of damage caused by animals, animal damage management professionals must consider not only the needs of those directly affected by animal damage but a range of environmental, sociocultural, and economic considerations as well.

Resolving animal damage problems requires consideration of both sociological and biological carrying capacities. The acceptance capacity, or cultural carrying capacity, is the limit of human tolerance for animals or the maximum number of a given species that can coexist compatibly with local human

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

populations. Biological carrying capacity is the land or habitat's ability to support healthy populations of animals 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 an animal 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 animal acceptance capacity. While the biological carrying capacity of the habitat may support higher populations of animals, in many cases the acceptance capacity is lower. Once the 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 animals and can be an integral component of animal management (Berryman 1991, The Wildlife Society 2015). The threat of damage or loss of resources is often sufficient for people to initiate individual actions and the need for damage management can occur from specific threats to resources. Those animals have no intent to do harm. They utilize habitats (*e.g.*, feed, shelter) where they can find a niche. If their activities result in lost economic value of resources or threaten human safety, people often characterize this as damage. When damage exceeds or threatens to exceed an economic threshold and/or pose 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 the 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 the individual person has determined the losses associated with an animal or animals 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 an animal or animals was no longer tolerable to an individual person.

The need for action to manage damage and threats associated with mammals in Georgia arises from requests for assistance[5] received by WS. WS receives requests to reduce or 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 and 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 mammal species most likely to be responsible for causing damage to those four categories in the State based on previous requests for assistance. WS has provided technical assistance to those persons requesting assistance with resolving damage or the threat of damage. Table 1.1 lists WS' technical assistance projects involving mammal damage or threats of damage to those four major resource types in Georgia from the federal fiscal year[6] (FY) 2010 through FY 2015.

Technical assistance provides information and recommendations on activities to alleviate mammal damage that the requester could conduct without WS' direct involvement in managing or preventing the damage. This EA discusses technical assistance activities further in Chapter 3. Table 1.1 does not

[5]WS would only conduct mammal damage management after receiving a request for assistance. Before initiating damage management activities, WS and the cooperating entity would sign a Memorandum of Understanding, work initiation document, or other comparable document that would list all the methods the property owner or manager would allow WS to use on property they owned and/or managed.

[6]The federal fiscal year begins on October 1 and ends on September 30 the following year.

include direct operational assistance projects conducted by WS where a person or persons requested WS' assistance through the direct application of methods.

Table 1.1 – Technical assistance projects conducted by WS from FY 2010 through FY 2015

Species	Projects	Species	Projects
Bats (all species)	63	**Muskrat**	8
Beaver	455	**Nine-banded Armadillo**	79
Bobcat	24	**Raccoon**	83
Coyote	136	**Red Fox**	21
Eastern Chipmunk	3	**River Otter**	7
Fallow Deer	2	**Roof Rat**	3
Feral Cat	28	**Striped Skunk**	22
Feral Dog	14	**Virginia Opossum**	31
Feral Swine	109	**White-tailed Deer**	237
Gray Fox	43	**Woodchuck**	13
Gray Squirrel	62	**TOTAL**	**1,443**

The technical assistance projects conducted by WS are representative of the mammal species that cause damage and threats in Georgia. As shown in Table 1.1, WS has conducted 1,443 technical assistance projects in Georgia that addressed damage and threats associated with those mammal species addressed in this assessment from FY 2010 through FY 2015. Table 1.2 lists those mammal species addressed in this EA and the resource types that those mammal species can cause damage to in Georgia. Many of the mammal species can cause damage to or pose threats to a variety of resources. In Georgia, most requests for assistance received by WS relate to mammal species causing damage or posing threats of damage to property, agriculture, and human safety.

Table 1.2 – Mammal species that WS could address and the resource type damaged by those species

Species	Resource[a]				Species	Resource			
	A	N	P	H		A	N	P	H
Big Brown Bat			X	X	**Mink**	X	X	X	X
Bobcat	X	X	X	X	**Muskrat**	X	X	X	X
Beaver	X	X	X	X	**Nine-banded Armadillo**	X	X	X	X
Brazilian Free-tailed Bat			X	X	**Raccoon**	X	X	X	X
Coyote	X	X	X	X	**Rafinesque's Big-eared Bat**			X	X
Eastern Chipmunk			X		**Red Fox**	X	X	X	X
Eastern Cottontail	X		X	X	**River Otter**	X	X	X	X
Evening Bat			X	X	**Roof Rat**	X	X	X	X
Fallow Deer	X	X	X	X	**Silver-haired Bat**			X	X
Feral Cat	X	X	X	X	**Striped Skunk**	X	X	X	X
Feral Dog	X	X	X	X	**Tri-colored Bat**			X	X
Feral Swine	X	X	X	X	**Virginia Opossum**	X	X	X	X
Gray Fox	X	X	X	X	**White-tailed Deer**	X	X	X	X
Gray Squirrel			X		**Woodchuck**	X	X	X	X
Little Brown Myotis			X	X					

[a]A=Agriculture, N =Natural Resources, P=Property, H=Human Safety

All of the species addressed in this EA can cause damage to property, including posing strike risks at airports and airbases or posing as attractants for other species that are strike risks. For example, high densities of cottontail rabbits at an air facility may attract raptors to the area and those raptors may pose strike risks to aircraft. Nearly all of the species can pose threats to agricultural resources or cause damage to those resources. For example, predatory mammals (*e.g*., coyotes, bobcats, fox, and raccoons) may kill livestock. Raccoons may enter storage facilities to feed on stored animal feed and contaminate the feed with their feces.

More specific information regarding mammal damage to those main categories, including damages or threats that could occur on properties owned or managed by the TVA, are discussed in the following subsections of the EA.

Need for Mammal Damage Management on TVA Properties and Facilities

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 mammal species most likely to be responsible for causing damage to those four categories in the State based on previous requests for assistance. Table 1.3 summarizes the mammal species and the resource types that those species could damage on TVA-managed lands.

Table 1.3 – Mammal species that WS could address on TVA properties and the resource type damaged by those species

Species	Resource[a]				Species	Resource			
	A	N	P	H		A	N	P	H
Bobcat	X	X		X	Mink	X	X	X	X
Beaver	X	X	X	X	Muskrat		X	X	X
Coyote	X	X	X	X	Nine-banded Armadillo	X		X	
Eastern Chipmunk			X		Raccoon	X	X	X	X
Feral Cat	X	X	X	X	Red Fox	X	X	X	X
Feral Dog	X	X	X	X	Striped Skunk	X	X	X	X
Feral Swine	X	X	X	X	Virginia Opossum	X	X	X	X
Gray Fox	X	X	X	X	White-tailed Deer	X	X	X	X
Gray Squirrel			X		Woodchuck	X		X	X

[a]A=Agriculture, N =Natural Resources, P=Property, H=Human Safety

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 two hydroelectric dams in Georgia at Blue Ridge Reservoir and Nottely Reservoir. The TVA also owns or maintains electrical power substations, switching stations, and the associated transmission lines and rights-of-way easements in Georgia. In addition, the TVA operates public recreation areas throughout the Tennessee River Valley region, including campgrounds, day-use areas, and boat launching ramps.

Mammal damage and threats of damage occurring at facilities and properties owned or managed by the TVA primarily have occurred to property, human safety, and operational reliability of the electrical system. Woodchucks, beaver, muskrats, and armadillos burrowing into earthen levees and dikes used to impound water can compromise the integrity of the structures and threaten the safety of people downstream from these impoundments.

Many species of animals reside on TVA-managed lands. Those animals frequently become overpopulated or lose their fear of people, sometimes resulting in transmission of zoonotic diseases and aggressive behavior toward people. Many of those lands are public or recreational lands and those people using those lands expect the TVA to manage mammal populations and reduce the possibilities of disease transmission and attacks by wildlife. Mammals frequently enter substations and power generation facilities and threaten the interruption of power by chewing on various plastic components or climbing into areas of electric current and shorting out electrical circuits.

All of those damage issues and others occur throughout TVA owned and managed properties. The TVA has requested assistance from WS to address wildlife damage in the past and may request assistance with additional mammal damage issues in the future. For several years, this cooperative relationship has allowed WS to address TVA's requests for assistance by conducting operational control of these species. As the populations of many of those species increase and thrive in those areas managed or owned by the TVA, both WS and TVA expect increases in the need for mammal damage management in the future.

Need for Mammal Damage Management to Protect Human Health and Safety

The primary request for assistance to reduce threats to human safety received by WS is to lessen the threat of diseases transmission from exposure to animals and threats to human safety at air facilities from aircraft striking mammals. Zoonoses (*i.e.*, animal diseases transmissible to people) are often a major concern of people when requesting assistance with managing threats from mammals. Disease transmission could occur from direct interactions between people and mammals or from interactions with pets and livestock that have direct contact with wild mammals. Pets and livestock often encounter and interact with wild mammals, which can increase the opportunity of transmission of disease to people. Table 1.4 shows common diseases that could affect people that wild mammals can transmit in addition to diseases that could affect other animals, including domestic species. Those threats include viral, bacterial, mycotic (fungal), protozoal, and rickettsial diseases.

Table 1.4 - Animal diseases in the Eastern United States that pose potential health risks through transmission to people (Beran 1994, Davidson 2006)[†]

Disease	Causative Agent	Hosts[‡]	Human Exposure
Anthrax	*Bacillus antracis*	cat, dog	inhalation, ingestion
Tetanus	*Clostridium tetani*	mammals	direct contact
Dermatophilosis	*Dermatophilus congolensis*	mammals	direct contact
Leprosy	*Mycobacterium leprae*	armadillo	inhalation, direct contact
Pasteurellaceae	*Haemophilus influenzae*	mammals	bite or scratch
Salmonellosis	*Salmonella* spp.	mammals	ingestion
Yersinosis	*Yersinia* spp.	cat	ingestion
Chlamydioses	*Chlamydophilia felis*	cat	inhalation, direct contact
Typhus	*Rickettsia prowazekii*	opossum	inhalation, ticks, fleas
Sarcoptic mange	*Sarcoptes scabiei*	red fox, coyote, dog	direct contact
Trichinosis	*Trichinella spiralis*	raccoon, fox	ingestion, direct contact
Rabies	*Lyssavirus* spp.	mammals	direct contact
Visceral larval	*Baylisascaris procyonis*	raccoon, skunk	ingestion, direct contact
Leptospirosis	*Leptospira interrogans*	mammals	ingestion, direct contact
Echinococcus	*Echinococcus multilocularis*	fox, coyote	ingestion, direct contact
Toxoplasmosis	*Toxoplasma ondii*	cat, mammals	ingestion, direct contact
Spirometra	*Spirometra mansonoides*	bobcat, raccoon, fox	ingestion, direct contact
Giardiasis	*Giardia lamblia, G. duodenalis*	mammals	ingestion, direct contact

[†]Table 1.4 is not an exhaustive list of animal diseases considered infectious to people. The zoonoses provided are the more common infectious diseases for the species addressed in this EA and are only a representation of the approximately 100 to 3,000 zoonoses known to exist.

[‡] The host species provided for each zoonosis includes only those mammalian species addressed in this EA unless the zoonoses listed potentially infects a broad range of animals. The use of the general term "*mammals*" as the host species denotes zoonoses that could infect a broad range of mammals. The diseases listed do not necessarily infect only those mammalian species covered under this EA but likely infect several species of

mammals or groups of mammals. For a complete discussion of the more prevalent diseases in free-ranging mammals, please refer to Beran (1994) and Davidson (2006).

Individuals or property owners that request assistance with mammals frequently are concerned about potential disease risks but are unaware of the types of diseases that can be transmitted by those animals. In those types of situations, assistance is requested because of a perceived risk to human health or safety associated with wild animals living in close association with people, from animals acting out of character by roving in human-inhabited areas during daylight, or from animals showing no fear when people are present. Under the proposed action, WS could assist in resolving those types of requests for assistance.

In many circumstances when human health concerns are the primary reason for requesting WS' assistance there may have been no actual cases of transmission of disease to people by mammals. Thus, the risk of disease transmission would be the primary reason for requesting assistance from WS. Situations in Georgia where the threat of disease associated with wild or feral mammal populations may include:

- Exposure of residents to the threat of rabies due to high densities of raccoons or from companion animals encountering infected raccoons.
- Exposure of people to the threat of rabies posed by skunks that den under buildings or from companion animals interacting with infected skunks.
- Threats of parasitic infections to people from *Giardia* spp. that could occur from high feral cat populations in a park or recreation area.
- Concern about the threat of histoplasmosis from the disturbance of a large deposit of guano in an attic where a large colony of bats routinely roost or raise young.
- Accumulated droppings from denning or foraging raccoons and the subsequent exposure of the public to raccoon roundworm in fecal deposits.
- Exposure of domestic livestock to the bacterium, *Brucella suis*, by feral swine. *B. suis* causes swine brucellosis.

The most common disease concern expressed by individuals requesting assistance is the threat of rabies transmission to people, pets, and livestock. Rabies is an acute fatal viral disease of mammals, most often transmitted through the bite of a rabid animal that poses an indirect and direct threat to people. Indirect threats to people occur from exposure to pets or livestock that become infected from bites of a rabid animal. Direct threats can occur from handling infected animals or from aggressive animal behavior caused by rabies. The disease effectively can be prevented in people when exposure is identified early and treated. In addition, people can vaccinate domestic animals and pets for rabies. However, the abundant and widely distributed reservoir among wild mammals complicates rabies control. The vast majority of rabies cases reported to the Centers for Disease Control and Prevention (CDC) each year occur in raccoons, skunks (primarily *Mephitis mephitis*), and bats (Order Chiroptera) (CDC 2011).

Over the last 100 years, the vector of rabies in the United States has changed dramatically. About 90% or greater of all animal cases reported annually to the CDC now occur in wildlife (Krebs et al. 2000, CDC 2011). Before 1960, the majority of cases the CDC received occurred in domestic animals. The principal rabies hosts today are wild carnivores and bats. The number of rabies-related human deaths in the United States has declined from more than 100 annually in the early 1900s to an average of one or two people per year in the 1990s. Modern day prophylaxis, which is the series of vaccine injections given to people who have been potentially or actually exposed, has proven nearly 100% successful in preventing mortality when administered promptly (CDC 2011). In the United States, human fatalities associated with rabies occur in people who fail to seek timely medical assistance, usually because they were unaware of their exposure to rabies. Although human rabies deaths are rare, the estimated public health costs associated with disease detection, prevention, and control have risen, exceeding $300 million annually. Those costs include the vaccination of companion animals, maintenance of rabies laboratories, medical costs, such as those incurred for exposure case investigations, rabies post-exposure prophylaxis (PEP), and animal control programs (CDC 2011).

Accurate estimates of the aforementioned expenditures are not available. Although the number of PEPs given in the United States each year is unknown, it has been estimated to be as high as 40,000. When rabies becomes epizootic (*i.e*., affecting a large number of animals over a large area) or enzootic (*i.e*., present in an area over time but with a low case frequency) in a region, the number of PEPs in that area increases. Although the cost varies, a course of rabies immunoglobulin and five doses of vaccine given over a 4-week period typically exceeds $1,000 (CDC 2011) and has been reported to be as high as $3,000 or more (Meltzer 1996). As epizootics spread in animal populations, the risk of exposures requiring treatment of large numbers of people that contact individual rabid domestic animals infected by wild rabid animals increases. One case in Massachusetts involving contact with, or drinking milk from, a single rabid cow required PEPs for 71 people (CDC 1999). The total cost of this single incident exceeded $160,000 based on a median cost of $2,376 per PEP in Massachusetts. Likely, the most expensive single mass exposure case on record in the United States occurred during 1994 in Concord, New Hampshire when a kitten from a pet store tested positive for rabies after a brief illness. Because of potential exposure to the kitten or to other potentially rabid animals in the store, at least 665 persons received post-exposure rabies vaccinations at a total cost of more than $1.1 million (Noah et al. 1995). The American Veterinary Medical Association (AVMA) estimated the total cost for this specific incident, including investigation, laboratory testing, and rabies immunoglobulin and vaccines was more than $1.5 million (Barrows 2004).

Raccoons have been associated with the spread of rabies throughout the eastern United States, including Georgia (USDA 2009*a*). Rabies in raccoons was virtually unknown prior to the 1950s. The first documented case of rabies occurred in Florida where it spread slowly during the next three decades into Georgia, Alabama, and South Carolina. People likely unintentionally introduced rabies into the Mid-Atlantic States by translocation of infected animals (Krebs et al. 1998). The first cases appeared in West Virginia and Virginia in 1977 and 1978, respectively. Since then, the raccoon variant of rabies expanded to form the most intensive rabies outbreak in the United States. The variant is now enzootic in all of the eastern coastal states, as well as Alabama, Pennsylvania, Vermont, West Virginia, and most recently, parts of Ohio (Krebs et al. 2000). The raccoon rabies epizootic front reached Maine in 1994, reflecting a movement rate of about 30 to 35 miles per year. The westward movement of the raccoon rabies front has slowed, probably in response to both natural geographic and man-made barriers. The Appalachian Mountains and perhaps river systems flowing eastward have helped confine the raccoon variant to the eastern United States. In addition, the USDA has created an oral rabies vaccine (ORV) "*barrier*" of vaccinated wild animals on the western edge of the Appalachian Mountains (USDA 2009*a*). If this combined barrier were breached by the raccoon variant of rabies, research suggests that raccoon populations would be sufficient for rabies to spread westward at a rate similar to or greater than the rate at which this rabies strain has spread in the eastern United States (Sanderson and Huber 1982, Glueck et al. 1988, Hasbrouck et al. 1992, Mosillo et al. 1999).

The raccoon variant of rabies presents a human health threat through potential direct exposure to rabid raccoons, or indirectly through the exposure of pets that have an encounter with rabid raccoons. Additionally, the number of pets and livestock examined and vaccinated for rabies, the number of diagnostic tests requested, and the number of post exposure treatments are greater when raccoon rabies is present in an area. Human and financial resources allocated to rabies-related human and animal health needs also increase, often at the expense of other important activities and services.

Skunks are also an important wildlife host for the rabies virus in North America and are second only to raccoons in being the most commonly reported rabid wildlife species in the United States (Majumdar et al. 2005). The skunk variant of rabies occurs in the Midwest and California; however, different variants of rabies can infect skunks throughout North America, such as the raccoon variant. The distribution of rabies in skunks extends from Georgia to Maine east of the Appalachians, Texas to the Canadian border, and throughout the northern two thirds of California (Majumdar et al. 2005).

The fox is one of the four major maintenance hosts for rabies in North America. In the 1950s, rabies in red fox spread throughout Canada, parts of New England, and Alaska. The range has since decreased, but fox rabies persists in Alaska and parts of Texas. Clinical signs of rabies in fox often manifest as the "*furious*" form of rabies (Majumdar et al. 2005).

In an effort to halt the westward spread of the raccoon variant of the rabies virus and to limit the spread of the canine variant from Texas, WS began participating in the distribution of ORV baits (fishmeal polymer containing Raboral V-RG® vaccine [Merial, Athens, Georgia, USA]). Currently, WS participates in the distribution of ORV baits and the surveillance of wildlife rabies vectors in 26 states, including Georgia.

Majumdar et al. (2005) implicated increasing populations of raccoons in certain areas to outbreaks of distemper. Distemper has not been identified as transmissible to people. However, people who feel threatened by the possibility of disease transmission often request assistance after observing sick raccoons on their property. Symptoms of distemper often lead to abnormal behavior in raccoons that are similar to symptoms associated with rabies. Raccoons with distemper often lose their fear of people and can act aggressively, which increases the risk to people, livestock, or companion animals from bites. Distemper can also occur in coyotes, red fox, and gray fox with symptoms that are similar to those symptoms exhibited by animals infected with the rabies virus.

Diseases and parasites affecting feral cats and dogs can have particularly serious implications to human health given the close association of those animals with people and companion animals. The topic of feral animals and their impacts on native wildlife and human health elicits a strong response in numerous professional and societal groups with an interest in the topic. Most professional wildlife biologists consider feral cats and dogs to be non-native species that can have detrimental effects to the native ecosystems, especially in the presence of a human altered landscape. However, a segment of society views feral animals to be an extension of companion animals that should be cared for and for which affection bonds are often developed, especially when societal groups feed and care for individual feral animals. Of special concern are those cats and dogs considered companion animals that are not confined indoors at all times but are allowed to range freely or unrestrained outside the home for extended periods. If interactions occur between companion animals and feral animals of the same species, exposure of companion animals to a wide-range of zoonoses can occur. Companion animals could bring those zoonoses into the home where direct contact between pets and people increases the likelihood of disease transmission. Free-ranging animals that people consider companion animals also are likely to affect multiple people if disease transmission occurs since those animals are likely to come in direct contact with several members of families and friends before diagnosis of a disease occurs. Feral cat colonies have become established at several TVA sites and facilities, including public recreation areas, which can threaten the human health and safety.

Several known diseases that are infectious to people, including rabies, occur in feral cats and dogs. A common zoonosis found in cats is ringworm. Ringworm (*Tinea* spp.) is a contagious fungal disease contracted through direct interactions with an infected person, animal, or soil. Other common zoonoses of cats are pasteurella, salmonella, cat scratch disease, and numerous parasitic diseases, including roundworms, tapeworms, and toxoplasmosis.

Most of the zoonoses known to infect cats and dogs that are infectious to people are not life threatening if diagnosed and treated early. However, certain societal segments are at higher risks if exposed to zoonoses. Women who are pregnant, people receiving chemotherapy for immunologic diseases and organ transplants, and those with weakened immune systems are at increased risk of clinical disease if exposed to toxoplasmosis (Jessup 2004). In 1994, five children in Florida were hospitalized with encephalitis that was associated with cat scratch fever (Jessup 2004). In another example, the daycare center at the University of Hawaii in Manoa was closed for two weeks in 2002 because of concerns about potential transmission of murine typhus (*Rickettsia typhi*) and flea (*Ctenocephalides felis*) infestations afflicting 84 children and faculty. The fleas at the facility originated from a feral cat colony that had grown from 100 cats to over 1,000 cats, despite a trap, neuter, and release effort (Jessup 2004).

A study in France determined that stray cats serve as major reservoirs for the bacterium *Bartonella* spp. Consequently, stray cats and their fleas (*C. felis*) are the only known vectors for infecting house bound cats and people with this bacterium. The flea does not infect people, but fleabites can often infect pet cats. Human infections that may result from exposure of this bacterium via stray cats include cat scratch disease in immunocompetent patients, bacillary angiomatosis, hepatic peliosis in immunocompromised patients, endocarditis, bacteremia, osteolytic lesions, pulmonary nodules, neuroretinitis, and neurologic diseases (Heller et al. 1997). In areas where dog rabies has been eliminated, but rabies in wildlife has not, cats often are the primary animal transmitting rabies to people (Vaughn 1976, Eng and Fishbein 1990, Krebs et al. 1998).

Feral swine can pose a threat to human safety from disease transmission, from aggressive behavior, and from vehicles and aircraft striking swine. Feral swine are potential reservoirs for at least 30 viral and bacterial diseases (Samuel et al. 2001, Williams and Barker 2001, Davidson 2006) and 37 parasites (Forrester 1992) that are transmissible to people. Brucellosis, salmonellosis, toxoplasmosis, trichinosis, tuberculosis, and tularemia are some of the common diseases that feral swine could carry that can also infect people (Hubalek et al. 2002, Seward et al. 2004, Stevens 2010). In addition, feral swine can pose risks to domestic livestock through the potential transmission of diseases between feral swine populations and domestic livestock where interactions may occur.

Conflicts involving bats can include property damage, but primarily involve threats to the health of people, pets, and livestock. The buildup of bat droppings and urine in attics and between walls can result in odor problems and discoloration of walls and ceilings (Agency for Toxic Substances and Disease Registry 1998). In addition to the threat of rabies from direct contact or a bat entering the living area of a home, there are other threats associated with bat colonies, including histoplasmosis, fungal spores, and mites.

Bat droppings, particularly when they accumulate over many years, are likely to contain the fungus *Histoplasma capsulatum*, or with fungi species, such as molds, especially in warm, moist conditions. When people disturb fecal accumulations containing *H. capsulatum* and inhale spores from the fungus, they may become ill with a disease known as histoplasmosis. Symptoms of histoplasmosis include some combination of mild, flu-like respiratory illness, a general ill feeling, chest pain, fever, cough, headache, loss of appetite, shortness of breath, joint and muscle pains, chills, and hoarseness. Although there are other, more rare illnesses associated with exposure, the most likely is histoplasmosis. Similarly, mold spores released into the air may result in an increase of asthma attacks (Agency for Toxic Substances and Disease Registry 1998).

Bat bugs (*Cimex adjunctus*) are free-living ectoparasites of bats that feed on blood from bats. They will bite people in the absence of their primary hosts. The main means of dispersal for bat bugs is by clinging to the fur of bats as bats move between locations. Typically, bat bug infestations originate from bat populations established in attics, wall voids, unused chimneys, or uninhabited portions of a house. Bat bugs typically do not wander far from occupied bat roosting sites where they have easy access to food. However, if their normal hosts leave, bat bugs can seek other sources of food and may crawl about and invade living areas within a house and bite people (Jones and Jordan 2004). Although their bite is not particularly harmful, the person may experience an allergic reaction and develop a skin rash in response (Agency for Toxic Substances and Disease Registry 1998).

The intention of this brief discussion on zoonoses is to address the more commonly known zoonoses found in the United States for those species specifically addressed in this EA and is not an exhaustive discussion of all potential zoonoses. Limited information and understanding of disease transmission from wildlife to people exists for most infectious zoonoses. In most cases when human exposure occurs, the presence of a disease vector across a broad range of naturally occurring sources, including occurring in wildlife populations, can complicate determining the origin of the vector. A person with salmonella poisoning, for example, may have contracted salmonella bacterium from direct contact with an infected pet but also may have contracted the bacterium from eating undercooked meat or from other sources.

Public awareness and the health risks associated with zoonoses have increased in recent years; however, disease transmission directly from animals to people is uncommon. However, the infrequency of such transmission does not diminish the concerns of those people fearful of exposure requesting assistance since disease transmission could occur. This EA briefly addresses some of the more commonly known zoonotic diseases associated with mammals. The intention of this brief discussion on zoonoses is to address the more commonly known zoonoses found in the United States for those species specifically addressed in this EA and is not an exhaustive discussion of all potential zoonoses. Those zoonotic diseases remain a concern and continue to pose threats to human safety where people encounter mammals.

Limited information and understanding of disease transmission from animals to people exists for most infectious zoonoses. In most cases when human exposure occurs, the presence of a disease vector across a broad range of naturally occurring sources, including occurring in animal populations, can complicate determining the origin of the vector. For example, a person with salmonella poisoning may have contracted salmonella bacterium from direct contact with an infected pet but also may have contracted the bacterium from eating undercooked meat or from other sources. WS actively attempts to educate the public about the risks associated with disease transmission from animals to people through technical assistance and by providing technical leaflets on the risks of exposure.

In addition to disease transmission threats, WS also receives requests for assistance from perceived threats of physical harm from animals, especially from predatory animals. Human encroachment into wildlife habitat increases the likelihood of human-wildlife interactions. Those species that people are likely to encounter are those most likely to adapt to and thrive in human altered habitat. Several predatory and omnivorous animal species thrive in urban habitat due to the availability of food, water, and shelter. Many people enjoy animals to the point of purchasing food specifically for feeding animals despite laws prohibiting the act in many areas. The constant presence of human created refuse, readily available water supplies, and abundant rodent populations found in some areas often increase the survival rates and carrying capacity of animal species that are adaptable to those habitats. Often the only limiting factor of animal species in and around areas inhabited by people is the prevalence of disease. Overabundant animals that congregate into small areas because of the unlimited amount of food, water, and shelter can confound the prevalence of diseases.

As people are increasingly living with wildlife, the lack of harassing and threatening behavior by people toward many species of wildlife has led to a decline in the fear wildlife have toward people. When animal species begin to habituate to the presence of people and human activity, a loss of apprehension occurs that can lead to 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 animals attacking people occurs rarely, the number of attacks appears to be on the increase. Timm et al. (2004) reported that coyotes attacking people have increased in California and the recent, highly publicized coyote attacks, including a fatal attack on a 19-year old woman in Nova Scotia (Canadian Broadcast Company 2009), have only heightened people's awareness of the threat of such encounters.

Although attacks on people associated with those species addressed in this EA occurs rarely, requests for assistance to lessen the threat of possible attacks could occur from people in Georgia. Often, animals exhibiting threatening behavior or a loss of apprehension to the presence of people is a direct result and indication of an animal inflicted with a disease. Therefore, requests for assistance could occur from a desire to reduce the threat of disease transmission and/or from fear of aggressive behavior from an animal that is less apprehensive of people or induced as a symptom of disease.

Burrowing by woodchucks may sometimes threaten earthen dams as they form networks of burrows, which can weaken such structures, causing erosion and failure. Such incidents can threaten the safety and lives of people living downstream from the dam. As part of the proposed program, WS could provide mammal damage management assistance, upon request, involving those mammal species addressed in this EA that pose a threat to human health and safety in Georgia.

Disease Surveillance and Monitoring

WS could conduct or assist with disease monitoring or surveillance activities for any of the mammal species addressed in this EA. Most disease sampling would occur ancillary to other wildlife damage management activities (*i*.*e*., disease sampling would occur after wildlife have been captured or lethally removed for other purposes). For example, WS may sample deer harvested during the annual hunting season or collect samples during other damage management programs for Chronic Wasting Disease. WS could collect ticks from the carcasses of raccoons after lethally removing the raccoon to alleviate damage. WS could sample feral swine harvested by hunters or during damage management activities to test for classical swine fever, swine brucellosis, pseudorabies, or other diseases.

Need to Respond to Emergency Efforts

Both large-scale natural disasters (*e*.*g*., hurricanes, tornadoes, floods) and small-scale localized emergencies (*e*.*g*., release of exotic animals, traffic accidents involving animal transport vehicles) may occur in which WS' personnel could receive requests to assist federal, state, and local governments in charge of responding to those situations. Those requests for assistance would be on extremely short notice and rare emergencies that would be coordinated by federal, state, and local emergency management agencies. For example, WS' personnel may receive requests to participate in the lethal removal of cattle that were injured or were released from their transport vehicle at the scene of an accident to prevent those animals from endangering other drivers. WS could be asked to corral those animals that were uninjured and euthanize those animals that have been injured to reduce their suffering. In another example, WS' personnel may receive requests to assist local and state law enforcement in immobilization or lethal control of exotic animals that have been accidentally released in the aftermath of a hurricane or tornado.

Need for Mammal Damage Management at Airports

Airports provide ideal conditions for many animal species due to the large open grassy areas around runways and taxiways adjacent to brushy, forested habitat used as noise barriers. Access to most airport properties is restricted so mammal species living within airport boundaries are not harvestable during hunting and trapping seasons and insulated from many other human disturbances.

The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with animals is increasing (Dolbeer 2000, MacKinnon et al. 2001, Dolbeer 2009). Collisions between aircraft and animals are a concern throughout the world because animal strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996, Thorpe 1997, Keirn et al. 2010). Aircraft collisions with animals can also erode public confidence in the air transport industry as a whole (Conover et al. 1995).

Between 1990 and 2014, there were 3,360 reported aircraft strikes involving terrestrial mammals in the United States (Dolbeer et al. 2015). The number of mammal strikes actually occurring is likely to be much greater, since Dolbeer (2009) estimated that entities reported 39% of actual animal strikes to civil aircraft. Aircraft have collided with a reported 41 species of terrestrial mammals from 1990 through 2014, including white-tailed deer, raccoons, gray fox, red fox, cats, dogs, coyotes, opossum, beaver, muskrats, river otters, rabbits, woodchucks, feral swine, and striped skunks. In addition, aircraft in the United States have struck 21 species of bats (Dolbeer et al. 2015). Of the terrestrial mammals reported struck by aircraft, 37% were carnivores (primarily coyotes), causing nearly $4.3 million in damages (Dolbeer et al. 2015). Deer accounted for 34% of the reported strikes involving terrestrial mammals in the United States causing over $55 million in damages (Dolbeer et al. 2015). Data also indicates that a much higher percentage of mammal strikes resulted in aircraft damage compared to bird strikes (Dolbeer et al. 2015). Costs of those collisions vary, but data from the Federal Aviation Administration (FAA) reveals that mammal strikes in the United States cost the civil aviation industry approximately 315,127 hours of down time and over $60 million in direct monetary losses between 1990 and 2014 (Dolbeer et al. 2015).

From 1990 through 2012, about 31% of terrestrial mammal strikes in the United States have resulted in damage compared to 9% for birds (Dolbeer et al. 2015). In addition to direct damage, an aircraft striking a mammal can pose serious threats to human safety if the damage from the strike causes a catastrophic failure of the aircraft leading to a crash. For example, damage to the landing gear during the landing roll and/or takeoff run can cause a loss of control of the aircraft causing additional damage to the aircraft, which can increase the threat to human safety. Nearly 64% of the reported mammal strikes from 1990 through 2014 occurred at night, with most strikes occurring during the landing roll or the takeoff run (Dolbeer et al. 2015).

According to reports filed with the FAA (2016), between 1990 and 2016, there have been 30 aircraft strikes involving white-tailed deer, 36 incidents involving bats, 16 incidents involving coyotes, three strikes involving opossum, two strikes involving fox (species not identified), eight incidents involving eastern cottontails, one involving a gray fox, two strikes involving a free-ranging cat, one strike involving a raccoon, and one involving a free-ranging dog in Georgia. Airports in Georgia have requested assistance with managing threats to human safety and damage to property caused by mammals present inside the area of operations of an airport. The infrequency of mammal strikes does not lessen the need to prevent threats to human safety and the prevention of damage to property. Preventing damage and reducing threats to human safety would be the goal of cooperators requesting assistance at airports in Georgia given that a potential strike could lead to the loss of human life and considerable damage to property.

Animal populations near or found confined within perimeter fences at airports can be a threat to human safety and cause damage to property when struck by aircraft. Those animals confined inside an airport perimeter fence would not be considered distinct populations nor separate from those populations found outside the perimeter fence. Animals found within the boundaries of perimeter fences originate from populations outside the fence. Those individuals of a species inside the fence neither exhibit nor have unique characteristics from those individuals of the same species that occur outside the fence; therefore, those individuals of a species confined inside an airport perimeter fence do not warrant consideration as a unique population under this analysis.

Need for Mammal Damage Management to Alleviate Damage to Agricultural Resources

Red fox, gray fox, bobcats, beaver, coyotes, deer, armadillos, opossum, mink, river otters, skunks, raccoons, roof rats, feral cats, feral dogs, and feral swine can cause losses or injury to crops (*e.g.*, corn), livestock (*e.g.*, sheep, goats, cattle, pigs, horses), and poultry (*e.g.*, chickens, turkeys, geese, ducks) through consumption, flooding, or predation. During 2001, crop and livestock losses from animals in the United States totaled $944 million, with field crop losses totaling $619 million, livestock and poultry losses totaling $178 million, and losses of vegetables, fruits, and nuts totaling $146 million. Those losses include destruction of or damage to crops in the field and death or injury to livestock. In 2001, the National Agricultural Statistics Service (NASS) reported that raccoons were responsible for 6%, 3%, and 6% of the total damage to field crops; livestock and poultry; and vegetables, fruits, and nuts, respectively, in the United States (NASS 2002). In addition, white-tailed deer accounted for 58% of the total field crop damage and 33% of vegetable, fruit, and nut damage. Feral swine accounted for 3% or $18.5 million in damages to field crops (NASS 2002).

In 2010, the NASS (2011) reported cattle and calf losses from animal predation totaled 219,900 head in the United States according to livestock producers. Animal predation represented 5.5% of the total cattle and calf losses reported by livestock producers in 2010 totaling nearly $98.5 million in economic losses. Agricultural producers identified coyotes as the primary predator of livestock with 53.1% of cattle and calf losses attributed to coyotes. Producers also identified livestock losses associated with bobcats, bears, and dogs. Producers spent nearly $188.5 million on non-lethal methods to reduce cattle and calf losses from predation by animals in 2010 (NASS 2011). The primary non-lethal method employed by livestock producers was the use of guard animals with a reported 36.9% of producers using guard animals. Producers also reported using exclusion fencing, frequent checking, and culling as additional employed methods for reducing predation (NASS 2011).

In Georgia, the NASS (2011) reported 1,300 cattle and 3,500 calves were killed in 2010 by animal predators. The economic loss from animal predators in Georgia was estimated at $2.2 million in 2010 (NASS 2011). Coyotes were attributed to 7.0% of the cattle losses and 53.7% of the calves lost in Georgia. Livestock producers in the State attributed dogs to 14.1% of the cattle and 15.8% of the calves lost (NASS 2011). Cattle producers in Georgia reported using a number of non-lethal methods to reduce losses due to predators. Of those cattle producers in Georgia using at least one non-lethal method, 31.9% were using exclusion fencing along with 49.2% reporting the use of guard animals (NASS 2011).

Cattle producers in the United States indicated coyotes, dogs, and mountain lions and bobcats[7] caused 53.1%, 9.9%, and 8.6%, respectively, of the cattle and calf losses attributed to animal predators in 2010 (NASS 2011). As expected, those predators are known to prey on other livestock.

Beaver, which can be carriers of the intestinal parasite *Giardia lamblia*, can contaminate human water supplies and cause outbreaks of the disease Giardiasis in people (Woodward 1983, Beach and McCulloch 1985, Wade and Ramsey 1986, Miller and Yarrow 1994). Giardiasis is an illness caused by a microscopic parasite that the CDC reports as one of the most common causes of waterborne disease in people across the United States (CDC 2015). People can contract giardiasis by swallowing contaminated water or putting anything in their mouth that has touched the fecal matter of an infected animal or person.

[7]The 2011 NASS cattle loss report groups mountain lion and bobcat predation into one category and does not separate losses attributed to the two species. Mountain lions, given their preference for larger prey, are likely the cause of most of the losses attributed to this category, especially to adult cattle. However, bobcats are known to prey upon calves though infrequently.

Symptoms of giardiasis include diarrhea, cramps, and nausea (CDC 2015). Beaver can also be carriers of tularemia, a bacterial disease that is transmittable to people through bites by insect vectors, bites of infected animals, or by handling animals or carcasses that are infected (Wade and Ramsey 1986). In cattle ranching sections of Wyoming, Skinner et al. (1984) found that the fecal bacteria count was much higher in beaver ponds than in other ponds, something that can be a concern to ranchers and recreationists.

Although reports of rabies in beaver and muskrats are not common, those species have tested positive for rabies in the United States. Between 2008 and 2012, 2 muskrats and 10 beaver across the United States have tested positive for the rabies virus (Blanton et al. 2009, Blanton et al. 2010, Blanton et al. 2011, Blanton et al. 2012, Dyer et al. 2013). Beaver infected with the rabies virus have aggressively attacked pets and people (Brakhage and Sampson 1952, CDC 2002, Caudell 2012). In 2001, a beaver tested positive for rabies that was exhibiting aggressive behavior by charging canoes and kayaks on a river in Florida (CDC 2002). In 2012, a beaver, that tested positive for rabies, attacked a person wading in a New York river (Caudell 2012). The person suffered six puncture wounds over their body and underwent treatment for rabies (Caudell 2012).

Beaver activity in certain situations can become a threat to public health and safety (*e.g.*, burrowing into or flooding of roadways and railroad beds can result in serious accidents) (Miller 1983, Woodward 1983). Increased water levels in urban areas resulting from beaver activity can lead to unsanitary conditions and potential health problems by flooding septic systems and sewage treatment facilities (DeAlmeida 1987, Loeb 1994). Beaver damming activity can also create conditions favorable to mosquitoes and can hinder mosquito control efforts or result in population increases of these insects (Wade and Ramsey 1986). While the presence of these insects is largely a nuisance, mosquitoes can transmit diseases, such as encephalitis (Green 1982) and West Nile Virus (CDC 2000). Furthermore, the damming of streams can sometimes increase the presence of aquatic snakes using the area, including the venomous cottonmouth (*Agkistrodon piscivorus*) (Wade and Ramsey 1986).

Burrowing by muskrats and woodchucks (commonly referred to as groundhogs) may sometimes threaten earthen dams as they form networks of burrows, which can weaken such structures, causing erosion and failure. Such incidents can threaten the safety and lives of people living downstream from the dam. For that reason, managers of such sites are concerned with preventing excessive burrowing by those animals at dam sites. Much of the damage caused by muskrats is primarily through their burrowing activity (Perry 1982, Miller 1994, Linzey 1998) in dikes, dams, ditches, ponds, and shorelines. Muskrats can dig burrows into banks and levees, which can compromise the integrity of embankments (Perry 1982, Linzey 1998). Muskrats can dig burrows with underwater entrances along shorelines and burrowing may not be readily evident until serious damage has occurred. When water levels drop, muskrats often expand the holes and tunnels to keep pace with the retreating water level. Additionally, when water levels rise muskrats expand the burrows upward. Those burrows can collapse when people or animals walk over them and when heavy equipment (*e.g.*, mowers, tractors) crosses over.

Woodchucks can cause damage to field crops, such as row and forage crops, orchards, nursery plants, and commercial gardens. Cottontail rabbits can damage orchard trees by gnawing at the base of the tree. Trees can be badly damaged when the bark is girdled, which may occur when feeding by rabbits is severe. Similar damage can occur in nurseries that grow landscape ornamentals and shrubs.

River otters and, to a lesser extent, raccoons may prey on fish and other cultured species at hatcheries and aquaculture facilities (Bevan et al. 2002). River otters may even prey on fish in marine aquaculture facilities (Goldburg et al. 2001).

The domestic cat has been found to transmit *Toxoplasma gondii* to both domestic and wild animal species. Cats have been found to be important reservoirs and the only species known to allow for the completion of the life cycle for the protozoan parasite *T. gondii* (Dubey 1973, Teutsch et al. 1979). Both feral and domiciled cats may be infected by this protozoan, but this infection is more common in feral cats. Fitzgerald et al. (1984) documented that feral cats transmitted *T. gondii* to sheep in New Zealand, resulting in ewes aborting fetuses and found *Sarcocystis* spp. contamination in the musculature of sheep. Dubey et al. (1995) found cats to be 68.3% positive for seroprevalence of *T. gondii* on swine farms in Illinois and the major reservoir for this disease. The main sources for infecting cats are thought to be birds and mice.

Diseases that may be communicable from feral cats to companion cats include feline panleukopenia infection, feline calicivirus infection, feline reovirus infection, and feline syncytium-forming virus infection (Gillespie and Scott 1973). Of the four feline diseases, feline panleukopenia is likely the most serious. Reif (1976) found that during the acute stages of feline panleukopenia, fleas were vectors of this disease to other cats. Feline panleukopenia infection is cyclic in nature, being more prevalent in the July to September period.

Agricultural damage and threats caused by feral swine can occur to a variety of crops, livestock, and other agricultural resources (Beach 1993, Seward et al. 2004, West et al. 2009, Hamrick et al. 2011). Damage occurs from direct consumption of agricultural resources and from trampling, rooting, and/or wallowing that are common activities of feral swine (Beach 1993). Rooting is a common activity of feral swine where they overturn sod and soil in search of food (West et al. 2009, Stevens 2010, Hamrick et al. 2011). Feral swine also wallow in water and mud to regulate body temperature and to ward off skin parasites.

Damage and threats to livestock associated with feral swine occurs from predation on livestock and the risks associated with disease transfer from feral swine to domestic livestock (West et al. 2009, Hamrick et al. 2011). Feral swine can also cause damage to other agricultural resources. For example, feral swine can cause damage to pastures and land used for hay by rooting and wallowing, can cause damage to ponds and water sources for livestock, and can cause damage from the consumption of livestock feed. Feral swine feeding activities in agricultural crops can also lead to increased erosion from the removal of vegetation that leaves the soil bare along with the overturning of soil caused by rooting.

In addition, feral swine also damage pastures, land used for hay, and sod farms through rooting and wallowing activities (Beach 1993, West et al. 2009, Stevens 2010, Hamrick et al. 2011). Rooting activities can also lead to increased erosion and soil loss. Wallowing and rooting activities in watering areas for livestock can result in severely muddied water, algal blooms, oxygen depletion, bank erosion, and reduction in fish viability (Beach 1993). Since feral swine often travel in family groups, damage from rooting and wallowing can be extensive often encompassing several acres.

Additional risks associated with feral swine are the potential for disease transmission from feral swine to domestic livestock, especially to domestic swine. Feral swine are potential reservoirs for several diseases that are known to be transmissible between feral swine and domestic livestock (Wood and Barrett 1979, Corn et al. 1986, Beach 1993, Davidson 2006). Corn et al. (1986) found feral swine tested in Texas were positive for pseudorabies, brucellosis, and leptospirosis. A study in Oklahoma found samples from feral swine tested positive for antibodies of porcine parvovirus, swine influenza, and porcine reproductive and respiratory syndrome virus (Saliki et al. 1998). Porcine reproductive and respiratory syndrome is a highly infectious virus that causes reproductive failure and respiratory disease in swine (USDA 2009*b*). The total cost of productivity losses due to porcine reproductive and respiratory syndrome in the domestic swine herd in the United States was estimated at $664 million annually during 2011 and represented an increase from the $560 million annual cost estimated in 2005 (Holtkamp et al. 2013).

Pseudorabies is a viral disease associated with an extremely contagious herpes virus that can have negative effects on reproduction in domestic swine. An economic analysis estimated that the annual cost of pseudorabies to pork producers in the United States at more than $30 million annually in lost production as well as testing and vaccination costs (USDA 2008*b*). Brucellosis is a bacterial disease that can also have negative effects on reproduction of swine.

Cholera, trichinosis, and African swine fever are additional diseases that can be transmitted between livestock and feral swine. Disease transmission is likely to occur where domestic livestock and feral swine have a common interface, such as at water sources and livestock feeding areas. Although several diseases carried by swine are also transmissible to other livestock, the primary concern is the potential transmission of diseases from feral swine to domestic swine. Many of the diseases associated with feral swine also negatively affect the health and marketability of domestic swine that can lead to economic losses to the livestock producer. A disease outbreak not only has negative economic implications to the individual livestock producer but an outbreak also could cause economic losses that can negatively affect the statewide swine industry. The WS program in Georgia could conduct disease surveillance in the feral swine population as part of the National Wildlife Disease Surveillance Program.

The United States is one of the world's largest producers of pork and is the second largest exporter of pork. Pork production in the United States accounts for about 10% of the total world supply. The retail value of pork sold to consumers exceeds $30 billion annually. In addition, the pork industry supports more than 600,000 jobs (USDA 2008*b*). Although the source of livestock disease outbreaks can be difficult to identify, a risk of transmission and the spreading of diseases to domestic swine and other livestock exists wherever feral swine and domestic livestock interact (Witmer et al. 2003). In addition to large-scale commercial operations, small-scale "*backyard*" swine operations where domestic swine could interact with feral swine are also at risk (Saliki et al. 1998). With the large number of domestic swine in the State, the potential exists for severe economic losses to occur because of the transmission of infectious diseases between feral and domestic swine.

In addition to the potential for disease transmission, feral swine can also kill livestock. Feral swine can kill calves, kids (goats), lambs, and poultry (West et al. 2009, Stevens 2010). Predation occurs primarily on young livestock but feral swine can also kill weakened or injured livestock. If feral swine populations continue to increase, WS could receive requests for assistance to address localized predation by feral swine. Since feral swine so thoroughly consume young prey, there is often little evidence remaining to suggest that a birthing and subsequent predation occurred. If a landowner is not alert to the possibility of feral swine predation, it is easy to overlook this as a cause for low production. Frequently, even when predation is considered, feral swine often escape suspicion because people generally underestimate their capabilities as a predator (Beach 1993).

Examples of some of the requests for assistance to resolve or alleviate damage to agricultural resources that the WS' program in Georgia has responded to include:

- Coyotes attacking and killing calves, lambs, chickens, and domestic swine
- Raccoons, skunks, and armadillos digging up grass and sod while foraging for insects
- Gray squirrels feeding on strawberries, peaches, and pecans
- Gray fox killing chickens and domestic waterfowl
- Striped skunks killing chickens
- River otters killing commercially raised catfish and sportfish
- White-tailed deer feeding on soybeans, corn, and strawberries

Need for Mammal Damage Management to Resolve Damage Occurring to Natural Resources

Natural resources can be those assets belonging to the public that government agencies, as representatives of the people, often manage and hold in trust. Such resources may be plants or animals, including threatened and endangered (T&E) species, or habitats in general. Examples of natural resources in Georgia could include parks and recreational areas; natural areas, including unique habitats or topographic features; threatened or endangered plants and animals; and any plant or animal populations that the public has identified as a natural resource.

Some of the target mammal species addressed in this EA can threaten the welfare of another species' population. An example of this would be nest predation of a local ground-nesting bird population by mammalian predators, such as raccoons, opossum, skunks, armadillos, feral swine, feral cats, coyotes, or fox. While predation is not generally a threat to a healthy animal population, it could limit the recovery of threatened or endangered species or contribute to the local extirpation of populations already depleted by other factors. Massey (1971) and Massey and Atwood (1981) found that predators can prevent federally endangered least terns (*Sterna antillarum*) from nesting or cause them to abandon previously occupied sites. In another study, mammalian predators adversely affected the nesting success of least terns on sandbars and sandpits (Kirsch 1996).

Raccoons, coyotes, feral swine, fox, and armadillos can predate the eggs and hatchlings of sea turtles, as well as, adult sea turtles. Besides direct predation, those predators can also expose turtle nests to the elements and to predation by crabs, birds, and other mammals. Several species of sea turtles can nest along the beaches of the State, including loggerhead sea turtles (*Caretta caretta*), green turtles (*Chelonia mydas*), leatherback sea turtles (*Dermochelys coriacea*), and Kemp's Ridley sea turtles (*Lepidochelys kempii*). The recovery plan for the loggerhead sea turtle lists the following recovery goal: "*Reduce the annual rate of mammalian predation to at or below 10% of nests….using ecologically sound predator control programs*". In addition, the recovery plan states, "*individual problem animals can be targeted and removed without negatively affecting the local populations of native species*" (National Marine Fisheries Service and United States Fish and Wildlife Service 2008). Several studies have documented the effectiveness of predator management in turtle nesting areas (*e.g.*, see Garmestani and Percival 2005, Engeman et al. 2010). WS could receive requests for assistance to conduct predator management at sea turtle nesting colonies in order to meet predation tolerances listed in the recovery plan for sea turtles.

Nationwide, scientists estimate that cats kill hundreds of millions of birds and more than a billion small mammals, such as rabbits, squirrels, and chipmunks, each year. Feral and free-ranging cats are known to prey on birds as large as mallards (*Anas platyrhynchos*) (Figley and VanDruff 1982) and young brown pelicans (*Pelecanus occidentalis*) (Anderson et al. 1989) along with mammals as large as hares and rabbits. Langham (1990) found that mammals made up 74% of a feral cats diet in the farmlands of New Zealand, while 24% were birds. The American Bird Conservancy (2011) stated, "*cats kill common* [bird] *species such as the Northern cardinal, blue jay, and house wren, as well as rare and endangered species such as the piping plover, Florida scrub-jay, and California least tern*". Some feral and free-ranging cats kill more than 100 animals each year. For example, at a wildlife experiment station, a roaming, well-fed cat killed more than 1,600 animals over 18 months, primarily small mammals (American Bird Conservancy 2011).

Researchers at the University of Wisconsin coupled their four-year cat predation study with the data from other studies, and estimated that rural feral and free-ranging cats killed at least 7.8 million and perhaps as many as 217 million birds a year in Wisconsin (Coleman et al. 1997). In some parts of Wisconsin, feral and free ranging cat densities reached 114 cats per square mile, outnumbering all similarly sized native predators (Coleman et al. 1997). Churcher and Lawton (1989) observed 77 well fed, free ranging cats in a British village for one year, and estimated that 30% to 50% of the animals caught by the cats were birds.

Based on information acquired in the study, Churcher and Lawton (1989) estimated that cats killed more than 20 million birds in Britain each year with cats catching more than 70 million animals overall annually. Based on surveys conducted by Woods et al. (2003) in Great Britain, 986 free-ranging cats caught 14,370 prey items between April 1 and August 31 during 1997. During their study, Woods et al. (2003) found that free-ranging cats killed a minimum of 44 species of birds, 20 species of mammals, four species of reptiles, and 3 species of amphibian. Woods et al. (2003) then estimated that free-ranging cats killed 92 million animals across Great Britain between April 1 and August 31 during 1997.

The diet of feral and free-ranging cats varies depending on availability, abundance, and geographic location. In a survey of New Zealand scientific literature, Fitzgerald (1990) concluded that prey selection of feral and free-ranging cats was dependent on availability. Fitzgerald (1990) found that cats on the mainland of New Zealand fed most heavily on mammals while cats on the islands fed almost exclusively on birds (particularly seabirds). Liberg (1984) found that cats in southern Sweden fed predominantly on native mammals with the selection of prey based more on availability than abundance. Pearson (1971) found that cats were serious predators of California voles (*Microtus californicus*) and that the greatest pressure on voles occurred when vole numbers were lowest.

A study on a southern Illinois farmstead concluded that well-fed cats preferred small rodents; however, they also consumed birds (George 1974). Small rodents may be particularly susceptible to over harvest by cats and other predators (Pearson 1964). Coman and Brunner (1972) found that small mammals were the primary food item for feral cats in Victoria, Australia. Prey selection was directly related to proximity of cats to human habitation. Pearson (1964) found rodents composed a large portion of a cat's diet. Some people view the predation of rodents by cats as beneficial, but native small mammals are important to maintaining biologically diverse ecosystems. Field mice and shrews are also important prey for birds, such as great horned owls (*Bubo virginianus*) and red-tailed hawks (*Buteo jamaicensis*).

Childs (1986) and Childs (1991) found that urban cat predation on rats was size limiting. Domesticated cats preyed on few rats of reproductive size or age. In rural areas, rats were more vulnerable to cat predation for longer periods. The duration of susceptibility of rats to predation was attributed to abundance of garbage and artificial food sources in the urban environment. Artificial feeding of cats also reduces predation to non-native rodents because of size differences in urban rats. In rural setting, cats can control rat populations for longer durations but ultimate suppression of population growth typically requires the use of chemical methods (*e.g.*, poisons). Jackson (1951) found that feral and free-ranging cats in urban areas of Baltimore, Maryland were insignificant predators of Norway rats (*Rattus norvegicus*). The largest percentage of ingested food was comprised of garbage. It was estimated that a cat in the study area would consume roughly 28 rats per year.

Reptiles may provide an important food source to cats when birds and mammals are less abundant, and in some situations, cats have been observed preying on threatened species of reptiles. Domesticated cats have been identified as major nest and/or hatchling predators of sea turtles. A study by Seabrook (1989) on the Aldabra Atoll, Seychelles found feral cats had an adverse effect on green turtle hatchlings. Seabrook (1989) found a positive correlation in cat activity and green turtle nesting at Aldabra Atoll. Cats are known to have contributed to the near extirpation of the West Indian rock iguana (*Cyclura carinata*) on Pine Cay in the Caicos Islands (Iverson 1978).

Cats can adversely affect local wildlife populations, especially in habitat "*islands*", such as suburban and urban parks, wildlife refuges, and other areas surrounded by human development (Wilcove 1985). The loss of bird species from habitat islands is well documented and nest predation is an important cause of the decline of neotropical migrant birds (Wilcove 1985). Hawkins et al. (1999) conducted a two-year study in two parks with grassland habitat. One park had no cats but more than 25 cats were being fed daily in the other park. There were almost twice as many birds seen in the park with no cats as in the park with cats. The California thrasher (*Toxostoma redivivum*) and the California quail (*Callipepla californica*), both ground-nesting birds, were seen during surveys in the no-cat area; however, they were never seen in the cat area. In addition, more than 85% of the native deer mice (*Peromyscus* spp.) and harvest mice (*Reithrodontomys megalotis*) trapped were in the no-cat area; whereas, 79% of the house mice (*Mus musculus*), a non-native species, were trapped in the cat area. The researchers concluded, "*Cats at artificially high densities, sustained by supplemental feeding, reduce abundance of native rodent and bird populations, change the rodent species composition, and may facilitate the expansion of the house mouse into new areas*" (Hawkins et al. 1999).

Impacts from cat predation are not always direct, but may be indirect in the form of competition for food resources. George (1974) speculated that domestic cats were not a direct limiting factor on bird populations. However, the author did find evidence indicating cats indirectly could affect some birds of prey by competing for a limited resource (primarily small rodents).

Feral swine compete with over 100 species of native wildlife for important and limited natural food supplies. Some species including quail, turkey, endangered sea turtles, and shorebirds are at risk of predation by nest destruction and the consuming of eggs. Feral swine cause damage to natural areas such as parks and wildlife management areas. Those sites suffer erosion and local loss of critical ground plants and roots, as well as destruction of seedlings because of feral swine feeding and rooting (Barrett and Birmingham 1994). Many state and federal natural resource managers are now in the process of controlling feral swine because of their known impact to endangered plants and animals (Thompson 1977).

Feral swine can feed on many smaller animals (some threatened or endangered), disrupt ecosystems via rooting, and feed on rare and endangered plants. Many experts in the fields of botany and herpetology have observed declines in some rare species of plants, reptiles, amphibians, and soil invertebrates in areas inhabited by feral swine (Singer et al. 1982). Feral swine can also disturb large areas of vegetation and soils through rooting, and feral swine inhabiting coastal, upland, and wetland ecosystems can uproot, damage, and feed on rare native species of plants and animals. Feral swine can disrupt natural vegetative communities, eliminate rare plants and animals, alter species composition within a forest including both canopy and low growing species (Lipscomb 1989, Frost 1993), increase water turbidity in streams and wetlands (reducing water quality and impacting native fish), and increase soil erosion and alter nutrient cycling (Singer et al. 1982, DeBenedetti 1986).

One of the more important seasonal food resources used by feral swine is wild fruit and nut crops, especially oak mast (Wood and Roark 1980). Mast crops, such as beechnut (*Fagus* spp.), acorns (*Quercus* spp.), and hickory nuts (*Carya* spp.), are an important food source for deer, turkey, black bear (*Ursus americanus*), and squirrels (Knee 2011). Oak mast is an important food source for white-tailed deer and wild turkey (*Meleagris gallopavo*). Each adult feral swine can consume up to 1,300 pounds of mast per year (Knee 2011). When feral swine actively compete for mast, resident deer and wild turkey may enter the winter with inadequate fat reserves; thus, threatening the viability of these native wildlife species (Beach 1993). They can also compete for acorns and hickory nuts with native wildlife during years of poor mast production (Campbell and Long 2009). In years of poor mast production, feral swine were found to have negative effects on white-tailed deer populations due to competition for acorns (Wood and Roark 1980). Due to their acute sense of smell, feral swine more rapidly and efficiently consume fallen mast crop (Beach 1993). Feral swine also have the ability to change to other food sources when acorns were depleted, which deer are often unable to do (Beach 1993). Consumption of hard mast by feral swine in forests also reduces the potential for forest regeneration, further affecting the food chain necessary to maintain species diversity and stable populations (Campbell and Long 2009).

Feral swine will consume animal material year round, including earthworms, arachnids, crustaceans, insects, gastropods, fish, amphibians, reptiles, birds, and mammals (Mayer and Brisbin 2009). The rooting behavior of feral swine has been identified as the cause of the near extirpation of northern short-tailed shrews (*Blarina brevicuada*), and southern red-backed voles (*Clethrionomys gapperi*) in areas with intensive rooting due to the removal of leaf litter, which is crucial for the survival of the shrew and vole (Singer et al. 1984). Feral swine will often search out and excavate food caches used by small mammals, potentially affecting their ability to survive (Campbell and Long 2009).

Feral swine can cause direct mortality through predation on native wildlife species. Feral swine are known to feed on many smaller animals (some threatened or endangered), and will consume voles, shrews, turtles, amphibians, and shrub- or ground-nesting birds (Campbell and Long 2009). Many species, including quail, turkey, and shorebirds, are at risk of predation by nest destruction and the consuming of eggs (Campbell and Long 2009). A study conducted in northern Texas found that feral swine consumed 23.5% and 11.5 % of simulated Northern bobwhite (*Colinus virginianus*) nests in each of the study areas. Researchers concluded feral swine nest predation could be a contributing factor in Northern bobwhite population declines (Timmons et al. 2011).

Plant forage makes up approximately 88% of a feral swine's dietary composition and is consumed year-round (Mayer and Brisbin 2009). This high dependence on vegetation may be why feral swine can cause the greatest damage to environmentally sensitive areas (Campbell and Long 2009). Feral swine can reduce recruitment of saplings, increase the spread of invasive plants, prevent forest regeneration, reduce seedlings and seedling survival, and eliminate understory (Campbell and Long 2009). Rooting behavior by feral swine in beech forest understory was found to be so severe that recovery was unlikely to occur (Bratton 1975). Where feral swine reduced herbaceous and belowground vegetation, recovery time was expected to take more than three years (Howe et al. 1981). Feral swine reduce the amount of vegetative ground cover and leaf litter, reducing the critical microclimatic conditions necessary for seedling establishment and growth in forests (Chavarria et al. 2007).

In terrestrial plant communities, disturbance can threaten native communities by promoting the spread of invasive, exotic plant species (Tierney and Cushman 2006). Following disturbance through feeding activities by feral swine, percent cover of native perennial grasses recovered at a consistently slower rate than exotic grasses (Tierney and Cushman 2006). Tierney and Cushman (2006) also found that removing or reducing the size of feral swine populations is an effective technique for restoring native perennial grasses.

Habitat damage by feral swine is most pronounced in wet environments (Engeman et al. 2007). Wet soils may make it easier for feral swine to obtain the foods they favor, such as the roots, tubers, and bulbs that are characteristic of many wetland plants. Choquenot et al. (1996) found that there appeared to be a strong correlation between soil moisture and rooting damage. Aquatic macrophytes are a key component of habitat in wetlands, providing both an important food resource and structural complexity to the waterscape for associated biota (Thomaz et al. 2008). Macrophytes are an aquatic plant that grows in or near water and are emergent, submergent, or floating. The destruction of wetland vegetation by feral swine was also found to alter production and respiration regimes causing anoxic (depleted of dissolved oxygen) conditions (Doupe et al. 2010). Lower dissolved oxygen levels caused chronic sub-lethal effects for the associated biota.

Feral swine can affect lakes, ponds, streams, and wetlands, since their rooting and wallowing activities near water sources may increase water turbidity in streams and wetlands, and increase soil erosion and alter nutrient cycling (Singer et al. 1982, DeBenedetti 1986). Increases in water turbidity reduce water quality and can affect native fishes (DeBenedetti 1986). Doupe et al. (2010) found that feral swine foraging in wetland floodplains disrupted physical, chemical, and biological environments by increasing turbidity, destroying aquatic macrophytes, and by causing the proliferation of bare ground and open water. Feral swine spend considerable time in aquatic habitat foraging or wallowing (Mersinger and Silvy 2007). They are known to forage both in and out of water to obtain wetland roots and bulbs (Doupe et al. 2010). Due to their foraging behavior, feral swine are more likely to disturb the wetland substrate and water body.

Kaller and Kelso (2003) found that feral and free-ranging swine were linked to increased levels of fecal coliform and other potentially pathogenic bacteria in several watersheds in Louisiana. Kaller et al. (2007) used DNA fingerprinting to determine that feral swine contribute detectable *E. coli* into aquatic ecosystems. Additionally, some species of freshwater mussels and aquatic insects were negatively affected by feral swine fecal coliform within the watershed (Kaller and Kelso 2006).

Deer overabundance can affect native vegetation and natural ecosystems in addition to ornamental landscape plantings. White-tailed deer selectively forage on vegetation (Strole and Anderson 1992), and thus, can negatively affect certain herbaceous and woody species and on overall plant community structure (Waller and Alverson 1997). These changes can lead to adverse effects on other wildlife species, which depend on those plants for food and/or shelter. Numerous studies have shown that over browsing by deer can decrease tree reproduction, understory vegetation cover, plant density, and plant diversity (Warren 1991). By one count, deer browsing disturbed 98 species of threatened or endangered plants, many of them orchids and lilies (Ness 2003).

The alteration and degradation of habitat from over-browsing by deer can have a detrimental effect on the health of local deer populations and may displace other wildlife communities (*e.g.*, neotropical migrant songbirds and small mammals) that depend upon the understory vegetative habitat destroyed by deer browsing (Virginia Department of Game and Inland Fisheries 2007). Similarly, deCalesta (1997) reported that deer browsing affected vegetation that songbirds need for foraging, escape cover, and nesting. In certain areas, higher deer densities reduced species richness and abundance of intermediate canopy nesting songbirds (deCalesta 1997). Intermediate canopy-nesting birds declined 37% in abundance and 27% in species diversity at higher deer densities. Five species of birds disappeared from areas with densities of 38.1 deer per square mile and another two disappeared at 63.7 deer per square mile. Casey and Hein (1983) found that three species of birds no longer could be found in a research preserve stocked with high densities of ungulates and that the densities of several other bird species were lower than in an adjacent area with lower deer density. Waller and Alverson (1997) hypothesize that by competing with squirrels and other fruit-eating animals for oak mast, deer may further affect many other animal and insect species.

WS has received numerous requests in the past for assistance in resolving mammal damage and conflicts caused to natural resources. As part of the proposed program, WS could provide assistance, upon request, involving target mammal species to any requester experiencing such damage throughout Georgia.

Need for Mammal Damage Management to Alleviate Property Damage

Mammals cause damage to a variety of property types in Georgia each year. Property damage can occur in a variety of ways and can result in costly repairs and clean-up. Mammal damage to property occurs primarily through direct damage to structures. One example of direct damage to property occurs when gray squirrels gnaw on the wiring of vehicles. Accumulations of fecal droppings can cause damage to buildings and other structures. For example, fecal droppings from bats roosting in an attic can cause damage to insulation and support structures. Aircraft striking mammals can also cause substantial damage requiring costly repairs and aircraft downtime. Raccoons, skunks, woodchucks, and armadillos can cause damage to property by digging under porches, buildings, homes, and many other places.

Armadillos often cause damage to lawns and turf while digging for grubs and insects. Feral swine can root up turf in neighborhoods and golf courses. Coyotes can attack companion animals.

Feral swine can damage landscaping, golf courses, roads, drainage ditches, and cause erosion by feeding in those areas. Feral swine dig or root in the ground with their nose in search of desired roots, grubs, earthworms, and other food sources. The rooting and digging activity of feral swine turns sod and grass over, which often leaves the area bare of vegetation and susceptible to erosion. Feral swine can also pose a threat to property when motor vehicles and aircraft strike swine. Mayer and Johns (2007) collected data on 179 feral swine-vehicle collisions involving 212 feral swine. Mayer and Johns (2007) suggested that vehicular accidents with feral swine are costly due to their mass; and that potentially, the total annual cost of feral swine-vehicle collisions in the United States can be as high as $36 million, roughly $1,173 per vehicle (Mayer and Johns 2007).

Deer can damage and destroy landscaping and ornamental trees, shrubs, and flowers by browsing on those trees and plants. Developing rural areas into residential areas could enhance deer habitat in those areas. Fertilized lawns, gardens, and landscape plants in those residential areas may serve as high quality sources of food for deer (Swihart et al. 1995). Furthermore, deer are prolific and adaptable, characteristics that allow them to exploit and prosper in most suitable habitat near urban areas, including residential areas (Jones and Witham 1990). The succulent nature of many ornamental landscape plants, coupled with high nutrient contents from fertilizers, offers an attractive food. In addition to browsing pressure, male deer can damage ornamental trees and shrubs from antler rubbing, which can result in broken limbs and bark removal. While large trees may survive antler-rubbing damage, smaller trees often die or they become scarred to the point that they are not aesthetically acceptable for landscaping.

Deer-vehicle collisions are a serious concern nationwide because of losses to property and the potential for human injury and death (Conover et al. 1995, Romin and Bissonette 1996, Conover 1997). The economic costs associated with deer-vehicle collisions include vehicle repairs, human injuries and fatalities, and picking up and disposing of deer (Drake et al. 2005). State Farm Mutual Automobile Insurance (2012) estimated that 1.23 million deer-vehicle collisions occur annually in the United States causing approximately 200 fatalities. In 1995, the estimated damage to vehicles associated with vehicles striking deer was $1,500 per strike (Conover et al. 1995). Estimated damage costs associated with deer collisions in 2011 were $3,171 per incident, which was an increase of 2.2% over the 2010 estimate (State Farm Mutual Automobile Insurance 2011). An estimated 42,996 deer-vehicle collisions occurred in Georgia from July 1, 2011 through June 30, 2012 (State Farm Mutual Automobile Insurance 2012). Based on the average repair costs associated with vehicle strikes estimated at $3,171 in 2010 and the number of strikes that have occurred in the State estimated at 42,996 from July 2011 through June 2012, deer-vehicle collisions resulted in over $136.3 million in damage to property in the State. Often, deer-vehicle collisions go unreported, especially when there was no recovery of a deer carcass or when little vehicle damage occurred. A Cornell University study estimated that the actual number of deer-vehicle collisions could be as high as six times the reported number (Decker et al. 1990).

Incidences of deer-vehicle collisions on highways passing through TVA Dam Reservation properties have been reported to TVA personnel in recent years from public stakeholders. Some of these dam reservation properties have elevated deer populations and WS could be requested to provide assistance to reduce local deer populations on TVA properties.

Airports provide ideal conditions for feeding and bedding sites for deer due to the large grassy areas adjacent to brushy, forested habitat used as noise barriers. Deer living within airport boundaries are usually protected from hunting and many other human disturbances. Deer are currently regarded as the number one hazardous animal species to aircraft across the nation (DeVault et al. 2011) and caused damage to aircraft in 86% of the strikes where deer were involved (Wright 2001). In general, deer strikes result in major component damage to the aircraft. Deer-aircraft strikes can also result in loss of human life, injury to passengers or people on the ground, and damage or malfunction of aircraft, aircraft navigational aids, or airport facilities. Mammals colliding with aircraft during the most vulnerable phases of flight, takeoff or landing, can cause the aircraft to crash or sustain physical damage (Dolbeer et al. 2015). Deer are characteristically unpredictable in their initial response to approaching aircraft. Deer may wander onto runway surfaces and be startled into the path of oncoming aircraft, and at night, they may freeze when caught in the beams of landing lights, resulting in a strike.

WS could also be requested to provide assistance associated with mammal damage at historical sites within the State. WS has previously been requested to provide assistance associated with woodchucks burrowing under buildings, both residential and nonresidential, and compromising foundations and footings. Woodchucks can cause extensive damage by burrowing and denning in earthen levees and other mounds. Burrowing activities can threaten the integrity of the earthen embankments. In addition, burrows can be aesthetically displeasing to the public and can cause damage to mowing equipment. In addition, there are thousands of archaeological and historical sites on TVA-managed properties, some of which are extremely sensitive and could be disturbed by the burrowing and activities of mammals. Many of those sites, especially earthen mounds, have been damaged by the burrowing of woodchucks and could be damage by similar activities associated with nine-banded armadillos. WS may be requested to alleviate damage on some of those sites in the future to help protect the most sensitive resources.

Burrowing activities of woodchucks, beavers, and muskrats can severely damage levees, dikes, earthen dams, landfills, and other structures (Federal Emergency Management Agency 2005). Woodchucks and beavers burrowing into roadbeds and embankments could potentially weaken or cause the collapse of those structures. Woodchucks also cause damage by chewing underground utility cables, sometimes resulting in power outages. Additionally, woodchuck burrows may cause damage to property when tractors and other equipment drop into a burrow or roll over due to a burrow.

In some situations, the damage and threats caused by beaver outweigh the benefits (Grasse and Putnam 1955, Woodward et al. 1985, Novak 1987). Damage to resources associated with beaver are most often a result of their feeding, burrowing, and dam building behaviors. Beaver cause an estimated $75 to $100 million dollars in economic losses annually in the United States, with total losses in the southeastern United States over a 40-year period estimated to be $4 billion (Novak 1987).

Beaver often will gnaw through trees and other woody vegetation for use in dam building, food caches, and the building of lodges. The girdling and felling of trees and other woody vegetation can cause economic losses, can threaten human safety and property when trees fall, and the loss of trees can be aesthetically displeasing to property owners. The loss of timber (*e.g.*, from flooding, gnawing) is the most common type of damage associated with beaver (Hill 1976, Hill 1982, Woodward et al. 1985, Baker and Hill 2003). Tracts of bottomland hardwood timber up to several thousand acres in size may be lost to beaver activity (Miller and Yarrow 1994). Timber damage caused by beaver in the southeastern United States has been estimated at $2.2 million annually in Mississippi (Arner and Dubose 1982), $2.2 million in Alabama (Hill 1976), and $45 million in Georgia (Godbee and Price 1975). Shwiff et al. (2011) estimated the Beaver Control Assistance Program in Mississippi provided average direct program benefits that ranged from $25 million to $57 million per year between 2005 and 2009. In 1991 and 1992, Dams et al. (1995) estimated beaver caused $817.28 in damages to timber resources per acre in areas of the Chauga River drainage in northwestern South Carolina where beaver activities occurred. Over 84% of the economic losses caused by beaver in the Chauga River drainage were damages to the yellow poplar (*Liriodendron tulipifera*), which can be a commercially important timber resource within the drainage (Dams et al. 1995).

In addition to damage associated with beaver feeding and gnawing on trees, damage can occur from dam building activities. Beaver dams impound water, which can flood property resulting in economic damage. Flooding from beaver dams can cause damage to roads, impede traffic, inundate timber, weaken earthen embankments, and cause damage to residential and commercial utilities.

Beaver often inhabit sites in or adjacent to urban/suburban areas and cut or girdle trees and shrubs in yards, undermine yards and walkways by burrowing, flood homes and other structures, destroy pond and reservoir dams by burrowing into levees, gnaw on boat houses and docks, and cause other damage to private and public property (Wade and Ramsey 1986). Additionally, impounded water may damage roads and railroads by saturating roadbeds or railroad beds (Jensen et al. 2001). Burrowing by beaver can compromise the banks of roadbeds and railroad beds. During a survey of people in the United States and Canada, D'Eon et al. (1995) found that culvert blockage and road flooding were the most frequently reported types of beaver damage. Jensen et al. (2001) stated, "*Small culverts may be especially prone to plugging for numerous reasons. Small culverts often constrict streams, which increases stream velocity and generates sound that beavers may respond to (Novak 1987)*".

WS has received numerous requests in the past for assistance in resolving property damage caused by mammals. As part of the proposed program, WS could provide assistance, upon request, involving target mammal species to any requester experiencing such damage throughout Georgia.

1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

Actions Analyzed

This EA documents the need for managing damage caused by the mammal species identified in Section 1.1, the issues associated with meeting that need, and alternative approaches to address those issues and to meet the need for action. WS' mission is to provide federal leadership with managing damage and threats of damage associated with animals (see WS Directive 1.201). WS would only provide assistance when the appropriate property owner or manager requested WS' assistance. WS could receive a request for assistance from a property owner or manager to conduct activities on property they own or manage, which could include federal, state, tribal, county, municipal, and private land within the State of Georgia.

Appendix B of this EA discusses the methods available for use or recommendation under each of the alternative approaches evaluated[8]. The alternatives and Appendix B also discuss how WS and other entities could recommend or employ methods to manage damage and threats associated with mammals in the State. Therefore, the actions evaluated in this EA are the use or recommendation of those methods available under the alternatives and the employment or recommendation of those methods by WS to manage or prevent damage and threats associated with mammals from occurring when requested by the appropriate resource owner or manager. WS' activities that could involve the lethal removal of target mammal species under the alternatives would only occur when agreed upon by the requester. In addition, lethal removal would only occur by WS when authorized by the GDNR, when required, and only at levels authorized.

Native American Lands and Tribes

The WS program in Georgia would only conduct damage management activities on Native American lands when requested by a Native American Tribe. WS would only conduct activities after WS and the

[8] Appendix B contains a complete list of chemical and non-chemical methods available for use under the identified alternatives. However, listing methods neither implies that all methods would be used by WS to resolve requests for assistance nor does the listing of methods imply that all methods would be used to resolve every request for assistance.

Tribe requesting assistance signed a Memorandum of Understanding (MOU), a work initiation document, or another comparable document. Therefore, the Tribe would determine what activities would be allowed and when WS' assistance was required. 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 likely occur. Those methods available to alleviate damage associated with mammals 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 Tribe requesting WS' assistance approved the use of those methods. Therefore, the activities and methods addressed under the alternatives would include those activities that WS could employ on Native American lands, when requested and when agreed upon by the Tribe and WS.

Period for which this EA is Valid

If the preparation of an Environmental Impact Statement (EIS) is not warranted, based on the analyses associated with this EA, WS would review activities conducted under the selected alternative to ensure those activities occurred within the parameters evaluated in this EA. This EA would remain valid until WS and the TVA, in consultation with the GDNR, determined that new needs for action, changed conditions, new issues, or new alternatives having different environmental impacts must be analyzed. At that time, WS and the TVA would supplement this analysis or conduct a separate evaluation pursuant to the NEPA. Under the alternative analyzing no involvement by WS, no review or additional analyses 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 damage management activities conducted by WS in Georgia under the selected alternative, including activities conducted on TVA properties, when requested.

Site Specificity

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 mammals under the alternatives would only occur when authorized by the GDNR, when required, and only at levels authorized.

This EA analyzes the potential impacts of mammal damage management based on previous activities conducted on private and public lands in Georgia where WS and the appropriate entities entered into a MOU, work initiation document, or another comparable document. This EA also addresses the potential impacts of managing damage caused by mammals in areas where WS and a cooperating entity could sign additional agreements in the future. Because the need for action would be to reduce damage and because the program's goals and directives would be to provide assistance when requested, within the constraints of available funding and workforce, it is conceivable that additional damage management efforts could occur. Thus, this EA anticipates those additional efforts and analyzes the potential effects of those efforts as part of the alternatives.

Many of the mammal species addressed in this EA occur statewide and throughout the year in the State; therefore, damage or threats of damage could occur wherever those mammals occur. Planning for the management of mammal 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. Although WS and the TVA could predict some locations where mammal damage would occur, WS and the TVA could not predict every specific location or the specific time where such damage would occur in any given year. In addition, the threshold triggering an entity to request assistance from WS to manage damage associated with mammals is often unique to the individual; therefore, predicting where and when WS would receive such a request for assistance would be difficult. This EA emphasizes major issues as those issues relate to specific areas whenever possible; however, many issues apply wherever mammal damage and the resulting management actions occur and are treated as such.

Chapter 2 of this EA identifies and discusses issues relating to managing damage caused by mammals in Georgia. The standard WS Decision Model (Slate et al. 1992; see WS Directive 2.201) would be the site-specific procedure for individual actions that WS could conduct 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 in accordance with WS Directive 2.210.

The analyses in this EA would apply to any action that may occur by WS in any locale and at any time within Georgia. In this way, WS and the TVA believe the two agencies meet the intent of the NEPA with regard to site-specific analysis and that this is the only practical way for WS and the TVA to comply with the NEPA and still be able to accomplish their missions.

Summary of Public Involvement

WS, in cooperation with the TVA, initially developed the issues associated with conducting mammal damage management in consultation with the GDNR. WS and the TVA defined the issues and identified the preliminary alternatives through the scoping process. As part of this process, and as required by the Council on Environmental Quality (CEQ) and APHIS implementing regulations for the NEPA, WS will make this document available to the public for review and comment. WS will make the document available to the public through legal notices published in local print media, through direct notification of parties that have requested notification, or that WS has identified as having a potential interest in the reduction of threats and damage associated with mammals in the State. In addition, WS will post this EA on the APHIS website for review and comment.

WS will provide for a minimum of a 30-day comment period for the public and interested parties to provide new issues, concerns, and/or alternatives. Through the public involvement process, WS will clearly communicate to the public and interested parties the analyses of potential environmental impacts on the quality of the human environment. WS would fully consider new issues, concerns, or alternatives the public identifies during the public involvement period to determine whether WS and the TVA should revisit the EA and, if appropriate, revise the EA prior to issuance of a Decision.

1.4 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS

WS' Environmental Assessment – Oral Vaccination to Control Specific Rabies Virus Variants in Raccoons, Gray Fox, and Coyotes in the United States: WS issued an EA that analyzed the environmental effects of WS' involvement in the funding of and participation in ORV programs to eliminate or stop the spread of raccoon rabies in a number of eastern states (including Georgia) and gray fox and coyote rabies in Texas (USDA 2009*a*). WS determined the action would not have a significant impact on the quality of the human environment.

WS' Environmental Assessments in Georgia: WS previously developed an EA that addressed WS' activities to manage damage associated with several species of mammals (USDA 2008*a*) and separate EAs that evaluated the need to manage damage caused by white-tailed deer (USDA 2002), aquatic rodents (USDA 2004), and feral swine (USDA 2005). This EA will address more recently identified changes in activities and will assess the potential environmental impacts of program alternatives based on those changes, primarily a need to evaluate new information. Since this new EA will re-evaluate activities conducted under the previous EAs to address a new need for action and the associated affected environment, the analysis and the outcome of the Decision issued for this EA will supersede the previous EAs that addressed managing damage associated with white-tailed deer (USDA 2002), aquatic rodents (USDA 2004), feral swine (USDA 2005), and several other species of mammals (2008*a*).

Final Environmental Impact Statement - Feral Swine Damage Management: The APHIS and cooperating agencies prepared a programmatic EIS to address feral swine damage management in the United States, American Samoa, Mariana Islands, United States Virgin Islands, Guam, and Puerto Rico (USDA 2015*a*). The Record of Decision selected the preferred alternative in the EIS to implement a nationally coordinated program that integrates methods to address feral swine damage. In accordance with the Record of Decision, WS developed this EA to be consistent with the EIS and the Record of Decision.

TVA's 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's 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 (TVA 2011*b*).

Georgia Comprehensive Wildlife Conservation Strategy

The GDNR has developed an extensive wildlife conservation plan that evaluates species of plants and animals within the State (GDNR 2005*a*) and has prepared a state wildlife action plan (GDNR 2015). The goal of the conservation plan developed in 2005 "*…is to conserve Georgia's animals, plants, and natural habitats through proactive measures emphasizing voluntary and incentive-based programs on private lands, habitat restoration and management by public agencies and private conservation organizations, rare species survey and recovery efforts, and environmental education and public outreach activities*" (GDNR 2005*a*). The state wildlife action plan further states, "*The ultimate goal of a* [State Wildlife Action Plan] *is to protect and maintain the full complement of species native to a state or region*" (GDNR 2015). WS consulted the Comprehensive Wildlife Conservation Strategy (GDNR 2005*a*) and the state Wildlife Action Plan (GDNR 2015) as part of this analysis and the alternatives would be consistent with both plans.

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 animal damage management.

WS' Legislative Authority

The primary statutory authority for the WS program is 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 when managing animal damage.

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 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 operates two hydroelectric dams in Georgia. The TVA also owns or maintains 23 substations and switching stations, and nearly 449 miles of transmission lines in Georgia serving 130,466 households and 24,000 commercial and industrial customers in 12 counties.

In addition, the TVA manages the Blue Ridge and Nottely reservoirs and part of the Chatuge Reservoir in Georgia totaling nearly 11,000 acres with more than 250 miles of shoreline. The TVA also manages recreational, natural, and cultural resources on more than 1,700 acres of public land in Georgia. The TVA conducts and requests assistance from WS to provide animal 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' ORV program across the states within the Tennessee River Basin and Valley.

United States Environmental Protection Agency

The United States Environmental Protection Agency (EPA) is responsible for implementing and enforcing the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which regulates the registration and use of pesticides. The EPA is also responsible for administering and enforcing the Section 404 program of the Clean Water Act (CWA) with the United States Army Corps of Engineers that established a permit program for the review and approval of water quality standards that directly affect wetlands.

Georgia Department of Natural Resources, Wildlife Resources Division

The Georgia Department of Natural Resources' authority in wildlife management is given under Title 27, Chapters 1 - 5 of the Official Code of Georgia Annotated. The mission of the Wildlife Resources Division is to manage, protect, conserve, and enhance the wildlife and aquatic resources of Georgia for the sustainable benefit of the people of Georgia.

Georgia Department of Natural Resources, Environmental Protection Division

The Environmental Protection Division within the GDNR is the State agency that works to protect and improve water resources throughout the State. The mission of the Environmental Protection Division "*…is a state agency charged with protecting Georgia's air, land, and water resources through the authority of state and federal environmental statutes*". The Environmental Protection Division is responsible for reviewing Water Quality Certifications applications required by Section 401.

Georgia Department of Agriculture

The Pesticide Division of the GDA enforces state laws pertaining to the use and application of pesticides. Under the Georgia Pesticide Use and Application Act this section monitors the use of pesticides in a variety of pest management situations. It also licenses private and commercial pesticide applicators and pesticide contractors. Under the Georgia Pesticide Control Act, the division licenses restricted use pesticide dealers and registers all pesticides for sale and distribution in the state of Georgia.

The GDA currently has a MOU with WS, which establishes a cooperative relationship between WS and the GDA outlines responsibilities, and sets forth annual objectives and goals of each agency for resolving animal damage in Georgia.

1.6 COMPLIANCE WITH LAWS AND STATUTES

Several laws or statutes would authorize, regulate, or otherwise affect WS' activities under the alternatives. WS would comply with applicable federal, state, and local laws and regulations in accordance with WS Directive 2.210. Below are brief discussions of those laws and regulations that would relate to damage management activities that WS could conduct in the State.

National Environmental Policy Act

All federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.). WS follows the CEQ regulations implementing the NEPA (40 CFR 1500 et seq.) along with the USDA (7 CFR 1b) and the 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 that federal agencies must accomplish 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. In part, the CEQ, through regulations in 40 CFR, Parts 1500-1508, regulate federal activities that could affect the physical and biological environment. In accordance with regulations of the CEQ and the USDA, the APHIS has published guidelines concerning the implementation of the NEPA (see 44 CFR 50381-50384).

Pursuant to the NEPA and the CEQ regulations, this EA documents the analyses resulting from proposed federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to ensure that WS and the TVA infuse the policies and goals of the NEPA into agency actions. WS and the TVA prepared this EA by integrating as many of the natural and social sciences as warranted, based on the potential effects of the alternatives, including the potential direct, indirect, and cumulative effects of the alternatives.

Endangered Species Act

Under the Endangered Species Act (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 and the TVA conduct consultations with the United States Fish and Wildlife Service (USFWS) pursuant to Section 7 of the ESA 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)). Evaluation of the alternatives in regards to the ESA will occur in Chapter 4 of this EA.

Federal Insecticide, Fungicide, and Rodenticide Act

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

National Historic Preservation Act of 1966, as amended

The National Historic Preservation Act (NHPA) and its implementing regulations (see 36 CFR 800) require federal agencies to initiate the Section 106 process if an agency determines that the agency's actions are undertakings as defined in Section 800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties. If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under Section 106. None of the mammal damage management methods described in this EA that would be available cause major ground disturbance, any physical destruction or damage to property, any alterations of property, wildlife habitat, or landscapes, nor would involve the sale, lease, or transfer of ownership of any property. In general, the use of such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas that could result in effects on the character or use of historic properties. Therefore, the methods that would be available under the alternatives would not generally be the types of methods that would have the potential to affect historic properties. If WS and/or the TVA planned an individual activity with the potential to affect historic resources under an alternative selected because of a decision on this EA, WS and/or the TVA would conduct the site-specific consultation, as required by Section 106 of the NHPA, as necessary.

The use of noise-making methods, such as firearms, at or in close proximity to historic or cultural sites for the purposes of removing animals have the potential for audible effects on the use and enjoyment of historic property. However, WS would only use such methods at a historic site at the request of the owner or manager of the site to resolve a damage problem, which means such use, would be to benefit or protect 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. WS and/or the TVA would conduct site-specific consultation as required by the Section 106 of the NHPA, as necessary, in those types of situations.

Native American Graves Protection and Repatriation Act of 1990

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

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 mammals that may cause safety and health concerns at workplaces.

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

This law places administration of pharmaceutical drugs, including those immobilizing drugs used for animal capture and handling, under the United States Food and Drug Administration.

Controlled Substances Act of 1970 (21 USC 821 et seq.)

This law requires an individual or agency to have a special registration number from the United States Drug Enforcement Administration to possess controlled substances, including controlled substances used for animal capture and handling.

Animal Medicinal Drug Use Clarification Act of 1994

The Animal Medicinal Drug Use Clarification Act (AMDUCA) and its implementing regulations (21 CFR 530) establish several requirements for the use of animal drugs, including those animal drugs used to capture and handle wildlife in damage management programs. Those requirements are: (1) a valid "*veterinarian-client-patient*" relationship, (2) well defined record keeping, (3) a withdrawal period for animals that have been administered drugs, and (4) identification of animals. A veterinarian, either on staff or on an advisory basis, would be involved in the oversight of the use of animal capture and handling drugs under any alternative where WS could use those immobilizing drugs and euthanasia chemicals. Veterinary authorities in each state have the discretion under this law to establish withdrawal times (*i.e.*, a period after a drug was administered that must lapse before an animal may be used for food) for specific drugs. Animals that people might consume within the withdrawal period must be identifiable (*e.g.*, use of ear tags) and labeled with appropriate warnings.

Airborne Hunting Act

The Airborne Hunting Act, passed in 1971 (Public Law 92-159), and amended in 1972 (Public Law 92-502) added to the Fish and Wildlife Act of 1956 as a new section (16 USC 742j-l) that prohibits shooting or attempting to shoot, harassing, capturing or killing any bird, fish, or other animal from aircraft except for certain specified reasons. Under exception [see 16 USC 742j-l, (b)(1)], state and federal agencies are allowed to protect or aid in the protection of land, water, wildlife, livestock, domesticated animals, human life, or crops using aircraft.

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

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

Section 401 of the Clean Water Act

As required by Section 401 of the CWA (see 33 USC 1341), an applicant for a permit issued pursuant to Section 404 of the CWA must also possess a permit from the state in which the discharge originates or will originate, when applicable. The Environmental Protection Division within the GDNR is responsible for reviewing Water Quality Certifications applications required by Section 401 of the CWA.

Section 404 of the Clean Water Act

Section 404 (see 33 USC 1344) of the CWA prohibits the discharge of dredged or fill material into waters of the United States without a permit from the United States Army Corps of Engineers unless the specific activity is exempted in 33 CFR 323 or covered by a nationwide permit by 33 CFR 330.

Food Security Act

The Wetland Conservation provision (Swampbuster) of the 1985 (16 USC 3801-3862), 1990 (as amended by Public Law 101-624), and 1996 (as amended by Public Law 104-127) farm bills require all agricultural producers to protect wetlands on the farms they own. Wetlands converted to farmland prior to December 23, 1985 are not subject to wetland compliance provisions even if wetland conditions return because of lack of maintenance or management. If prior converted cropland is not planted to an agricultural commodity (crops, native and improved pastures, rangeland, tree farms, and livestock production) for more than five consecutive years and wetland characteristics return, the cropland is considered abandoned and then becomes a wetland subject to regulations under Swampbuster and Section 404 of the CWA.

Protection of Wetlands – Executive Order 11990

Executive Order 11990 was signed to "*minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands*". To meet those objectives, Executive Order 11990 requires federal agencies to consider alternatives to wetland sites, in planning their actions, and to limit potential damage, if a federal agency cannot avoid an activity affecting a wetland.

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

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

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

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

Invasive Species - Executive Order 13112

Executive Order 13112 establishes guidance for federal agencies to use their programs and authorities to prevent the spread or to control populations of invasive species that cause economic or environmental harm or harm to human health. 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. Pursuant to Executive Order 13112, the National Invasive Species Council has designated feral swine as meeting the definition of an invasive species. In addition, Lowe et al. (2000) ranked feral swine as one of the 100 worst invasive species in the world.

1.7 DECISIONS TO BE MADE

Based on agency relationships, MOUs, and legislative authorities, WS is the lead agency for this EA, and therefore, responsible for the scope, content, and decisions made. The TVA owns and operates several electrical power generation sites and transmission structures within Georgia, including electrical substations and transmission lines. In addition, the TVA manages lands within the State for recreational, natural, and cultural resources. Many of these sites experience damage associated with mammals within the State. The TVA would be the primary decision-maker for mammal damage management activities occurring on sites owned or managed by the TVA. As discussed previously, the GDNR is responsible for managing wildlife in the State of Georgia, including those wildlife species addressed in this EA.

As the authority for the management of wildlife populations in the State, the GDNR 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 GDNR establishes and enforces regulated hunting and trapping seasons in the State. The lethal removal of many of the species addressed in this EA can only occur when authorized by the GDNR; therefore, the lethal removal of those species to alleviate damage or reduce threats of damage would only occur at the discretion of the GDNR. Those activities that WS could conduct pursuant to the respective alternatives to reduce and/or prevent mammal damage in the State would be coordinated with the GDNR, which would ensure the GDNR has the opportunity to incorporate any activities WS' conducts into population objectives established for mammal populations in the State.

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

- How should WS respond to the need for action to manage damage caused by mammal species in the State?
- How should the TVA respond to the need for action to manage damage caused by mammal species on property they own or manage?
- Would implementation of the alternatives cause 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 did not consider in detail, with rationale. Pertinent portions of the affected environment will be included in this chapter in the discussion of issues. Additional descriptions of the affected environment occur during the discussion of the environmental effects in Chapter 4.

2.1 AFFECTED ENVIRONMENT

Those mammal species addressed in this EA are capable of utilizing a variety of habitats in the State. Most species of mammals addressed in this EA occur throughout the year across the State where suitable habitat exists for foraging and shelter. Damage or threats of damage caused by those mammal species could occur statewide in Georgia wherever those mammals occur. However, mammal damage management would only be conducted by WS when requested by a landowner or manager and only on properties where a MOU, work initiation document, or another comparable document were signed between WS and a cooperating entity.

Upon receiving a request for assistance, WS could conduct activities to reduce mammal damage or threats of damage on federal, state, tribal, municipal, and private properties in Georgia. Areas where damage or threats of damage could occur include, but would not be limited to agricultural fields, vineyards, orchards, farmyards, dairies, ranches, livestock operations, aquaculture facilities, fish hatcheries, grain mills, grain handling areas, railroad yards, waste handling facilities, industrial sites, natural resource areas, park lands, and historic sites; state and interstate highways and roads; railroads, railroad beds, and their right-of-ways; property in or adjacent to subdivisions, businesses, and industrial parks; timberlands, croplands, and pastures; private and public property where burrowing mammals cause damage to structures, dams, dikes, ditches, ponds, and levees; public and private properties in rural/urban/suburban areas where mammals cause damage to landscaping and natural resources, property, and were a threat to human safety through the spread of disease. The area would also include airports and military airbases where mammals were a threat to human safety and to property; areas where mammals negatively affect wildlife, including T&E species; and public property where mammals were negatively affecting historic structures, cultural landscapes, and natural resources. Chapter 4 also contains additional information on the affected environment.

In addition, mammal damage management could occur at facilities owned or managed by the TVA when mammal species addressed in this assessment damage or pose threats of damage to property, to natural resources, to human safety, or to the reliability of electric system transmission. Damage management activities could be conducted at any of the two TVA power generation facilities, 23 TVA electrical substations, or along any of the 449 circuit miles of transmission lines and right-of-way easements owned by the TVA in Georgia. Activities could be conducted along Blue Ridge and Nottely reservoirs, as well as a portion of the Chatuge reservoir, in Georgia, including facilities and areas associated with those reservoirs. In addition, activities could be conducted on the 1,700 acres of recreational, natural, and cultural resources owned or managed by the TVA in Georgia.

WS' personnel could also conduct activities to reduce damage or threats of damage on recreational, natural, and cultural lands owned or managed by the TVA. The TVA manages recreational and natural resources on more than 1,700 acres of public land around Blue Ridge, Nottely, and Chatuge reservoirs.

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 their potential impacts on the "*human environment*", it is reasonable for that agency to compare not only the effects of the proposed federal action, but also the potential impacts that occur or could occur in the absence of the federal action by a non-federal entity. This concept is applicable to situations involving federal assistance to reduce damage associated with animal species.

Neither state nor federal laws protect some animal species, such as most non-native invasive species. State authority or law manages most mammal species without any federal oversight or protection. In some situations, with the possible exception of restrictions on methods (*e.g*., firearms restrictions, pesticide regulations), unprotected animal species and certain resident wildlife species are managed with little or no restrictions, which allows anyone to lethally remove or capture those species at any time when they are committing damage. The GDNR has the authority to manage wildlife populations in the State and the authority to allow the lethal removal or capture of wildlife for damage management purposes.

When a non-federal entity (*e.g.*, agricultural producers, municipalities, counties, private companies, individuals, or any other non-federal entity) takes an action to alleviate mammal damage or threat of damage, the action is not subject to compliance with the NEPA due to the lack of federal involvement in the action. Under such circumstances, the environmental baseline or status quo would be an environment that includes those resources as other non-federal entities manage or affect those resources in the absence of the federal action. Therefore, in those situations in which a non-federal entity has decided that a management action directed towards mammals 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. WS' involvement would not change the environmental status quo if the requester had conducted the action in the absence of WS' involvement in the action.

A non-federal entity could lethally remove mammals to alleviate damage without the need for authorization when those species are non-native or are unregulated by the GDNR. In addition, other entities could remove some species of mammals to alleviate damage during the hunting and/or trapping season, and/or through authorization by the GDNR. In addition, most methods available for resolving damage associated with mammals would also be available for use by other entities. Therefore, WS' decision-making ability would be restricted to one of three alternatives. WS could take the action using the specific methods as decided upon by the non-federal entity, provide technical assistance only, or take no action. If WS' takes no action or provides just technical assistance, another entity could take the action anyway using the same methods without the need for authorization, during the hunting or trapping season, or through authorization by the GDNR. 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, it is clear that in those situations where a non-federal entity has obtained the appropriate authorization, and has already made the decision to remove or otherwise manage mammals to stop damage with or without WS' assistance, WS' participation in carrying out the action would not affect the environmental status quo.

2.2 ISSUES ASSOCIATED WITH MAMMAL DAMAGE MANAGEMENT ACTIVITIES

Issues are concerns regarding potential effects that might occur from a proposed action. Federal agencies must consider such issues during the NEPA decision-making process. Initially, WS, in cooperation with the TVA, developed the issues related to managing damage associated with mammals in Georgia in consultation with the GDNR. In addition, WS will invite the public to review and comment on the EA to identify additional issues.

Chapter 4 discusses the issues, as those issues relate to the possible implementation of the alternatives, including the proposed action. WS and the TVA evaluated, in detail, the following issues:

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

Under certain alternatives, WS could employ methods available to resolve damage and reduce threats to human safety that target an individual animal of a mammal species or a group of animals after applying the WS Decision Model (Slate et al. 1992) to identify possible techniques (see WS Directive 2.201). A common issue when addressing damage caused by animals is the potential impacts of management actions on the populations of target species. Lethal and non-lethal methods would be available to resolve mammal damage or threats to human safety. Non-lethal methods could disperse, translocate, or otherwise make an area unattractive to target species causing damage, which could reduce the presence of those species at the site and potentially the immediate area around the site where an entity employed those methods. Employing lethal methods could remove a mammal or those mammals responsible for causing damage or posing threats to human safety. Therefore, the use of lethal methods could result in local population reductions in the area where damage or threats were occurring. The number of individual animals from a target species that WS could remove from the population using lethal methods would be dependent on the number of requests for assistance received, the number of individual animals involved with the associated damage or threat, the efficacy of methods employed, and the number of individuals the GDNR authorizes WS to remove.

Another concern is that activities conducted by WS would affect the ability of persons to harvest wildlife during the regulated hunting and/or trapping seasons either by reducing local populations through the lethal removal of mammals or by reducing the number of mammals present in an area through dispersal techniques. People in the State can harvest many of the mammal species addressed in this EA during annual hunting and/or trapping seasons. Bobcats, eastern cottontails, gray fox, gray squirrels, raccoons, red fox, Virginia opossum, and white-tailed deer are game species in the State, which people can harvest annually during hunting seasons. Mink, river otter, raccoons, gray fox, red fox, Virginia opossum, muskrats, striped skunks, and bobcats are furbearing species in the State that people can harvest during annual trapping seasons. In addition, feral swine, coyotes, armadillos, woodchucks, and beaver are unprotected nongame species in the State, which allow people to hunt those species throughout the year subject to certain provisions. In addition, people can use trapping methods to harvest coyotes and beaver throughout the year.

When authorized by the GDNR, people can also address some of the species using available methods themselves or seek assistance from other entities when those species cause damage or pose threats of damage outside of the annual hunting and/or trapping season. Some species (*e.g.*, feral cats, feral dogs) do not require authorization from the GDNR when causing damage or posing threats of damage. Therefore, any damage management activities conducted by WS under the alternatives addressed would be occurring along with other natural process 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.

The analysis will measure the number of individual animals lethally removed in relation to that species' abundance to determine the magnitude of impact to the populations of those species from the use of lethal methods. Magnitude may be determined either quantitatively or qualitatively. Determinations based on population estimates, allowable harvest levels, and actual harvest data would be quantitative. Determinations based on population trends and harvest trend data, when available, would be qualitative. Chapter 4 analyzes the effects on the populations of target mammal populations in the State from implementation of the alternatives addressed in detail, including the proposed action.

Issue 2 - Effects of Activities on the Populations of Non-target Animals, Including T&E Species

The issue of non-target species effects, including effects on T&E species, arises from the use of those methods available under each of the alternatives. The use of non-lethal and lethal methods has the potential to inadvertently disperse, capture, or kill non-target animals. There are also concerns about the potential for adverse effects to occur to non-target animals from the use of chemical methods. Chemical methods that would be available for use to manage damage or threats associated with those mammal species addressed in this EA include immobilizing drugs, euthanasia chemicals, reproductive inhibitors, fumigants, rodenticides, and repellents. Chapter 4 and Appendix B further discuss those chemical methods available for use to manage damage and threats associated with mammals in Georgia.

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 consultations with the USFWS pursuant to Section 7 of the ESA to ensure compliance. The WS program and the TVA also conduct consultations 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)]. As part of the scoping process for this EA, WS consulted with the USFWS pursuant to Section 7 of the ESA to facilitate interagency cooperation between WS and the USFWS. Chapter 4 discusses the potential effects of the alternatives on this issue.

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

An additional issue often raised is the potential risks to the safety of people 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 could use and would recommend only those methods that were legally available under each of the alternatives. Still, some concerns exist regarding the safety of methods available despite their legality and selectivity. As a result, this EA will analyze the potential for proposed methods to pose a risk to members of the public. In addition to the potential risks to the public associated with the methods available under each of the alternatives, risks to WS' employees would also be an issue. Injuries to WS' employees could occur during the use of methods, as well as subject to workplace accidents. Selection of methods, under the alternatives, would include consideration for public and employee safety.

The issue of using chemical methods as part of managing damage associated with animals relates to the potential for human exposure to occur from either direct contact with the chemical or exposure to the chemical from animals that have been exposed. Under the alternatives identified, the use or recommendation of chemical methods could include immobilizing drugs, euthanasia chemicals, fumigants, reproductive inhibitors, rodenticides, and repellents. The EPA through the FIFRA and the GDA through State laws would regulate pesticide use. The United States Drug Enforcement Administration and the United States Food and Drug Administration would regulate immobilizing drugs and euthanasia chemicals. In addition, the use of all chemical methods by WS would be subject to Georgia laws and WS' Directives. WS use of pesticides would comply with WS Directive 2.401. In addition, WS could use explosives to breach or remove beaver dams that were impounding water and causing flooding damage. WS' use, storage, and transportation of explosives would comply with applicable federal, state, and local laws and regulations, procedures outlined in the WS Explosives Safety Manual, and requirements set forth in the Occupational Safety and Health Administration standard for explosives (see 29 CFR 1910.109). The use of explosives by WS' personnel would comply with WS Directive 2.435.

Immobilizing drugs that could be available include ketamine and Telazol, which are anesthetics (*i.e*., general loss of pain and sensation) used during the capture of animals to eliminate pain, calm fear, and reduce anxiety when handling and transporting animals. Xylazine is a sedative that wildlife professionals often use in combination with ketamine to calm nervousness, irritability, and excitement in animals. Of concern would be the potential for immobilizing drugs used in animal capture and handling to cause adverse health effects in people that hunt or trap and consume the species involved. Among the species that WS could capture and handle under the proposed action, this issue would be a primary concern for wildlife species that people hunt or trap and consume as food. Euthanasia chemicals could include sodium pentobarbital, and potassium chloride, all of which WS would administer after anesthetizing an animal.

GonaCon™ is a product currently registered as a reproductive inhibitor but is only available to manage local deer populations. However, GonaCon™ is not currently registered for use in the State. If registered to manage a local deer population in the State, GonaCon™ would only be available for use by WS and/or the GDNR, and agents under their direct supervision. The application of GonaCon™ to manage local deer herds could only occur after the GDNR authorizes the use of the reproductive inhibitor.

Other chemical methods would include products containing the active ingredient aluminum phosphide (woodchucks only), gas cartridges (woodchucks, coyotes, red fox, striped skunks only), zinc phosphide (woodchucks, muskrats, roof rats only), repellents, and explosives (removal of beaver dams only).

Rodenticides containing zinc phosphide and aluminum phosphide are generally restricted-use pesticides, which, if available, could be purchased and applied by appropriately licensed people, and would not be products that were restricted to use by WS only. Products containing the active ingredient zinc phosphide are formulated on bait, which target animals ingest. According to the EPA, zinc phosphide, when ingested, reacts with the acids in the gut releasing phosphine gas, which interferes with cell respiration leading to the death of the animal (EPA 1998). WS would only use products containing the active ingredient zinc phosphide to target woodchucks, muskrats, and wood rats. However, no products containing the active ingredient zinc phosphide are currently registered for woodchucks or muskrats in the State. Products containing the active ingredient aluminum phosphide could be available as a fumigant. Fumigants containing aluminum phosphide as the active ingredient are formulated as tablets, which are placed inside woodchuck burrows and the burrows are sealed up. The aluminum phosphide in the tablet reacts with the moisture in the soil releasing phosphine gas. Since burrows are sealed after placing the tablets, the burrow fills with toxic phosphine gas. WS would only use aluminum phosphide as a fumigant to target woodchucks. Products containing the active ingredient aluminum phosphide are registered for use in the State. Products containing aluminum phosphide are restricted use pesticides and would be available to any appropriately licensed applicator.

Repellents for many mammal species contain different active ingredients with most ingredients occurring naturally in the environment. The most common ingredients of repellents are coyote urine, putrescent whole egg solids, capsaicin, or sand (Silica) mixed with a non-toxic carrier for application to surfaces. Repellents for mammals are not generally restricted-use products; therefore, a person does not need a pesticide applicators license to purchase or apply those products. People generally apply repellents directly to affected resources, which elicits an adverse taste or texture response when the target animal ingests the treated resource or the ingestion of the repellent causes temporary sickness (*e.g*., nausea). Products containing coyote urine or other odors associated with predatory animals are intended to elicit a fright response in target animals by imitating the presence of a predatory animal (*i.e*., animals tend to avoid areas where predators are known to be present). WS could employ or recommend for use those rodenticides and repellents that were available for use in the State (*i.e*., registered with the EPA pursuant to the FIFRA and registered with the GDA for use in Georgia). WS' personnel would only recommend those chemical methods that were available for use by people with the appropriate applicators license.

Gas cartridges could be available to fumigate burrows and den sites of woodchucks, coyotes, fox, and skunks in areas where damages were occurring. Gas cartridges act as a fumigant by producing carbon monoxide gas when ignited. The cartridges contain sodium nitrate, which when burnt, produces carbon monoxide gas. WS would place the cartridges inside active burrows and dens at the entrance, ignite the cartridge, and seal the entrance to the burrow or den with dirt, which allows the burrow or den to fill with carbon monoxide. Gas cartridges are generally not restricted use pesticides; therefore, anyone could purchase and use those products when the GDA has approved the use of those products in the State.

WS could also use binary explosives to remove or breach beaver dams in the State, when requested. Binary explosives require the mixing of two components for activation. WS' employees would keep the two components separated until ready for use at a beaver dam. WS has formed an Explosives Safety Committee composed of qualified WS' personnel that is responsible for developing explosives safety and security for WS, conducting explosives training, and certifying WS' explosives specialists.

Most methods available to alleviate damage and threats associated with mammals would be non-chemical methods. 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 removing bushes to eliminate food or shelter locations or planting vegetation that was less palatable to certain mammal species. Animal behavior modification methods would include those methods designed to disperse mammals from an area through harassment or exclusion. Behavior modification methods could include pyrotechnics, propane cannons, barriers, electronic distress calls, effigies, Mylar tape, and lasers. Exclusion or barriers may be the wrapping the trunks of desirable trees with woven wire or other material, barrier fencing, or electric fencing. Other mechanical methods could include cage traps, foothold traps, body-gripping traps, cable devices, cannon nets, shooting, or the recommendation that hunters and/or trappers reduce a local population of mammals during the annual hunting and/or trapping seasons.

The primary safety risk of most non-chemical methods occurs directly to the applicator or those persons assisting the applicator. However, risks to others do exist when employing non-chemical methods, such as when using firearms, cannon nets, pyrotechnics, or body-gripping traps. Most of the non-chemical methods available to address mammal damage in Georgia would be available for use under any of the alternatives and by any entity, when authorized. Chapter 4 further discusses the risks to human safety from the use of non-chemical methods as this issue relates to the alternatives. Appendix B provides a complete list of non-chemical methods available to alleviate damage associated with mammals.

Another concern is the threat to human safety from not employing methods or not employing the most effective methods to reduce the threats that mammals could pose. The need for action in Chapter 1 addresses the risks to human safety from diseases associated with certain mammal populations. The low risk of disease transmission from mammals 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 concerns occur when inadequately addressing threats to human safety associated with aircraft striking mammals at airports in the State. Mammals have the potential to cause severe damage to aircraft, which can threaten the safety of passengers. Limiting or preventing the use of certain methods to address the potential for aircraft striking mammals could lead to higher risks to passenger safety. Chapter 4 further evaluates those concerns in relationship to the alternatives.

Issue 4 - Effects of Mammal Damage Management Activities on the Aesthetic Value of Mammals

One issue is the concern that the proposed action or the other alternatives would result in the loss of aesthetic benefits of target mammals to the public, resource owners, or neighboring residents. People generally regard animals as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that animals 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 likely started when people began domesticating animals. The public today share a similar bond with animals and/or wildlife in general and in modern societies, a large percentage of households have indoor or outdoor pets. However, some people may consider individual wild animals and mammals as "*pets*" or exhibit affection toward those animals, especially people who enjoy viewing animals. Therefore, the public reaction can be variable and mixed to animal damage management because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to manage conflicts/problems between people and animals.

Animal populations provide a wide range of social and economic benefits (Decker and Goff 1987). Those include direct benefits related to consumptive and non-consumptive uses, indirect benefits derived from vicarious wildlife related experiences, and the personal enjoyment of knowing animals exists and contributes to the stability of natural ecosystems (Bishop 1987). Direct benefits are derived from a personal relationship with animals and 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 or in a zoo, photographing) (Decker and Goff 1987).

Indirect benefits or indirect exercised values arise without the user being in direct contact with the animal and originate from experiences, such as looking at photographs and films of animals, reading about animals, or benefiting from activities or contributions of animals (*e.g*., 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 animals vary considerably. Some people believe that WS should capture and translocate all animals to another area to alleviate damage or threats those animals pose. In some cases, people directly affected by animals strongly support removal. Individuals not directly affected by the harm or damage may be supportive, neutral, or totally opposed to any removal of animals from specific locations or sites. Some people totally opposed to animal damage management want WS to teach tolerance for damage and threats caused by animals, and that people should never kill animals. Some of the people who oppose removal of animals do so because of human-affectionate bonds with individual animals. Those human-affectionate bonds are similar to attitudes of a pet owner and result in aesthetic enjoyment.

In some cases, the presence of overabundant mammal species offends people, such as raccoons, armadillos, gray squirrels, coyotes, or feral species, such as cats or dogs. To such people, those species represent pests that are nuisances, which upset the natural order in ecosystems, and are carriers of diseases transmissible to people or other animals. In those situations, the presence of overabundant species can diminish their overall enjoyment of other animals by what they view as a destructive presence of such species. They are offended because they feel that those mammal species proliferate in such numbers and appear to remain unbalanced.

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 animals is an important but very complex concept that people can interpret 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."*

The AVMA (1987) has previously described suffering as a *"…highly unpleasant emotional response usually associated with pain and distress."* However, suffering *"…can occur without pain…,"* and *"…pain can occur without suffering…"*. Because suffering carries with it the implication of a time frame, 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 can occur when a person does not take action 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 in animals 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 using AVMA accepted methods of euthanasia when killing all animals, including wild and invasive animals. The AVMA has stated, "[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 mammals has both a professional and lay point of arbitration. Wildlife managers and the public must 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 with some methods (*e.g.*, foothold trap) changes in the blood chemistry of trapped animals indicate the existence of some level of "*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, Sharp and Saunders 2008, Sharp and Saunders 2011).

The decision-making process involves tradeoffs 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. Chapter 4 further discusses the issue of humaneness and animal welfare. Chapter 3 discusses SOPs intended to alleviate pain and suffering.

Issue 6 – Effects of Beaver Removal and Dam Manipulation on the Status of Wetlands in the State

Wetlands are a valuable component of land-based ecosystems that provide numerous direct and indirect benefits to people and wildlife (*e.g*., see Costanza et al. 1997, Millennium Ecosystem Assessment 2005). Between the 1780s and the 1980s, Dahl (1990) estimated 53% of the original wetland acres in the lower 48 states were lost, primarily from human development. Over that 200-year time span, Dahl (1990) estimated the wetland acres in Georgia decreased from 6,843,200 acres to 5,298,200 acres, which represented a 23% decline. Beaver, through their building of dams and impounding water, can have a unique role in establishing wetlands that not only provide benefit to the beaver, but to people and other wildlife. Wildlife professionals often consider beaver a "*keystone*" species for their ability to manipulate and create their own habitats, which can also provide benefits to other wildlife and people. Beaver may also be an inexpensive way of restoring wetlands or creating new wetlands (*e.g*., see Hey and Philippi 1995, Muller-Schwarze and Sun 2003, Buckley et al. 2011).

The issue of WS' potential impacts to wetlands could occur from activities conducted to alleviate damage or threats of damage associated with beaver, primarily from the breaching or removal of beaver dams. Beaver dam breaching or removal during activities to manage damage caused by beaver sometimes occurs in areas inundated by water from water impounded by beaver dams. Dam material usually consists of mud, sticks, and other vegetative material. Beaver dams obstruct the normal flow of water, which can change the preexisting hydrology from flowing or circulating waters to slower, deeper, more expansive waters that accumulate bottom sediment over time. The depth of the bottom sediment behind a beaver dam depends on the length of time water covers an area and the amount of suspended sediment in the water.

Beaver dams, over time, can establish new wetlands. The regulatory definition of a wetland stated by the United States Army Corps of Engineers and the EPA (40 CFR 232.2) is:

"*Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas*."

Therefore, the breaching or removal of a beaver dam could result in the degrading or removal of a wetland, if wetland characteristics exist at a location where a beaver dam occurs. The preexisting habitat (prior to the building of the dam) and the altered habitat (areas flooded by impounded water) have different ecological values to the fish and wildlife native to the area. Some species may benefit by the addition of a beaver dam that creates a wetland, while the presence of some species of wildlife may decline. For example, some darter species listed as federally endangered require fast moving waters over gravel or cobble beds, which beaver dams can eliminate; thus, reducing the availability of habitat. In areas where bottomland forests were flooded by beaver dams, a change in species composition could occur over time as trees die. Flooding often kills hardwood trees, especially when flooding persists for extended periods, as soils become saturated. Conversely, beaver dams could be beneficial to some wildlife, such as river otter, Neotropical migratory birds, and waterfowl that require aquatic habitats.

If water impounded by a beaver dam persists for an extended period, hydric soils and hydrophytic vegetation could eventually form. This process could take anywhere from several months to years depending on preexisting conditions. Hydric soils are those soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. In general, hydric soils form much easier where wetlands have preexisted. Hydrophytic vegetation includes those plants that grow in water or on a substrate that is at least periodically deficient in oxygen because of excessive water content.

If those conditions exist, then a wetland has developed that would have different wildlife habitat values than an area of impounded water from more recent beaver activity.

In addition, people often raise concerns regarding the use of lethal methods to remove beaver to alleviate damage or threats. If WS removed beaver from an area and removed or breached any associated beaver dam, the manipulation of water levels by removing/breaching the dam could prevent the establishment of wetlands by preventing water conditions to persist long enough to establish wetland characteristics. If WS removed beaver but left the beaver dam undisturbed, the lack of maintenance to the dam by beaver would likely result in the eventual recession of the impounded water as weathering eroded the dam.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

WS, the TVA, and the GDNR identified additional issues during the scoping process of this EA. WS and the TVA considered those additional issues but a detailed analysis did not occur for the reasons provided. Discussion of those additional issues and the reasons for not analyzing those issues in detail occur below.

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

The appropriateness of preparing an EA instead of an EIS was a concern WS and the TVA identified during the scoping process. Animal damage management falls within the category of actions in which the exact timing or location of individual activities can be difficult to predict well enough ahead of time to describe accurately such locations or times in an EA or even an EIS. Although WS could predict some of the possible locations or types of situations and sites where some kinds of animal damage would occur, the program cannot predict the specific locations or times at which affected resource owners would determine a damage problem had 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.

Ordinarily, according to the APHIS procedures implementing the NEPA, WS' individual damage management actions could be categorically excluded (7 CFR 372.5(c)). The intent in developing this EA has been to determine if the proposed action or the other alternatives could 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 for managing damage and threats to human safety associated with mammals 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 would provide a more comprehensive and less redundant analysis than multiple EAs covering smaller areas. If WS and the TVA made a determination through this EA that the proposed action or the other alternatives could have a significant impact on the quality of the human environment, then WS and the TVA would publish a notice of intent to prepare an EIS and this EA would be the foundation for developing the EIS. Based on previous requests for assistance, the WS program in Georgia would continue to conduct damage management on a small percentage of the land area in the State where damage was occurring or likely to occur.

A Site Specific Analysis Should be made for Every Location Where Mammal Damage Management Would 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, would be 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 this EA drove the analysis. 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 that WS' personnel would use to evaluate and respond to requests for assistance.

As discussed previously, one EA analyzing impacts for the entire State would provide a more comprehensive and less redundant analysis that allows 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 impact on the quality of the human environment, then an EIS would be prepared.

WS' Impact on Biodiversity

WS and the TVA do not attempt to eradicate any species of native wildlife in the State. WS and the TVA operate in accordance with federal and state laws and regulations enacted to ensure species viability. WS would use available methods to target individual mammals or groups of mammals 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 reproduction replaces the animals removed.

As stated previously, WS would only provide assistance under the appropriate alternatives after receiving a request to manage damage or threats. Therefore, if WS provided direct operational assistance under the alternatives, WS would provide assistance on a small percentage of the land area of Georgia. In addition, WS would only target those mammals identified as causing damage or posing a threat. WS would not attempt to suppress wildlife populations across broad geographical areas at such intensity levels for prolonged durations that significant ecological effects would occur. The goal of WS would not be to manage animal populations but to manage damage caused by specific individuals of a species. The management of wildlife populations in the State is the responsibility of the GDNR and activities associated with many of the mammal species addressed in the EA require authorization from the GDNR. Therefore, those factors would constrain the scope, duration, and intensity of WS' actions under the alternatives.

Often of concern with the use of certain methods is that mammals that WS lethally removes would only be replaced by other mammals after WS completes activities (*e.g.*, mammals that relocate into the area) or by mammals the following year (*e.g.*, increase in reproduction and survivability that could result from less competition). The ability of an animal population to sustain a certain level of removal and to return to pre-management levels demonstrates that limited, localized damage management methods have minimal impacts on species' populations.

For example, studies suggest coyote territories would not remain vacant for very long after removing coyotes from an area. Gese (1998) noted that adjacent coyote packs adjusted territorial boundaries following social disruption in a neighboring pack, thus allowing for complete occupancy of the area despite removal of breeding coyotes. Blejwas et al. (2002) noted that a replacement pair of coyotes occupied a territory in approximately 43 days following the removal of the territorial pair. Williams et al. (2003) noted that temporal genetic variation in coyote populations experiencing high turnover (due to removals) indicated that "*...localized removal effort does not negatively impact effective population size...*".

Chapter 4 evaluates the environmental consequences of the alternatives on the populations of target and non-target species based on available quantitative and qualitative parameters. The authorization of lethal removal by the GDNR would ensure cumulative removal levels would occur within allowable levels to maintain species' populations and meet population objectives for each species. Therefore, activities conducted pursuant to any of the alternatives would 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 processes is a concern that WS or other entities should establish a threshold of loss before employing lethal methods to resolve damage and that mammal damage should be a cost of doing business. In some cases, cooperators likely tolerate some damage and economic loss until the damage reaches a threshold where the damage becomes an economic burden. The appropriate level of allowed tolerance or threshold before employing lethal methods would differ among cooperators and damage situations. In some cases, any loss in value of a resource caused by animals could be financially burdensome to some people. In addition, establishing a threshold would be difficult or inappropriate to apply to human health and safety situations. For example, aircraft striking mammals could lead to property damage and could threaten passenger safety if a catastrophic failure of the aircraft occurred because of the strike. Therefore, addressing the threats of animal strikes prior to an actual strike occurring would be appropriate.

Mammal Damage Management Should Not Occur at Taxpayer Expense

An issue identified is the concern that WS should not provide assistance at the expense of the taxpayer or that activities should be fee-based. Funding for WS' activities could occur from federal appropriations, through state funding, and through cooperative funding. Funding for WS' activities would occur through cooperative service agreements with individual property owners or managers. WS receives a minimal federal appropriation for the maintenance of a WS program in Georgia. The remainder of the WS program would mostly be fee-based. WS would provide technical assistance to requesters as part of the federally funded activities; however, the majority of funding to conduct direct operational assistance in which WS' employees perform damage management activities would occur through cooperative service agreements between the requester and WS.

Additionally, damage management activities are an appropriate sphere of activity for government programs, since managing wildlife is a government responsibility. Treves and Naughton-Treves (2005) and the International Association of Fish and Wildlife Agencies (2005) discuss the need for wildlife damage management and that an accountable government agency is best suited to take the lead in such activities because it increases the tolerance for wildlife by those people being impacted by their damage and has the least impacts on wildlife overall.

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 that WS and the TVA are considering. However, the methods determined to be most effective to reduce damage and threats to human safety caused by mammals and that prove to be the most cost effective would likely receive the greatest application. As part of an integrated approach and as part of the WS Decision Model, 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 circumstance where mammals were causing damage or posing a threat. Additionally, management operations may be constrained by cooperator funding and/or objectives and needs. Therefore, the cost of methods can often influence the availability of methods to resolve damage, which can influence the effectiveness of methods.

Mammal Damage Should be managed by Private Nuisance Wildlife Control Agents or Trappers

People experiencing damage caused by the target animals could contact wildlife control agents and private trappers to reduce mammal damage when deemed appropriate by the resource owner. The GDNR maintains a website of nuisance animal trappers in the State[9]. In addition, WS could refer persons requesting assistance to agents and/or private individuals under all of the alternatives fully evaluated in the EA.

WS Directive 3.101 provides guidance on establishing cooperative projects and interfacing with private businesses. WS Directive 2.345 outlines WS' policy regarding requests for assistance involving rodent species in urban areas. WS would only respond to requests for assistance received and would not respond to public bid notices. 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 mammals. As described in Appendix B, the lethal removal of mammals with firearms by WS to alleviate damage or threats could occur using a handgun, rifle, or shotgun. 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).

The removal of mammals by WS using firearms in the State would occur primarily from the use of rifles. However, WS' personnel could employ shotguns or handguns to remove some species. To reduce risks to human safety and property damage from bullets passing through mammals, the use of firearms would be applied in such a way (*e.g.*, caliber, bullet weight, distance) to ensure the bullet does not pass through mammals. Mammals that were removed using firearms would occur within areas where retrieval of mammal carcasses for proper disposal is highly likely (*e.g.*, at an airport). With risks of lead exposure occurring primarily from ingestion of bullet fragments, the retrieval and proper disposal of mammal carcasses would greatly reduce the risk of scavengers ingesting lead that carcasses may contain.

However, deposition of lead into soil could occur if, during the use of a firearm, the projectile passed through a mammal, if misses occurred, or if the retrieval of the carcass did not occur. 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 generally stays within the top 20 cm (about 8 inches). In addition, concerns occur that lead from bullets deposited in soil from shooting activities could contaminate ground water or surface water from runoff. Stansley et al. (1992) studied lead levels in water subject 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

[9] The website can be accessed at http://gadnrle.org/sites/uploads/le/pdf/Special-Permits/Nuisance_Wildlife_Trappers_List.pdf; accessed January 19, 2016.

acidic), but lead did transport more readily under slightly acidic conditions. Although Stansley et al. (1992) detected elevated lead levels in water in a stream and a marsh that were in the shot "*fall zones*" at a shooting range, the study did not find higher lead levels in a lake into which the stream drained, except for one sample collected near a parking lot. Stansley et al. (1992) believed the lead contamination near the parking lot was due to runoff from the lot, and not from the shooting range areas. The study also indicated that even when lead shot was highly accumulated in areas with permanent water bodies present, the lead did not necessarily cause elevated lead levels in water further downstream. Muscle samples from two species of fish collected in water bodies with high lead shot accumulations had lead levels that were well below the accepted threshold standard of safety for human consumption (Stansley et al. 1992).

Craig et al. (1999) reported that lead levels in water draining away from a shooting range with high accumulations of lead bullets in the soil around the impact areas were far below the "*action level*" of 15 parts per billion as defined by the EPA (*i.e.*, requiring action to treat the water to remove lead). The study found that the dissolution (*i.e*., capability of dissolving in water) of lead declines when lead oxides form on the surface areas of the spent bullets and fragments (Craig et al. 1999). Therefore, the lead oxide deposits that form on the surface of bullets and shot 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 that WS could deposit and the concentrations that would occur from WS' activities to reduce mammal damage using firearms, as well as most other forms of dry land small game hunting in general, lead contamination of water from such sources would be minimal to nonexistent.

Since those mammals removed by WS using firearms could be lethally removed by the entities experiencing damage using the same method in the absence of WS' involvement, WS' assistance with removing those mammals would not be additive to the environmental status quo. The proficiency training received by WS' employees in firearm use and accuracy would increase the likelihood that mammals were lethally removed humanely in situations that ensure accuracy and that misses occur infrequently, which further reduces the potential for lead to be deposited in the soil from misses or from projectiles passing through carcasses. Based on current information, the risks associated with lead projectiles that WS could contribute to the environment due to misses, the projectile passing through the carcass, or from mammal carcasses that may be irretrievable would be below any level that would pose any risk from exposure or significant contamination.

Effects on Human Health from Consumption of Deer Meat Donated by WS

Of concern under this issue would be the consumption of deer meat donated to a charitable organization after WS lethally removed the deer. Of recent concern is the potential for lead and other contaminants to be present in the deer meat processed for human consumption. The potential for the spreading of zoonotic diseases in deer processed and donated for human consumption is also a concern. Under the proposed action alternative, WS could donate meat from deer lethally removed during damage management activities to charitable organizations for human consumption (see WS Directive 2.510). The WS program in Georgia would only donate meat from deer if the program implemented Alternative 1. WS could recommend the donation or consumption of meat under the technical assistance only alternative (Alternative 2) but WS' personnel would not provide direct operational assistance under a technical assistance only alternative.

Stewart and Veverka (2011) documented that white-tailed deer shot with lead ammunition in the head or extreme upper neck in sharpshooting situations showed no deposition of lead fragments in the meat of the animals that people would process for human consumption. Lower neck shots do frequently experience lead fragmentation in the loin muscle and Stewart and Veverka (2011) recommended removing the loins prior to processing to ensure that people did not ingest the fragments. WS' personnel would receive training to shoot and target the head and upper neck of white-tailed deer. WS would not donate any deer shot in the lower neck or would process those deer to avoid the areas that could contain lead fragments. Research on the overall health of the fallow deer population on Little Saint Simon Island in Georgia concluded there was no indication that human consumption of fallow deer meat from the island would be unsafe (Morse et al. 2009). WS' personnel would follow WS Directive 2.510 and WS Directive 2.515 when donating deer carcasses to meat processors.

If WS donated deer for human consumption, WS' personnel would follow WS' policies pertaining to the testing or labeling of meat in order to address potential health concerns. The testing of deer donated for exposure to substances such as organophosphate and carbamate insecticides, lead, mercury, arsenic, organochlorines, and organic chemicals could occur prior to distribution for human consumption. WS would not donate deer immobilized using immobilizing drugs or euthanized using euthanasia chemicals for human consumption. WS would dispose of carcasses of deer euthanized with euthanasia chemicals pursuant to WS Directive 2.515. Deer removed by any method for disease sampling or in an area where zoonotic diseases of concern were known to be prevalent and of concern to human health after consuming processed deer meat would not be donated for consumption and would be disposed of by deep burial or incineration. WS' adherence to policy would not result in adverse effects to human health from the donation of deer meat.

Donation of Feral Swine Removed Through Management Activities for Human Consumption

Under the Federal Meat Inspection Act, inspectors must inspect all swine prior to the swine entering into any establishment for slaughter. Inspections occur by the Food Safety and Inspection Services under the USDA. The Food Safety and Inspection Services ruled that all swine are amenable to the Federal Meat Inspection Act and even if donated, those swine entered into a system of commerce; therefore, the processing of all animals must occur under inspection at an official establishment. This would entail examining the animal alive, at rest and in motion from both sides before passing the animal for slaughter.

In most instances, it would be difficult to trace the origins of feral swine or determine fitness for human consumption due to the potential for feral swine to carry disease (Wyckoff et al. 2009). Transporting live feral swine to slaughter facilities also increases the potential for spreading disease to domestic swine at the facility. Therefore, the WS program in Georgia would not donate feral swine to food banks.

Potential for Feral Swine to Disperse to Other Areas Due to Management Activities

Methods involving the exclusion, pursuit, shooting, and/or harassment of feral swine could lead to the abandonment of localized areas traditionally used by swine in Georgia. If WS' personnel unintentionally dispersed feral swine under the alternatives, damages and threats could arise in other areas.

Under the alternatives where WS would be involved with managing damage, WS would evaluate the damage or threat situation to determine the appropriate methods. Activities conducted under the alternatives would be coordinated between WS, the TVA, the GDNR, and local entities to monitor feral swine populations in areas where dispersal may occur. WS' personnel would consider the potential for methods to disperse feral swine as part of the evaluation of the damage situation and would incorporate those considerations into the decision-making process associated with the alternatives to determine the methods to employ and recommend. WS' personnel would likely use methods that could result in the exclusion, harassment, or dispersal of feral swine (*e.g.*, shooting, propane cannons, pyrotechnics) in those situations where damage, threats of damage, and/or threats to human safety require immediate resolution.

In those situations where feral swine could disperse to areas where damage could occur, individual feral swine could also be radio collared to locate and monitor movements of feral swine. WS could use radio collaring to track movements and locations of feral swine. The tracking of feral swine in relationship to damage management activities would also provide the ability to monitor movements and potential dispersal to other areas. Feral swine often form large groups, which allow personnel to capture, collar, and release one individual of the group. Once released, the collared swine often returns to the group. By collaring one individual, WS' personnel can monitor and track the movement and location of an entire group of feral swine. Radio telemetry would be available to monitor the movements of feral swine and to respond as necessary to swine potentially dispersing.

Coordination between agencies and local entities would ensure people could identify and address any dispersing feral swine when they cause damage or threaten human safety. The limited use of methods that disperse feral swine should further ensure they do not displace to other areas within Georgia. In addition, the passiveness of the primary methods proposed for use should limit dispersal of feral swine. Feral swine also occur statewide in the State; therefore, dispersal is not likely to disperse feral swine into areas where they are not already present.

WS is also considering the use of aircraft to aid in alleviating or preventing feral swine damage. Under the proposed action alternative, aerial operations could include the use of aircraft for surveillance and monitoring, as well as, WS' employees shooting feral swine from aircraft. Surveillance and monitoring activities would use aircraft to locate feral swine, to determine the size of a local population, and when using radio telemetry, to locate radio collared swine.

The use of aircraft could rapidly reduce feral swine densities in an area (Saunders 1993, Choquenot et al. 1999, Campbell et al. 2010). Studies conducted in Australia found that shooting feral swine from an aircraft reduced local populations of swine by 65 to 80% and surviving feral swine could continue to cause damage and pose disease risks (Saunders and Bryant 1988, Hone 1990, Saunders 1993). Choquenot et al. (1999) found that the feral swine density in an area could influence the efficiency of aerial gunning. Saunders and Bryant (1988) found feral swine "*...became attuned to the significance of a hovering helicopter and* [feral swine] *modified their behaviour* [sic] *to avoid detection*." Dexter (1996) concluded that harassment caused by the use of aircraft in New South Wales, Australia had little effect on the movements of surviving swine since no statistically significant differences were observed in the hourly distance moved by surviving feral swine, the home ranges of surviving feral swine, and their positions within their home ranges. Campbell et al. (2010) stated the use of aircraft to shoot feral swine "*...had only minor effects on the behavior of surviving swine*..." and the use of aircraft to remove feral swine "*...should be considered a viable tool*..." when managing disease outbreaks. Based on available information, feral swine are not likely to disperse long-distances due to damage management activities.

Effects of Activities on Soils, Water, and Air Quality

The implementation of those alternative approaches discussed in Section 3.1 by WS would meet the requirements of applicable federal laws, regulations, and Executive Orders for the protection of the environment, including the Clean Air Act and Executive Order 13514[10]. The actions discussed in this EA do not involve major ground disturbance, construction, or habitat alteration. Chapter 3 discusses the SOPs to reduce risks to the environment that WS would incorporate into activities when implementing applicable alternative approaches to managing damage. Activities that WS could implement pursuant to those applicable alternative approaches discussed in Section 3.1 would not alter aquatic systems or cause changes in the flow, quantity, or storage of water resources. Personnel of WS would use, store, and dispose of all chemical methods in accordance with applicable laws and regulations pursuant to WS

[10]Executive Order 13514 mandates that at least 15 percent of existing federal buildings and leases meet Energy Efficiency Guiding Principles by 2015, and that annual progress be made toward 100 percent conformance of all federal buildings, with a goal of 100% of all new federal buildings achieving zero-net-energy by 2030. "*Zero-net-energy building*" is defined in Executive Order 13514 as "*a building that is designed, constructed, and operated to require a greatly reduced quantity of energy to operate, meet the balance of energy needs from sources of energy that do not produce greenhouse gases, and therefore result in no net emissions of greenhouse gases and be economically viable*".

Directive 2.210. The use, storage, and disposal of chemical methods by WS' personnel would also follow WS' directives, including WS Directive 2.401, WS Directive 2.405, WS Directive 2.415, WS Directive 2.430, WS Directive 2.455, and WS Directive 2.465.

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

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

Influence of Global Climate Change

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

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

If WS selected an alternative approach to meeting the need for action that allows the program to provide assistance (see Section 3.1), WS would monitor activities, in context of the issues analyzed in detail, to determine if the need for action and the associated impacts remain with the parameters established and analyzed in this EA. Pursuant to SOPs discussed in Section 3.3 and Section 3.4, WS would continue to coordinate activities to reduce and/or prevent mammal damage in the State with the GDNR. The mission of the GDNR is "*…to sustain, enhance, protect and conserve Georgia's natural, historic and cultural resources for present and future generations…*". Therefore, coordinating activities would ensure the GDNR had the opportunity to incorporate any activities the WS program conducts into population objectives established for wildlife populations in the State. If WS determines there to be a new need for action, changed conditions, new issues, or new alternatives having different environmental impacts, WS would supplement this analysis or conduct a separate evaluation pursuant to the NEPA. Through monitoring, the WS program in Georgia can evaluate and adjust activities as changes occur over time.

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

Greenhouse Gas Emissions by the WS Program

Under the alternative approaches intended to meet the need for action discussed in Chapter 3, WS could potentially produce criteria pollutants (*i.e*., pollutants for which maximum allowable emission levels and concentrations are enforced by state agencies). Those activities could include working in the office, travel from office to field locations, and travel at field locations (vehicles or ATV). During evaluations of the national program to manage feral swine, the WS program reviewed greenhouse gas emissions for the entire national WS program (USDA 2015*a*). The analysis estimated effects of vehicle, aircraft, office, and ATV use by WS for FY 2013 and included the potential new vehicle purchases that could be associated with a national program to manage damaged caused by feral swine. The review concluded that the range of Carbon Dioxide Equivalents (includes CO_2, NO_x CO, and SO_x) for the entire national WS program would be below the reference point of 25,000 metric tons per year recommended by CEQ for actions requiring detailed review of impacts on greenhouse gas emissions. The activities that WS could conduct under the alternative approaches discussed in Chapter 3 would have negligible cumulative effects on atmospheric conditions, including the global climate.

CHAPTER 3: ALTERNATIVES

Section 3.1 contains a discussion of the alternatives that WS and the TVA developed to meet the need for action discussed in Chapter 1 and to address the identified issues discussed in Chapter 2. WS and the TVA developed the alternatives based on the need for action and issues using the WS Decision model (Slate et al. 1992). The alternatives will receive detailed environmental impacts analysis in Chapter 4 (Environmental Consequences). Section 3.2 discusses alternatives considered but not analyzed in detail, with rationale. In addition, Section 3.3 discusses the SOPs that WS would incorporate into the relevant alternatives.

3.1 DESCRIPTION OF THE ALTERNATIVES

WS and the TVA developed the following alternatives to meet the need for action and address the identified issues associated with managing damage caused by mammals in the State.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

This alternative would continue the current implementation of an adaptive integrated methods approach utilizing non-lethal and lethal techniques when WS receives a request for assistance in the State. This approach to managing damage associated with mammals would integrate the use of the most practical and effective methods to resolve a request for damage management as determined by a site-specific evaluation for each request. WS' personnel would determine the appropriate methods to reduce damage and threats of damage by using the WS Decision Model (see discussion below on the WS Decision Model).

A major goal of the program would be to resolve and prevent damage caused by mammals and to reduce threats to human safety. To meet this goal, WS would continue to respond to requests for assistance with, at a minimum, technical assistance, or when funding[11] was available, operational damage management. WS would provide those entities requesting assistance with information regarding the use of appropriate non-lethal and lethal techniques.

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 mammals, or 3) providing technical assistance and direct operational assistance to a property owner or manager experiencing damage. The removal of some of the mammal species addressed in this EA can only legally occur under authorization by the GDNR and only at levels authorized, unless the GDNR affords those mammal species no protection, in which case, no authorization for lethal removal would be required. To meet the need for action, the objectives of this alternative would be to assist all of the people requesting WS' assistance, within the constraints of available funding and workforce.

WS could provide property owners or managers requesting assistance with information regarding the use of effective and practical non-lethal and lethal techniques. WS would give preference to non-lethal methods when practical and effective under this alternative (see WS Directive 2.101). Property owners or managers may choose to implement WS' recommendations on their own (*i.e.*, technical assistance), use contractual services of private businesses, use volunteer services of private organizations, use the services of WS (*i.e.*, direct operational assistance), take the management action themselves, or take no further action.

WS would work with those persons experiencing mammal damage to address those mammals responsible for causing damage as expeditiously as possible. To be most effective, damage management activities should occur as soon as mammals begin to cause damage. Once animals become familiar with a particular location (*i.e.*, conditioned to an area), dispersing those animals or making the area unattractive can be difficult. 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.

The WS Decision Model would be the implementing mechanism for a damage management program under Alternative 1, which would be adapted to an individual damage situation. This alternative would allow WS to use the broadest range of methods to address damage or the threat of damage. When WS received a request for direct operational assistance, WS would conduct site visits to assess the damage or threats, would identify the cause of the damage, and would apply the Decision Model described by Slate et al. (1992) and WS Directive 2.201 to determine the appropriate methods to resolve or prevent damage. Discussion of the Decision Model and WS' use of the Model under Alternative 1 occurs below. In addition, WS would give preference to non-lethal methods when practical and effective (see WS Directive 2.101). When receiving requests for assistance associated with roof rats, grey squirrels, chipmunks, and woodchucks, the WS program in Georgia would follow WS Directive 2.345. When receiving requests for assistance associated with feral or free-ranging dogs, the WS program would follow WS Directive 2.340.

Non-lethal methods that would be available for use by WS under this alternative include, but are not limited to minor habitat modification, behavior modification, lure crops, visual deterrents, live traps, drop

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[11] Funding for WS to conduct damage management activities could occur through federal appropriations, state appropriations, or from cooperative funding.

nets, cannon nets, translocation, exclusionary devices, water control devices for beaver, frightening devices, immobilizing drugs, reproductive inhibitors, and chemical repellents (see Appendix B for a complete list and description of potential methods). In addition, WS could remove or breach beaver dams using binary explosives and hand tools. Once the determination was made that removing or breaching a beaver dam was appropriate and the beaver dam could be removed in accordance with the CWA (see Appendix E), the breaching or removal of the dam could be conducted manually using hand tools or when safe and appropriate, with use of binary explosives. Lethal methods that would be available to WS under this alternative include body-gripping traps, cable devices, the recommendation of harvest during hunting and/or trapping seasons, fumigants, euthanasia chemicals, rodenticides, and shooting, including the use of firearms from aircraft. Target mammal species live-captured using non-lethal methods (*e.g.*, live-traps, immobilizing drugs) could be euthanized. In addition, WS could use foothold traps and submersion rods or cables in drowning sets[12] for beaver. The lethal control of target mammals would comply with WS Directive 2.505.

Discussing methods does not imply that all methods would be used or recommended by WS to resolve requests for assistance and does not imply that all methods would be used to resolve every request for assistance. The most appropriate response would often be a combination of non-lethal and lethal methods, or there could be instances where application of lethal methods alone would be the most appropriate strategy. For example, if an entity requesting assistance had already attempted to alleviate damage using non-lethal methods, WS would not necessarily employ those same non-lethal methods, since the previous use of those methods were ineffective at reducing damage or threats to an acceptable level to the requester.

Many lethal and non-lethal methods are intended to be short-term attempts at reducing damage occurring at the time those methods were employed. Long-term solutions to managing mammal damage could include limited habitat manipulations and changes in cultural practices, which are techniques addressed further below and in Appendix B.

Non-lethal methods can disperse or otherwise make an area unattractive to mammals causing damage; thereby, reducing the presence of mammals at the site and potentially the immediate area around the site where non-lethal methods were employed. WS would give preference to non-lethal methods when addressing requests for assistance (see WS Directive 2.101). However, as stated previously, WS would not necessarily employ non-lethal methods to resolve every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model, especially when the requesting entity had used non-lethal methods previously and found those methods to be inadequate to resolving the damage or threats of damage. WS' employees could use non-lethal methods to exclude, harass, and disperse target animals from areas where damage or threats were occurring. When effective, non-lethal methods would disperse mammals from an area resulting in a reduction in the presence of those mammals at the site where a person employed those methods. For any management methods employed, the proper timing would be essential in effectively dispersing those mammals causing damage. Employing methods soon after damage begins or soon after a property owner or manager identifies threats, increases the likelihood that those damage management activities would achieve success in addressing damage. Therefore, coordination and timing of methods would be necessary to be effective in achieving expedient resolution of mammal damage.

Under Alternative 1, 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. In some situations, a cooperating entity has tried to employ non-lethal methods to resolve damage prior to contacting WS for assistance. In those cases, the methods employed by the requester were either

[12] Section 4.1 and Appendix B provides additional information on the use of foothold traps and submersion cables or rods.

unsuccessful or the reduction in damage or threats had not reached a level that was tolerable to the requesting entity. In those situations, WS could employ other non-lethal methods, attempt to apply the same non-lethal methods, or employ lethal methods. In many situations, the implementation of non-lethal methods, such as exclusion-type barriers, would be the responsibility of the requester, which means that, in those situations, the only function of WS would be to implement lethal methods, if determined to be appropriate using the WS Decision Model.

WS could employ lethal methods to resolve damage associated with those mammals identified by WS as responsible for causing damage or threats to human safety under this alternative[13]; however, WS would only employ lethal methods after receiving a request for the use of those methods. For example, surveys in North Carolina and Alabama indicated the majority of landowners with beaver damage on their property that were surveyed desired damage management via beaver removal (Hill 1976, Woodward et al. 1985). Loker et al. (1999) found that suburban residents also might desire lethal management methods to resolve beaver damage conflicts. Such conflicts that occur between property owners and beaver can result in negative effects that often outweigh the benefits of having beaver on an owner's property (Miller and Yarrow 1994). The use of lethal methods could result in local population reductions in the area where damage or threats were occurring since people could remove individual mammals from the population. WS and other entities often employ lethal methods to reinforce non-lethal methods and to remove mammals that WS or other entities identify as causing damage or posing a threat to human safety. The number of mammals removed from the population using lethal methods under Alternative 1 would be dependent on the number of requests for assistance received, the number of mammals involved with the associated damage or threat, and the efficacy of methods employed.

Often of concern with the use of lethal methods is that mammals that were lethally removed would only be replaced by other mammals either after the application of those methods (*e.g.*, mammals that relocate into the area) or by mammals the following year (*e.g.*, increase in reproduction and survivability that could result from less competition). As stated previously, WS would not use lethal methods as population management tools over broad areas. The intent of using lethal methods would be to reduce the number of individuals of a target mammal species present at a specific location where damage was occurring by targeting those mammals causing damage or posing threats. The intent of lethal methods would be to manage damage caused by those individuals of a mammal species and not to manage entire mammal populations.

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

[13] The lethal removal of some of the mammal species addressed in this EA could only legally occur under authorization by the GDNR and only at levels authorized, unless the GDNR affords those mammal species no protection, in which case, no authorization for lethal removal would be required.

WS may recommend mammals be harvested during the regulated hunting and/or trapping season for those species in an attempt to reduce the number of mammals causing damage. Managing mammal populations over broad areas could lead to a decrease in the number of mammals causing damage. Establishing hunting or trapping seasons and the allowed harvest levels during those seasons is the responsibility of the GDNR. WS does not have the authority to establish hunting or trapping seasons or to set allowed harvest numbers during those seasons.

Appendix B contains a complete list of methods available for use under this alternative. However, listing methods neither implies that all methods would be used by WS to resolve requests for assistance nor does the listing of methods imply that all methods would be used to resolve every request for assistance. As part of an integrated approach, WS may provide technical assistance and direct operational assistance to those people experiencing damage associated with mammals when those persons request assistance from WS.

Technical Assistance Recommendations

Under Alternative 1, WS could provide technical assistance to those persons requesting assistance with managing damage as part of an integrated methods approach. Technical assistance could occur as described in Alternative 2 of this EA. From FY 2010 through FY 2015, WS conducted 1,443 technical assistance projects that involved mammal damage to agricultural resources, property, natural resources, and threats to human safety (see Table 1.1).

Direct Operational Assistance

Operational damage management assistance would include damage management activities that WS' personnel conduct directly or activities that WS' employees supervise. Initiation of operational damage management assistance could occur when the problem could not be effectively resolved through technical assistance alone and there was a written MOU, work initiation document, or other comparable document signed between WS and the entity requesting assistance. The initial investigation by WS' personnel would define the nature, history, and extent of the problem; species responsible for the damage; and methods available to resolve the problem. The professional skills of WS' personnel could be required to resolve problems effectively, especially if chemical methods were necessary or if the problems were complex.

The following examples serve as illustrations of WS' operational damage management assistance projects. The examples are intended to present realistic examples of on-going projects only and are not an inclusive or all-encompassing list of all projects conducted by WS in Georgia.

Management of Animal Hazards to Aircraft and Air Passengers in Georgia

Upon receiving a request for assistance, WS evaluates animal hazards at an airport, prepares a Wildlife Hazard Assessment that identifies animal hazards, and assists the airport in developing a Wildlife Hazard Management Plan to address those hazards and threats.

Direct operational activities consist of various harassment techniques, and live capture and lethal removal techniques aimed at removing potentially injurious animals. WS' personnel also provide ongoing technical advice to airport managers regarding methodologies to reduce the presence of animals in areas of operations within airports, including providing technical advice on various habitat management projects implemented by airport personnel. In addition, WS promotes improved mammal strike record keeping, maintains a program of mammal identification, and monitors mammal numbers at participating airports to assist in developing an effective damage management program.

Management of Mammals That Threaten Power Generation and Transmission in Georgia

Upon receiving a request for assistance, WS conducts site visits and evaluates damage caused by various mammals on properties and facilities owned or managed by the TVA. Once WS' evaluation is complete and mammal damage is addressed through technical assistance or direct operational activities, each damage site then becomes part of a monitoring schedule for animal damage. Periodic monitoring of those known damage sites allows WS to better manage animal damage issues for the TVA by quickly identifying the repopulation of mammals that has caused specific damage in the past, identifying signs that damage is about to occur again (*e.g.*, woodchucks may open up burrows), and addressing the target species prior to damage occurring. Direct operational activities may consist of utilizing body-grip traps and padded foothold traps to remove woodchucks burrowing in earthen levees or flooding sensitive areas. Activities could include live traps to capture mammals, such as raccoons, fox, and skunks that pose threats to power transmission by chewing, denning, or otherwise shorting out electrical circuits. Assistance could include identifying species and installing exclusion mechanisms to keep bats from roosting in high human traffic areas of power production facilities or removing aggressive mammals that threaten TVA personnel safety or are depredating on protected T&E species that are nesting on property owned or managed by the TVA.

Management of Feral Swine in Georgia

WS evaluates agricultural damage or disease transmission caused by feral swine. Direct operational activities consist of various lethal removal techniques, including corral trapping, snaring, and shooting. In some cases, WS works with adjoining landowners to establish large cooperative relationships suitable for aerial operations to pursue feral swine with aircraft. WS' personnel demonstrate techniques for excluding feral swine from specific areas and utilize harassment techniques to provide time for agricultural crops to mature and become less attractive.

Management of Aquatic Rodents in Georgia

WS conducts site visits and evaluates damage caused by aquatic rodents when requested. WS' personnel provide technical assistance and demonstration of techniques available for use by the requester. Direct operational activities may consist of utilizing cable devices, body grip traps and foothold traps to remove the rodents causing damage. WS' personnel then determine if beaver dams can be removed in accordance with the CWA (see Appendix E). Once the determination that dam removal is appropriate and legal, it is conducted manually or when safe and appropriate, with use of explosives. In some instances, WS' personnel install hardware cloth to protect specific trees most susceptible to loss by beavers or install water flow devices to maintain water levels at appropriate levels instead of lethally removing beaver colonies.

Management of Domestic and Exotic Mammals in Georgia

Upon request for assistance, WS participates in emergency response situations where there is a need to capture or lethally control domestic or exotic mammals due to natural disasters, accidental releases, or disease outbreaks. Direct operational activities include various lethal and non-lethal removal techniques, including corral trapping, snaring and shooting from both ground and aircraft. While these cases are rare, WS' personnel are specially trained to respond to emergency response situations and have the skills and tools necessary to complement and support efforts of various state agencies that would take the lead in responding to these situations.

Educational Efforts

Education is an important element of activities because animal damage management is about finding balance and coexistence between the needs of people and needs of animals. This is extremely challenging as nature has no balance, but rather is in continual flux. In addition to the routine dissemination of recommendations and information to individuals or organizations, 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, WS' employees would continue to write technical papers and provide presentations at professional meetings and conferences so that other wildlife professionals and the public are aware of recent developments in damage management technology, programs, laws and regulations, and agency policies.

Research and Development

The National Wildlife Research Center (NWRC) functions as the research unit of WS by providing scientific information and the development of methods for animal damage management, which are effective and environmentally responsible. Research biologists with the NWRC work closely with wildlife managers, researchers, and others to develop and evaluate methods and techniques for managing animal damage. For example, research biologists from the NWRC were involved with developing and evaluating the reproductive inhibitor known under the trade name of GonaCon™. Research biologists with the NWRC have authored hundreds of scientific publications and reports based on research conducted involving animals and methods.

WS' Decision Making Procedures

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 damage complaints. 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 animal damage consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions, including WS.

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

1. **Receive Request for Assistance:** WS would only provide assistance after receiving a request for such assistance. WS would not respond to public bid notices.
2. **Assess Problem:** First, WS would make a determination as to whether the assistance request was within the authority of WS. If an assistance request were within the authority of WS, WS' employees would gather and analyze damage information to determine applicable factors, such as what species was responsible for the damage, the type of damage, the extent of damage, and the magnitude of damage. Other factors that WS' employees could gather and analyze would include the current economic loss or current threat (*e.g.*, threat to human safety), the potential for future losses or damage, the local history of damage, and what management methods, if any, were used to reduce past damage and the results of those actions.

3. **Evaluate Management Methods:** Once a problem assessment was completed, a WS' employee would conduct an evaluation of available management methods. The employee would evaluate available methods in the context of their legal and administrative availability and their acceptability based on 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, such as aquatic rodents burrowing into levees where non-lethal methods (*e.g.*, rip-rap) were not possible or practical.

Community-based Decision Making

WS could receive requests for assistance from community leaders and/or representatives. In those situations, the WS program in Georgia, under this alternative, would follow the "*co-managerial approach*" to solve animal 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 mammals and effective, practical, and reasonable methods available to the local decision-maker(s) to reduce damage or threats. This could include non-lethal and lethal methods. WS and other state and federal wildlife management agencies may facilitate discussions at local community meetings when resources were available. Under this approach, resource owners within a community and other community members directly or indirectly affected by mammal damage or the management of damage would have direct input into the resolution of such problems. They may implement management recommendations provided by WS or others, or may request direct operational assistance from WS, other wildlife management agencies, local animal control agencies, private businesses, or seek no further assistance.

The community representative(s) and/or decision-maker(s) for the local community would be elected officials or representatives of the communities. The community representative(s) and/or decision-maker(s) who oversee the interests and business of the local community would generally be residents of the local community or appointees that other members of the community popularly elected. 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 building owners may not indicate whether the business must manage animal damage themselves, or seek approval to manage animals 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). Under a community based decision-making process, WS could provide information, demonstration, and discussion on available methods to the appropriate representative(s) of the community and/or community decision-maker(s) that requested assistance, which would help ensure that decisions made by representatives of the community and/or the decision-makers were based on community-based input. WS would only provide direct operational assistance if the local community representative(s) and/or decision-maker(s) requested such assistance and only if the assistance requested was compatible with WS' recommendations.

By involving community representatives and/or community decision-makers in the process, WS could present information that would allow decisions on damage management to involve those individuals that the representatives and/or decision-maker(s) represent. As addressed in this EA, WS could provide technical assistance to the appropriate representative(s) and/or decision-maker(s), including demonstrations and presentation by WS at public meetings to allow for involvement of the community. Requests for assistance to manage damage caused by mammals often originate from the decision-maker(s) based on community feedback or from concerns about damage or threats to human safety. As representatives of the community, the community representative(s) and/or decision-maker(s) would be able to provide the information to local interests either through technical assistance provided by WS or through demonstrations and presentations by WS on damage management activities. This process would allow WS, the community representative(s), and/or decision-maker(s) to make decisions on damage management activities based on local input. The community leaders could implement management recommendations provided by WS or others, or may request management assistance from WS, other wildlife management agencies, local animal control agencies, or private businesses or organizations.

Private Property Decision-makers

In the case of private property owners, the decision-maker is the individual that owns or manages the affected property. The decision-maker has 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. WS could provide direct operational assistance when requested; however, WS would only provide assistance if the requested management actions were in accordance with WS' recommendations.

Public Property Decision-makers

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 make recommendations to reduce damage. WS could provide direct operational assistance when requested; however, WS would only provide assistance if the requested management actions were in accordance with WS' recommendations.

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

Under this alternative, WS would provide those cooperators requesting assistance with technical assistance only. Similar to Alternative 1, WS could receive requests for assistance from community representatives, private individuals/businesses, or from public entities. Technical assistance would provide those cooperators experiencing damage or threats associated with mammals with information, demonstrations, and recommendations on available and appropriate methods. The implementation of methods and techniques to resolve 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). Technical assistance may be provided through a personal or telephone consultation, or during an on-site visit with the requester. Generally, WS' personnel would describe several management strategies to the requester for short and long-term solutions to managing damage. WS' personnel would base those strategies on the level of risk, need, and the practicality of their application. WS would use the Decision Model to recommend those methods and techniques available to the requester to manage damage and threats of 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.

Under Alternative 2, WS would recommend an integrated approach similar to Alternative 1 when receiving a request for assistance; however, WS would not provide direct operational assistance under this alternative. WS would give preference to non-lethal methods when practical and effective under this alternative (see WS Directive 2.101). WS would base method and technique recommendations on information provided by the individual(s) seeking assistance using the WS Decision Model. In some instances, animal-related information provided to the requester by WS would result in tolerance or acceptance of the situation. In other instances, WS would discuss and recommend damage management options. WS would only recommend or loan those methods legally available for use by the appropriate individual. Similar to Alternative 1, those methods described in Appendix B would be available to those persons experiencing damage or threats associated with mammals in the State; however, immobilizing drugs, euthanasia chemicals, GonaCon™ (deer only), and the use of aircraft would have limited availability to the public and other entities under this alternative and Alternative 3. The use of explosives to remove or breach beaver dams could also have limited availability under this alternative with availability based on the number of entities qualified and capable of using explosives to remove beaver dams. The EPA has designated zinc phosphide and aluminum phosphide as a restricted use pesticide. Therefore, only persons that have completed the requirements for obtaining a pesticide applicators license issued by the GDA could purchase those restricted use pesticides and only licensed pesticide applicators could use those products or people under their supervision.

Licensed veterinarians or people under their supervision would be the only entities that could use immobilizing drugs and euthanasia chemicals. Under this alternative, the reproductive inhibitor available under the trade name of GonaCon™ would only be available for use by the GDNR or those persons under the supervision of the GDNR. At the time this EA was developed, GonaCon™ was not registered for use in the State. The availability of aircraft would also be limited, especially shooting from an aircraft. Shooting from an aircraft by entities other than WS to alleviate damage or threats of damage would require authorization from the GDNR.

The WS program in the State regularly provides technical assistance to individuals, organizations, and other federal, state, and local government agencies for managing mammal damage. Technical assistance would include collecting information about the species involved, the extent of the damage, and previous methods that the cooperator had attempted to resolve the problem. WS would then provide information on appropriate methods that the cooperator could consider to resolve 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 2010 and FY 2015, WS has conducted 1,443 technical assistance projects that involved mammal damage to agricultural resources, property, natural resources, and threats to human safety.

This alternative would place the immediate burden of operational damage management work on the resource owner, other governmental agencies, and/or private businesses. Those persons experiencing damage or were concerned with threats posed by mammals 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 resolve or prevent mammal damage as permitted by federal, state, and local laws and regulations or those persons could take no action.

Alternative 3 – No Mammal Damage Management Conducted by WS

This alternative would preclude all activities by WS to reduce threats to human health and safety, and to alleviate damage to agricultural resources, property, and natural resources. WS would not provide assistance with any aspect of managing damage caused by mammal species in the State. WS would refer all requests for assistance to resolve damage caused by mammals to the GDNR, other governmental agencies, and/or private entities.

Despite no involvement by WS in resolving damage and threats associated with mammals in the State, those persons experiencing damage caused by mammals could continue to resolve damage by employing those methods legally available since the removal of mammals to alleviate damage or threats could occur despite the lack of involvement by WS. The removal of mammals by a property owner or another entity could occur after authorization by the GDNR, when required, and during the hunting and/or trapping seasons. The GDNR does not consider feral swine, beaver, coyotes, armadillos, and woodchucks as protected non-game species; therefore, people can lethally remove those species at any time when they are causing damage (GDNR 2016*a*). In addition, property owners or managers experiencing damage could request assistance from other entities (*e.g.*, private trappers, private business).

Similar to Alternative 2, those methods described in Appendix B would generally be available to those people experiencing damage or threats associated with mammals in the State; however, GonaCon™ (deer only), immobilizing drugs, euthanasia chemicals, and the use of aircraft would have limited availability to the public and other entities under this alternative. The use of explosives to remove or breach beaver dams could also have limited availability under this alternative with availability based on the number of entities qualified and capable of using explosives to remove beaver dams. Licensed veterinarians or people under their supervision would be the only entities that could use immobilizing drugs and euthanasia chemicals. The availability of aircraft would also be limited, especially shooting from an aircraft. Shooting from an aircraft by entities other than WS to alleviate damage or threats of damage would require authorization from the GDNR. Under this alternative, the reproductive inhibitor available under the trade name of GonaCon™ would only be available for use by the GDNR or those persons under the supervision of the GDNR. At the time this EA was developed, GonaCon™ was not registered for use in the State. The EPA has designated zinc phosphide and aluminum phosphide as a restricted use pesticide. Therefore, only persons that have completed the requirements for obtaining a pesticide applicators license issued by the GDA could purchase those restricted use products and only licensed pesticide applicators could use those products or people under their supervision.

Those people experiencing damage or threats of damage could contact WS; however, WS would immediately refer the requester to the GDNR and/or to other entities. The requester could contact other entities for information and assistance with managing damage, could take actions to alleviate damage themselves without contacting any entity, or could take no further action.

3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

In addition to those alternatives analyzed in detail, WS and the TVA identified several additional alternatives. However, those alternatives will not receive detailed analyses for the reasons provided. Those alternatives considered but not analyzed in detail include the following.

Non-lethal Methods Implemented 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 mammals in the State. If the use of non-lethal methods failed to resolve the damage situation or reduce threats to human safety at each damage situation, WS could employ lethal methods to resolve the request. WS would apply non-lethal methods 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 other entities or by those persons experiencing mammal damage but would only prevent the use of those methods by WS until WS had employed non-lethal methods.

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 requester diligence 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, WS could only evaluate the presence or absence of non-lethal methods. The proposed action alternative (Alternative 1) and the technical assistance only alternative (Alternative 2) would be similar to a non-lethal before lethal alternative because WS would give preference to the use of non-lethal methods before lethal methods (see WS Directive 2.101). Adding a non-lethal before lethal alternative and the associated analysis would not contribute additional information to the analyses in the EA.

Use of Non-lethal Methods Only by WS

Under this alternative, WS would be required to implement non-lethal methods only to resolve damage caused by mammals in the State. WS would only employ those methods discussed in Appendix B that were non-lethal. No intentional lethal removal of mammals would occur by WS. The use of lethal methods could continue under this alternative by other entities or by those persons experiencing damage by mammals. The non-lethal methods used or recommended by WS under this alternative would be identical to those non-lethal methods identified in any of the alternatives.

In situations where non-lethal methods were impractical or ineffective to alleviate damages, WS could refer requests for information regarding lethal methods to the GDNR, other governmental agencies, local animal control agencies, private businesses, or other entities.

Property owners or managers could conduct management using any method that was legal. 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 mammal damage management techniques 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 was necessary, which could then become hazardous and pose threats to the safety of people and non-target species.

Using an integrated methods approach, Alternative 1 incorporates the use of non-lethal methods when addressing requests for assistance. In those instances where non-lethal methods would effectively resolve damage from mammals, WS would use or recommend those methods under Alternative 1. Since non-lethal methods would be available for use under the alternatives analyzed in detail, this alternative would not add to the analyses. Those persons experiencing damage or threats of damage could lethally remove mammals under any of the alternatives even if WS was limited to using non-lethal methods only.

Use of Lethal Methods Only by WS

This alternative would require the use of lethal methods only to reduce threats and damage associated with mammals. However, non-lethal methods can be effective in preventing damage in certain instances. For example, exclusion methods can be effective at preventing beaver from chewing on and felling trees. The use of one-way exclusion devices can be effective at allowing bats to exit a structure but prevent re-entry. Once bats have exited the structure, structural repairs could be completed to prevent re-entry of bats. In those situations where damage could be alleviated effectively using non-lethal methods, WS would employ or recommend those methods as determined by the WS Decision Model. Under WS Directive 2.101, WS must consider the use of non-lethal methods before lethal methods. Therefore, WS did not consider this alternative in detail.

Live-capture and Translocation of Mammals Only

Under this alternative, WS would address all requests for assistance using live-capture methods or the recommendation of live-capture methods and WS would translocate all target mammals live-captured. Mammals could be live-captured using immobilizing drugs, cage traps, foothold traps, cable devices, cannon nets, or rocket nets and WS would translocate those mammals to appropriate habitat for release. The success of translocation efforts would depend on efficiently capturing the target mammals causing damage and the existence of an appropriate release site (Nielsen 1988). Translocation sites would be identified and have to be approved by the GDNR and/or the property owner where the translocated mammals would be placed prior to live-capture and translocation. Live-capture and translocation of mammals could be conducted as part of the alternatives analyzed in detail. However, the translocation of mammals could only occur under the authority of the GDNR. Therefore, the translocation of mammals by WS would only occur as directed by the GDNR. When requested by the GDNR, WS could translocate mammals or recommend translocation under any of the alternatives analyzed in detail, except under the no involvement by WS alternative (Alternative 3). However, other entities could translocate mammals under Alternative 3, if authorized by the GDNR.

Translocation may be appropriate in some situations when the population of a species is low. However, target mammal species identified in Section 1.1 are generally abundant in much of the suitable habitat in Georgia, and translocation is not necessary for the maintenance of viable populations for those species in the State. Because those mammal species are abundant in Georgia, the mammals that WS translocated and released into suitable habitat would likely encounter other mammals of the same species with established territories. For example, if the GDNR authorized WS to translocate a beaver, the release of the beaver into suitable habitat would likely occur in areas where other beaver already occur. Beaver are territorial, and introducing a translocated beaver into a new area often disorientates the beaver because they are unfamiliar with their surroundings. Therefore, a translocated beaver would often be at a disadvantage. Territorial beaver often viciously attack other beaver that people release or that wander into their territories and those injuries sustained during those attacks oftentimes causes the death of translocated beaver (McNeely 1995). Survival of translocated animals is generally very poor due to the stress of translocation, and in many cases, released animals suffer mortality in a new environment (Craven et al. 1998, Petro et al. 2015). Courcelles and Nault (1983) found that 50% (n=10) of radio-collared, relocated beaver died, probably from stress or predation resulting from the relocation. Of the 30 beaver radio-tagged by Petro et al. (2015) in Oregon, eight died within 30 days of release and four died within 90 days of release, with predation and disease/illness being the primary cause of death. Petro et al. (2015) found that most predation on relocated beaver occurred during the first week after release.

Relocated beaver also may disperse long distances from the release site (Novak 1987). Only 12% of beaver relocated on streams and 33% of beaver relocated on lake and pothole areas remained at the release site (Knudsen and Hale 1965). Hibbard (1958) recorded an average dispersal distance by 17 relocated beaver to be approximately 9 miles in North Dakota, and Denney (1952) reported an average dispersal of 10.4 miles and a maximum dispersal of 30 miles for 26 beaver transplanted in Colorado. Beaver relocated on streams and later recaptured (n=200) moved an average distance of 4.6 miles, and in lake and pothole relocations (n=272) moved an average of 2 miles (Knudsen and Hale 1965). Of 114 beaver relocated in Wyoming, McKinstry and Anderson (2002) found that 51% of the beaver moved more than 6.2 miles from their release site. Petro et al. (2015) found relocated beaver in Oregon traveled a mean distance of nearly 2.1 stream miles within 16 weeks post-release, with the longest dispersal distance being 18.1 stream miles from the release site.

Generally, translocating mammals following live-capture that have caused damage would not be effective or cost-effective. Translocation is generally ineffective because mammal species are highly mobile and can easily return to damage sites from long distances, mammals generally already occupy habitats in other areas, and translocation could result in damage problems at the new location. For example, a property owner may give permission to relocate beaver to their property; however, since beaver are likely to disperse from their release site, they may cross several landowner boundaries during their dispersal, which entities must consider during efforts to translocate beaver (Petro et al. 2015). Live-trapping and translocating mammals is biologically unsound and not cost-efficient (Wade and Ramsey 1986). Translocation of animals is also discouraged by WS policy (see WS Directive 2.501) because of the stress to the translocated animals, poor survival rates, threat of spreading diseases, and the difficulties that translocated animals have with adapting to new locations or habitats (Nielsen 1988). Since WS does not have the authority to translocate mammals in the State, unless authorized by the GDNR, WS, and the TVA did not consider this alternative in detail.

Use of Non-lethal Methods and Approved Euthanasia Only

Under this alternative, WS would continue to employ an integrated methods approach but would only employ non-lethal methods to exclude, harass, or live-capture target mammal species. When deemed appropriate, WS could continue to remove target mammal species lethally; however, under this alternative, WS would only use methods that captured target mammals alive. Once live-captured, WS' personnel could euthanize target mammals using methods that meet the definition of euthanasia as defined by the AVMA. Under this alternative, the most common methods that would be available to live-capture target mammals would be certain cable devices, foothold traps, suitcase traps, and cage traps. Other non-lethal methods would also be available to resolve damage or threats of damage under this alternative and those methods would be similar to those non-lethal methods described under Alternative 1 (see Appendix B for a complete list).

Euthanasia methods would be restricted to those defined by the AVMA (2013) as acceptable or conditionally acceptable, and would include sodium pentobarbital, potassium chloride, carbon dioxide, and firearms (once live-captured). This alternative would be similar to Alternative 1 since WS would give preference to the use of non-lethal methods when practical and effective (see WS Directive 2.101). In addition, WS' personnel would be familiar with the euthanasia methods described by the AVMA and would use those methods to euthanize captured or restrained animals, whenever practicable (see WS Directive 2.430, WS Directive 2.505). Therefore, WS did not consider this alternative in detail.

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

Under this alternative, the only method that would be available to resolve requests for assistance by WS would be the recommendation and the use of reproductive inhibitors to reduce or prevent reproduction in mammals responsible for causing damage. Wildlife professionals often consider reproductive inhibitors for use where animal populations are overabundant and where traditional hunting or lethal control programs were not publicly acceptable (Muller et al. 1997). 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, and other factors often limit the use and effectiveness of reproductive control as a tool for animal population management.

Reproductive control for animals could occur through sterilization (permanent) or contraception (reversible). Sterilization could be accomplished through: 1) surgical sterilization (vasectomy, castration, and tubal ligation), 2) chemosterilization, and 3) through gene therapy. Contraception could be accomplished through: 1) hormone implantation (synthetic steroids such as progestins), 2) immunocontraception (contraceptive vaccines), and 3) oral contraception (progestin administered daily).

Population modeling indicates that reproductive control is more efficient 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 reproduction control technologies as a wildlife management tool for some species.

Novak (1987) conducted a review of research evaluating chemically induced and surgically induced reproductive inhibition as a method for controlling beaver populations. Research on several reproductive inhibitors proposed for use in beaver population reduction has occurred, including research on quinestrol (17-alpha-ethynyl-estradiol-3-cyclopentylether) and mestranol (Gordon and Arner 1976, Wesley 1978). The use of chemosterilants as a means of managing the reproductive output of beaver has been successful in controlled experiments (Davis 1961, Arner 1964). However, while evidence suggests chemosterilants could reduce beaver reproduction in controlled experiments, no practical and effective method for distributing chemosterilants in a consistent way to wild, free ranging beaver populations has been developed or proven (Hill et al. 1978, Wesley 1978). Although those methods were effective in reducing beaver reproduction by up to 50%, those methods were not practical or too expensive for large-scale application. Inhibition of reproduction also may affect behavior, physiological mechanisms, and colony integrity (Brooks et al. 1980). Additionally, reproductive control does not alleviate current damage problems (Organ et al. 1996).

Bromley and Gese (2001*a*, 2001*b*) conducted studies to determine if surgically sterilized coyotes would maintain territories and pair bond behavior characteristics of unsterilized coyotes, and if predation rates by sterilized coyote pairs would decrease. The results indicated that behaviorally, sterile coyote pairs appeared to be no different from unsterilized pairs, except for predation rates on lambs. Unsterilized coyote packs were six times more likely to prey on sheep than were sterilized packs (Bromley and Gese 2001*b*). Bromley and Gese (2001*b*) believed this occurred because sterile packs did not have to provision pups and food demands were lower. Therefore, sterilization could be an effective method to reduce lamb predation if wildlife professionals could capture and sterilize enough coyote breeding pairs. Bromley and Gese (2001*a*, 2001*b*) captured as many coyotes as possible from all packs on their study area and controlled coyote exploitation (mortality) on their study area. During their studies, Bromley and Gese (2001*a*, 2001*b*) found survival rates for coyotes in the unexploited study area were similar to those survival rates reported for mostly unexploited wild coyote populations. Seidler and Gese (2012) found similar results. Bromley and Gese (2001*b*) concluded a more effective and economical method of sterilizing resident coyotes was needed to make sterilization a practical management tool on a larger scale.

Currently, chemical reproductive inhibitors are not available for use to manage most mammal populations. Given the costs associated with live-capturing and performing sterilization procedures on mammals and the lack of availability of chemical reproductive inhibitors for the management of most mammal populations, this alternative was not evaluated in detail. If reproductive inhibitors become available to manage a large number of mammal populations and if an inhibitor has proven effective in reducing localized mammal populations, WS could evaluate the use of the inhibitor as a method available to manage damage. Currently, the only reproductive inhibitor that is registered with the EPA is GonaCon™, which is registered for use on white-tailed deer only. However, GonaCon™ was not registered for use in the State during the development of this EA. Reproductive inhibitors for the other mammal species addressed in this EA do not currently exist.

Compensation for Mammal Damage

The compensation alternative would require WS to establish a system to reimburse persons impacted by mammal damage and to seek funding for the program. 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. Evaluation of this alternative indicates that a compensation only alternative has many drawbacks. Compensation would require large expenditures of money and labor to investigate and validate all damage claims, and to determine and administer appropriate compensation. Compensation most likely would be below full market value and would give little incentive to resource owners to limit damage through improved cultural or other practices and management strategies. In addition, providing compensation would not be practical for reducing threats to human health and safety.

Short Term Eradication and Long Term Population Suppression

An eradication alternative would direct all WS' program efforts toward total long-term elimination of mammal populations wherever a person initiated a cooperative program with WS in Georgia. Eradication of native mammal species is not a desired population management goal of state agencies or WS. WS and the TVA did not consider eradication as a general strategy for managing mammal damage because WS, the TVA, the GDNR, and other agencies with interest in, or jurisdiction over, wildlife oppose eradication of any native wildlife species and eradication is not acceptable to most people.

Suppression would direct WS' program efforts toward managed reduction of certain problem populations or groups. In areas where WS could attribute damage to localized populations of mammals, WS could decide to implement local population suppression using the WS Decision Model. However, large-scale population suppression would not be realistic or practical to consider as the basis of the WS program. Problems with the concept of suppression would be similar to those described above for eradication. Typically, WS would conduct activities on a very small portion of the sites or areas inhabited or frequented by problem species in the State.

Establishment of a Bounty System

Most wildlife professionals have not supported payment of funds (bounties) for removing animals suspected of causing damage, or posing threats of damage, for many years (Latham 1960). WS concurs because of several inherent drawbacks and inadequacies in the payment of bounties. Bounties are often ineffective at controlling damage over a wide area, such as across the entire State. The circumstances surrounding the removal of animals are typically unknown and completely unregulated because it is difficult or impossible to assure people did not remove animals claimed for bounty from outside the area where damage was occurring. In addition, WS does not have the authority to establish a bounty program.

Trap-Neuter-Release Program for Feral and Free-ranging Cats and/or Dogs

This topic has undergone considerable debate in animal welfare and scientific communities for a number of years. The debate focuses on whether controlling feral, free-ranging, or invasive animal populations through Trap-Neuter-Release (TNR) programs are effective and alleviate problems (*i.e*., diseases, predation, agricultural damage, and human safety).

Theoretically, TNR programs would work if all animals of one sex or both were sterilized. However, the probability of controlling invasive species in the wild with this technique would not currently be reasonable, especially with many feral animals being self-sufficient and not reliant on people to survive. Additionally, some individuals within a population can be trap-shy. Capturing or removing trap-shy individuals often requires implementing other methods.

Of major concern would be the potential for disease and parasite transmission to people from direct contact during either sterilization or the risk of exposure after the animal was released. Once live-captured, performing sterilization procedures during field operations on anesthetized animals could be difficult. Sanitary conditions could be difficult to maintain when performing surgical procedures in field conditions. To perform operations under appropriate conditions, live-captured animals would need to be transported from the capture site to an appropriate facility, which could increase the threat from handling and transporting the animal. A mobile facility could be used; however, a mobile facility would still require additional handling and transporting of the live-captured animal to the facility. Once the surgical procedure was completed, the animal would have to be held to ensure recovery and transported back to the area where capture occurred.

TNR programs are often not as successful as desired and needed to reduce immediate threats posed by animals, especially when human safety is a concern (AVMA 2003, Barrows 2004, Levy and Crawford 2004, Jessup 2004, Winter 2004, AVMA 2014). Feral animals subjected to a TNR program would continue to cause the same problems[14] they caused before the TNR program was initiated because of slow attrition. TNR programs can take a decade or longer to reduce target species populations (Barrows 2004, Winter 2004), especially when acute issues need rapid solutions (Levy and Crawford 2004, Stoskopf and Nutter 2004). Several studies report that target species' populations often remain stable or increase following TNR programs due to immigration and reproduction from other members of the groups (Castillo and Clarke 2003, Levy and Crawford 2004, Winter 2004) with little to no resolution of threats to human safety or damages (Barrows 2004, Slater 2004, Winter 2004).

Other concerns arise when considering the legality of TNR programs given the documented damage caused by target species, especially to native wildlife (Barrows 2004, Levy and Crawford 2004, Jessup 2004). Some people have questioned whether TNR programs are violating the Migratory Bird Treaty Act and the ESA because released animals may continue to kill migratory birds and/or endangered species (Barrows 2004, Levy and Crawford 2004, Jessup 2004). Because of the continued threat to human safety created by TNR programs and the continued threat to T&E wildlife and native wildlife in general, this alternative was not considered further.

3.3 STANDARD OPERATING PROCEDURES FOR MAMMAL DAMAGE MANAGEMENT

SOPs improve the safety, selectivity, and efficacy of activities intended to resolve animal damage. The WS program in Georgia uses many such SOPs. WS' personnel would incorporate those SOPs into activities under the appropriate alternatives when addressing mammal damage and threats in the State.

Some key SOPs pertinent to resolving mammal damage in the State include the following:

[14] Brickner (2003), Levy et al. (2003), Barrows (2004), and Jessup (2004) reported that sterilized cats that do not spend any time on courting and mating are left with more time to hunt than non-sterilized cats and therefore, continue to remain as potential reservoirs of animal and human disease, a social nuisance, and continue to hunt and kill protected species.

- WS’ personnel would consistently use and apply the WS Decision Model to identify effective strategies to managing damage and the potential effects of those strategies when addressing mammal damage.

- WS’ personnel would follow the EPA-approved label directions for all pesticide use. The intent of the registration process for chemical pesticides is to assure minimal adverse effects occur to the environment when people use the chemicals in accordance with label directions.

- WS’ personnel would use immobilizing drugs and euthanasia chemicals according to the United States Drug Enforcement Administration, United States Food and Drug Administration, and WS’ directives and procedures.

- WS’ personnel would only use controlled substances registered with the United States Drug Enforcement Administration or the United States Food and Drug Administration.

- WS’ employees would follow approved procedures outlined in the WS’ Field Manual for the Operational Use of Immobilizing and Euthanizing Drugs (Johnson et al. 2001).

- WS’ employees that use controlled substances would receive training to use those substances and would receive certification to use controlled substances.

- WS’ employees who use pesticides and controlled substances would participate in State-approved continuing education to keep current of developments and maintain their certifications.

- Pesticide and controlled substance use, storage, and disposal would conform to label instructions and other applicable laws and regulations, and Executive Order 12898.

- WS’ personnel involved with specific damage management activities would receive appropriate Material Safety Data Sheets for pesticides and controlled substances.

- All personnel who use firearms would receive safety training according to WS’ Directives.

- WS’ employees participating in any aspect of aerial operations would receive training and certification in their role and responsibilities during the operations. All WS’ personnel would follow the policies and directives set forth in WS’ Directive 2.620; WS’ Aviation Operations Manual; WS’ Aviation Safety Manual and its amendments; Title 14 CFR; and Federal Aviation Regulations, Part 43, 61, 91, 119, 133, 135, and 137.

- WS’ employees would consider the use of non-lethal methods prior to the use of lethal methods when managing mammal damage.

- The removal of mammals by WS under Alternative 1 would only occur when authorized by the GDNR, when applicable, and only at levels authorized.

- WS’ employees would direct management actions toward localized populations, individuals, or groups of target species. WS would not conduct generalized population suppression across the entire State, or even across major portions of Georgia.

- WS’ personnel would dispose of carcasses retrieved after damage management activities in accordance with WS Directive 2.515. If WS’ personnel were directly involved with carcass burial (*i.e.*, WS' personnel physically or mechanically digging a hole in the ground to bury carcasses), siting decisions would occur after WS consulted with the Historic Preservation Division within the GDNR or the affected tribal authorities to avoid adverse effects on cultural/historic resources. If WS' personnel discovered cultural resources or artifacts during the burial of carcasses, WS would cease operations and contact the Historic Preservation Division or appropriate tribal authorities. However, WS' personnel rarely, if ever, are directly involved with the burial of carcasses in Georgia.

- WS' employees would release non-target animals live-captured in traps unless it was determined that the animal would not survive and/or that the animal could not be released safely.

- WS would use non-lead ammunition within the constraints of availability, performance, and safety.

- The use of all traps, cable devices, and other capture devices by WS' personnel would adhere to WS Directive 2.450.

- WS' personnel would handle all requests for assistance associated with feral dogs in accordance with the Georgia WS Feral Dog policy and WS Directive 2.340.

3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES

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

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

- Lethal removal would only occur by WS when authorized by the GDNR, when required, and only at levels authorized.

- WS would monitor the lethal removal of target mammals to evaluate population trends and to evaluate the magnitude of WS' removal of mammals 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.

- WS' personnel would use the WS Decision Model, designed to identify the most appropriate damage management strategies and their impacts to determine strategies for resolving mammal damage.

- WS would monitor activities under the selected alternative to ensure activities do not adversely affect mammal populations in the State.

- WS would provide the GDNR with information on WS' removal of target mammals to alleviate damage, which would ensure the GDNR has the opportunity to consider WS' removal as part of management objectives for mammal species in the State.

- WS' personnel would give preference to non-lethal methods when practical and effective.

Issue 2 - Effects of Activities on the Populations of Non-target Animals, Including T&E Species

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

- As appropriate, WS' personnel would use suppressed firearms to minimize the noise associated with the discharge of a firearm.

- Personnel would use lures, trap placements, and capture devices that employees would strategically place at locations likely to capture a target animal and minimize the potential of non-target animal captures.

- WS' personnel would release any non-target animals live-captured in cage traps, nets, or any other restraining device whenever it was possible and safe to do so.

- WS' personnel would check methods in accordance with WS Directive 2.210 and WS Directive 2.450. Personnel would directly monitor some live-capture methods (*e.g.*, drops nets, cannon nets, immobilizing drugs administered through a dart gun), which ensures that personnel could release non-target species quickly, if captured. In most cases, WS' personnel would check other live-traps (*e.g.*, cage traps, foothold traps, restraining cables), which do not require direct monitoring, at least once a day or in accordance with Georgia laws and regulations. Checking traps frequently would help ensure that WS' personnel could release live-captured non-target species in a timely manner.

- WS' employees would dispose of mammal carcasses retrieved after conducting damage management activities in accordance with WS Directive 2.515.

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

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

- WS' personnel would review all projects proposed for implementation for potential to take[15] bald eagles in accordance with the provisions of the Bald and Golden Eagle Protection Act. If WS' personnel identify potential risks of take, WS would work with the USFWS on measures to reduce risks and the need for a non-purposeful take permit.

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

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

[15]The Bald and Golden Eagle Protection Act defines "*take*" as "*pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb*." Disturb is defined as any activity that can result in injury to an eagle, or cause nest abandonment or decrease in productivity by impacting breeding, feeding, or sheltering behavior.

- WS' personnel would conduct shooting during times when public activity and access to the control areas were restricted, when possible. Personnel involved in shooting operations would receive training in the proper and safe application of this method.

- To provide procedures and accountability for WS' use of explosives to remove beaver dams, WS' employees would adhere to WS Directive 2.435.

- All personnel employing chemical methods would receive proper training and certification 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 Directive 2.401 and WS Directive 2.430 outline WS' use of chemicals and training requirements to use those chemicals.

- All chemical methods used by WS or recommended by WS would be registered with the EPA, the United States Drug Enforcement Administration, the United States Food and Drug Administration, and/or the GDA, as appropriate.

- When using immobilizing drugs for the capture of mammals, WS would adhere to all established withdrawal times for mammals established through consultation with the GDNR and veterinarian authorities. Although unlikely, in the event that WS was requested to immobilize mammals during a time when harvest of those mammal species was occurring or during a time where the withdrawal period could overlap with the start of a harvest season, WS would euthanize the animal or mark the animal with a tag. Tags would be labeled with a "*do not eat*" warning and appropriate contact information.

- WS' personnel would dispose of mammal carcasses retrieved after damage management activities in accordance with WS Directive 2.515.

- As allowed by law, WS' personnel would provide information about food safety and the safe handling of carcasses to reduce risks to landowners that prefer to retain feral swine carcasses or other animal carcass killed on their property for personal use (see WS Directive 2.510). Therefore, providing information about food safety and the safe handling of carcasses would minimize risks to human safety by emphasizing precautions for safe handling and preparation/consumption. In addition, WS' personnel would advise landowners to avoid feeding uncooked meat or other carcass products to pets or other animals.

Issue 4 - Effects of Mammal Damage Management Activities on the Aesthetic Value of Mammals

- WS' personnel would direct management actions to reduce or prevent damage caused by mammals 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.

- WS and the entity requesting assistance would agree upon all methods or techniques applied to resolve damage or threats to human safety by signing a work initiation document, MOU, or comparable document prior to the implementation of those methods.

- WS' personnel would give preference to non-lethal methods when practical and effective.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

- WS' Personnel would receive training in the latest and most humane devices/methods for removing target mammals causing damage.

- WS' personnel would check methods in accordance with WS Directive 2.210 and WS Directive 2.450. Personnel would directly monitor some live-capture methods (*e.g*., drops nets, cannon nets, immobilizing drugs administered through a dart gun), which ensures that personnel could release non-target species quickly, if captured. In most cases, WS' personnel would check other live-traps (*e.g*., cage traps, foothold traps, restraining cables), which do not require direct monitoring, at least once a day or in accordance with Georgia laws and regulations. Checking traps frequently would help ensure that personnel could release live-captured non-target species in a timely manner.

- When deemed appropriate using the WS Decision Model, WS' use of lethal methods would comply with WS' directives (*e.g*., see WS Directive 2.401, WS Directive 2.430, WS Directive 2.505).

- The NWRC is continually conducting research to improve the selectivity and humaneness of animal damage management devices used by personnel in the field.

- WS' personnel would consider the use of non-lethal methods prior to the use of lethal methods when managing mammal damage.

Issue 6 – Effects of Beaver Removal and Dam Manipulation on the Status of Wetlands in the State

- WS' personnel would remove beaver dams in accordance with federal and state laws and regulations for environmental protection. WS would conduct beaver dam removal to restore drainage or the stream channel for an area that has not become an established wetland.

- Upon receiving a request to remove beaver dams, WS would visually inspect the dam and the associated water impoundment to determine if characteristics exist at the site that would meet the definition of a wetland under section 404 of the CWA (40 CFR 232.2; see Issue 6 in Section 2.2 of this EA). If wetland conditions were present at the site, WS would notify the entities requesting assistance that a permit might be required to remove the dam and to seek guidance from the Environmental Protection Division within the GDNR and the United States Army Corps of Engineers pursuant to Georgia State Law and the CWA.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions when 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 that alternative relates to the issues identified. The WS program does not expect the alternatives to affect soils, geology, minerals, water quality/quantity, flood plains, wetlands, designated critical habitats, visual resources, air quality, prime/unique farmlands, aquatic resources, timber, and range significantly. Therefore, no further analysis associated with those resources occurs.

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 proposed 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 (Alternative 1) 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 GDNR, and the GDA.

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

As discussed previously, the activities of WS and/or other entities to alleviate damage or threats of damage could potentially affect the population of a target mammal species. Methods available to address mammal damage or threats of damage in the State would be either lethal methods or non-lethal methods. Non-lethal methods could disperse, exclude, or otherwise make an area unattractive to target mammals that were causing damage, which would reduce the presence of those mammals at the site and potentially the immediate area around the site. The dispersal of target mammal species to other areas would have a minimal effect on those species' populations. WS would not employ non-lethal methods over large geographical areas or apply those methods 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. Non-lethal methods generally have minimal impacts on overall populations of animals since those methods do not reduce the number of individuals in a species' population. Therefore, the use of non-lethal methods that disperse, exclude, or otherwise make an area unattractive would not have adverse effects on mammal populations in the State under any of the alternatives.

Another non-lethal method that could be available under the alternatives would be the reproductive inhibitor under the trade name GonaCon™. Currently, GonaCon™ is only available for use to reduce fertility in female white-tailed deer. Reproductive inhibitors, including GonaCon™, induce a decline in a localized population by limiting reproductive output. A reduction in the population occurs when the number of animals recruited into the population cannot replace those individuals that die from other causes each year, which equates to a net loss in the number of individuals in the population and a reduction in the localized population. Although not generally considered a lethal method since no direct removal occurs, reproductive inhibitors can result in the reduction of a target species' population.

In addition to non-lethal methods, lethal methods would be available to alleviate mammal damage. The use of lethal methods by any entity to alleviate damage could result in local population reductions in the area where damage or threats were occurring by removing individual target animals from a population. In addition, several mammal species addressed in this EA maintain sufficient population densities to allow for annual harvest seasons that typically occur during the fall and winter. The GDNR is responsible for establishing and regulating hunting and trapping seasons in the State. Therefore, the harvest of those mammals during hunting and/or trapping seasons in the State would be occurring in addition to any removal that could occur to alleviate damage. A discussion of the potential impacts on the populations of target mammal species occurs below for each alternative.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

When an entity experiences damage or threats of damage associated with mammal species, they could seek assistance from WS, could seek assistance from other entities, could conduct activities to resolve damage themselves, and/or could take no action. If WS implements Alternative 1 and an entity requests assistance from WS, WS could continue the current program that integrates methods adaptively to resolve requests for assistance. When WS' personnel receive a request for assistance, they would respond initially by providing technical assistance. Technical assistance would provide those cooperators with information, demonstrations, and recommendations on available and appropriate methods that the requester could use or implement themselves 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).

When providing technical assistance, WS' personnel would only recommend those methods that were legally available for the requester to use. For example, some chemical methods may require that the purchaser and the applicator possess a restricted-use pesticide applicators license, such as aluminum phosphide for woodchucks. In those cases, WS' personnel would not recommend the use of aluminum phosphide to those entities that do not possess a restricted-use applicators license or would recommend the entity obtain the appropriate license before attempting to purchase and use the product.

Under this alternative, WS could also provide direct operational assistance when an entity requests such assistance. Direct operational assistance would include activities that WS' personnel conduct directly or activities that WS' employees supervise. Initiation of direct operational assistance could occur when the problem could not be effectively resolved through technical assistance alone. Before conducting any direct operational assistance, the entity requesting assistance and WS must sign a MOU, work initiation document, or another comparable document that includes the methods the requester would allow WS to use and gives WS permission to conduct the activities on property the requester owns or manages.

Using the WS Decision Model, 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 (see WS Directive 2.101, WS Directive 2.105, WS Directive 2.201). Following this evaluation, WS' employees would incorporate methods deemed practical for the situation into a damage management strategy. When providing direct operational assistance under this alternative, WS' personnel could use those methods discussed in Appendix B singularly or in combination to resolve and prevent damage associated with mammals in the State. After WS' employees implement this strategy, employees would continue to monitor and evaluate the strategy to assess effectiveness. Most efforts to resolve animal damage consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy.

As discussed previously, non-lethal methods that live-capture, disperse, exclude, or otherwise make an area unattractive to target mammals would have a minimal effect on those species' populations since those methods do not reduce the number of individuals in a species' population. WS would not employ non-lethal methods over large geographical areas or apply those methods 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. Therefore, the use of non-lethal methods would not have adverse effects on mammal populations in the State if WS implemented this alternative.

WS' employees would give preference to non-lethal methods when addressing requests for assistance under Alternative 1 (see WS Directive 2.101). However, WS' employees would not necessarily employ or recommend non-lethal methods to resolve every request for assistance if an employee deemed those methods to be inappropriate 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. In addition, some methods are not practical for WS' personnel to implement. Implementation of most non-lethal methods for livestock protection falls within the purview of the livestock producer (Knowlton et al. 1999). Making structural changes to roadways by installing over-sized culverts in areas where beaver may be present would be a method that WS could recommend; however, the requester would be responsible for installing the culvert and making structural changes.

Therefore, if WS implements Alternative 1, WS' personnel could use and/or recommend the use of lethal methods when they deem those methods to be appropriate using the WS Decision Model. Lethal methods would remove individual animals from a species population. If WS implements Alternative 1, the number of animals removed from a species' population annually by WS using lethal methods would be dependent on the number of requests for assistance received, the number of animals involved with the associated damage or threat, and the efficacy of methods employed. To evaluate the effects of WS' activities on a species' population from the implementation of Alternative 1 and the use of lethal methods, the analyses below for each species anticipates the number of individual animals that WS could remove annually to alleviate damage or threats of damage. WS based the anticipated number of animals that personnel could lethally remove annually on the number of animals involved with previous requests for assistance and in anticipation of additional efforts to manage damage or threats of damage in the future. In addition, the GDNR has management authority over wildlife species in the State; therefore, lethal removal of wildlife species by WS would only occur when authorized by the GDNR, when required, and only at levels authorized.

To evaluate the magnitude of WS' anticipated annual removal of individuals from the statewide population of each species, the analysis for each of the species compares the anticipated annual removal by WS to the statewide population of that species. However, the statewide population for most species is not currently available; therefore, the analyses below calculates a statewide population estimate for a species when information is available to calculate an estimate. The estimated statewide population for a species uses the best available information. Frequently, current reliable information is not available for a species; therefore, population estimates often use conservative calculations based upon habitat availability and a species use of those habitats. The analyses calculated habitat availability using the major land resource areas in Georgia from the USDA-Natural Resources Conservation Service (Natural Resources Conservation Service 2014).

The land of Georgia is approximately 57,513 square miles (United States Census Bureau 2011), which represents approximately 36.8 million acres of land. The Natural Resources Conservation Service (2014) defines eight major land resource areas in Georgia. Differing combinations of soil types, climate, water resources, land use, and types of agricultural use characterize each land resource area. Table 4.1 describes those land resource areas found in Georgia. The resource data presented in Table 4.1 serves as the basis for current population estimates as presented in each species' population information and effects analysis.

Population and density information specific to Georgia for many of the target species is not available and is unknown. Frequently, population information is not available for a species, but people can calculate conservative estimates based upon the density of a species, the availability of habitat, and a species use of the habitats available. To evaluate the potential impacts to a target species population and to evaluate the magnitude of the potential impacts from activities that WS could conduct when implementing Alternative 1, a statewide population estimate for many of the target species has been calculated using available information from published literature and other sources. The analyses primarily derived population estimates from available density data for individual species, when available, and the land classification most likely to contain that particular species. When density data was available, the analyses based the population estimates on those species occupying a certain percentage of the land classifications that likely represented suitable habitat for a particular species. Since information on actual populations and densities was not available for most target species in Georgia, the analyses calculated a statewide population estimate based on a species only occupying a certain percentage of the available habitat to estimate a minimum population or a worst-case scenario.

Table 4.1 – Major land resource areas in Georgia with definitions

Land Resource Area	Area in Georgia (mi^2)	Brief Description
Southern Appalachian Ridge	2,531	Hardwoods or mixed hardwoods and pines in the Appalachian Mountains of northwest Georgia
Sand Mountain	241	Mixed oak, hickory-pine, and oak-hickory forests of the Appalachian Mountains in extreme northwest Georgia
Southern Blue Ridge	2,734	Primarily hardwoods or mixed hardwoods and pines in the Appalachian Mountains of northeast Georgia
Southern Coastal Plain	22,362	Mixed oak-pine forest mixed with grassland and cropland as mountainous areas transition to the coastal plains
Southern Piedmont	17,387	Upland areas support hardwoods and pines mixed with grasslands and croplands in north central part of State
Carolina and Georgia Sand Hills	2,946	Narrow band across central Georgia dominated by longleaf pine mixed with pine-oak; most land area in farms
Atlantic Coast Flatwoods	8,042	Bottomland hardwood forest mixed with pine; primarily forested mixed with cropland in southeastern Georgia
Tidewater Area	2,694	Occurs in extreme southeastern Georgia along coast; upland areas consist of loblolly pine and some oaks; blackgum, sweetgum, oaks, water tupelo, and bald cypress dominate the bottomland areas; primarily forest and farmlands

For example, the analysis estimated the statewide population of gray fox based on the species occupying only 50% of the land area within the State, which excluded urban areas. Gray fox occur statewide in a variety of habitats, including urban areas, so gray fox occupying only 50% of the land area of the State is unlikely. However, similar to many of the target species, the analyses evaluated gray fox occupying only 50% of certain land classifications to evaluate potential impacts based on a worst-case scenario and a minimum population estimate. Once WS derived a population estimate for a species, WS compared the anticipated number of animals from a species' population that WS could lethally remove annually to the calculated statewide population estimate for a species to determine the magnitude of lethal removal.

In addition to the annual lethal removal that could occur from WS during damage management activities using lethal methods, people can harvest many of the target mammal species during annual hunting and/or trapping seasons in the State. To evaluate potential cumulative impacts, harvest data is also included in the effects analysis for many of the mammal species. An annual mail survey conducted by the GDNR is the basis for the current harvest data available in Georgia. The mail survey samples licensed hunters and/or trappers to obtain estimates of actual harvest. The GDNR estimates annual harvest on a representative sample of licensed hunters and/or trappers, which does not include those hunters/trappers that are not required to hold a license (*e.g.*, landowners hunting on their own property). In addition, the harvest estimates based on the mail survey do not include illegal harvest of mammals or mammals that people legally removed to alleviate damage. Therefore, each harvest estimates likely represents a value that deviates from the actual harvest. However, the harvest information based on the mail survey is the best available information. In addition, the analyses may use harvest information from the National Furbearer Harvest Statistics Database maintained by the Association of Fish and Wildlife Agencies (2016).

As discussed previously, the analysis to determine the magnitude of impact from lethal removal can be determined either quantitatively or qualitatively. Population estimates, allowable harvest levels, and actual harvest data are quantitative examples. Population trends and harvest trend data are qualitative examples. If WS implemented Alternative 1, WS would monitor annual removal that could occur to alleviate damage or threats of damage. WS would monitor the annual removal of target mammal species by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of removal remains below the level that would cause undesired adverse effects to the viability of native species' populations. The potential impacts on the populations of target mammal species from the implementation of Alternative 1 occur for each species below.

BAT POPULATION INFORMATION AND EFFECTS ANALYSIS

Among the 40 species of bats found north of Mexico, only a few cause problems for people. Bats that congregate into groups are colonial bats, while those bats that live alone are solitary bats. The colonial species most often encountered in and around buildings in the United States are the little brown myotis, the big brown bat, the Brazilian free-tailed bat, the evening bat, the pallid bat (*Antrozous pallidus*), and the Yuma myotis (*Myotis yumanensis*) (Greenhall and Frantz 1994). Solitary bats typically roost in tree foliage or under bark. However, occasionally, solitary bats can be associated with buildings, some only as transients during migration (Greenhall and Frantz 1994).

Conflicts involving bats can include property damage, but primarily involve threats to people, pets, and livestock. The buildup of bat droppings and urine in attics and between walls can result in odor problems and discoloration of walls and ceilings (Agency for Toxic Substances and Disease Registry 1998). Rabies occurs at low levels within bat populations. For example, the CDC states, "*even among bats submitted for rabies testing because they could be captured, were obviously weak or sick, or had been captured by a cat, only about 6% had rabies*" (CDC 2011). In addition to the threat of rabies from direct contact or a bat entering the living area of a home, there are other threats associated with bat colonies, including histoplasmosis, fungal spores, and mites.

Bat droppings, particularly when they are thick, are likely to promote the growth of the fungus, *Histoplasma capsulatum* or other fungal species, such as molds, especially in warm, moist conditions. As long as people are not in contact with fungal spores, they are unlikely to be affected by them. When people inhale spores from *Histoplasma capsulatum*, they may become ill with a disease known as histoplasmosis. Symptoms of histoplasmosis include some combination of mild, flu-like respiratory illness, a general ill feeling, chest pain, fever, cough, headache, loss of appetite, shortness of breath, joint and muscle pains, chills, and hoarseness. Although there are other, more rare illnesses associated with exposure, the most likely is histoplasmosis. Similarly, mold spores released into the air may result in increases in asthma attacks (Agency for Toxic Substances and Disease Registry 1998).

Bat bugs (*Cimex adjunctus*) are free-living ectoparasites of bats that feed on blood. They will bite people in the absence of their primary hosts. The main means of dispersal for bat bugs is phoresy (*i.e.*, hitching a ride on a bat to a new location by clinging to the fur of their host animal). Typically, bat bug infestations originate from bat populations established in attics, wall voids, unused chimneys, or uninhabited portions of a house. Bat bugs typically do not wander far from occupied bat roosting sites where they have easy access to food. However, if their normal hosts are eliminated or their hosts have vacated an area, bat bugs will seek other sources of food and may crawl about and invade living areas within a house (Jones and

Jordan 2004). Similarly, bat mites may enter the home and bite people. Although their bite is not particularly harmful, the person may experience an allergic reaction and develop a skin rash in response (Agency for Toxic Substances and Disease Registry 1998).

At least sixteen species of bats are likely to occur in Georgia (GDNR 2016*b*). Table 4.2 identifies the bat species found in Georgia and provides information related to their occurrence in the State and provides information on their roosting/rearing/hibernating behaviors. Several bat species in Georgia are known to roost, raise young, or hibernate in various human structures. Such behavior sometimes causes human/bat conflicts, especially perceived or actual threats of rabies, by people who encounter bats in such locations, especially when bats enter the living space of a home. Bat species that WS' personnel could address when they occur in structures include the big brown bat, Brazilian free-tailed bat, evening bat, little brown myotis, Rafinesque's big-eared bat, silver-haired bat, and the tri-colored bat[16]. Those species of bats can occur in buildings and other man-made structures. Most requests for WS' direct operational assistance would likely occur in relation to bats inhabiting human-occupied buildings.

Some of those bat species that may occur in the State are listed as threatened, endangered, or as species of management concern by federal and state agencies. The USFWS has placed the Indiana bat (*Myotis sodalis*), gray bat (*Myotis grisescens*), and northern long-eared bat (*Myotis septentrionalis*) on the List of Endangered and Threatened Wildlife. The Indiana bat and the gray bat are not generally associated with human dwellings and structures (see Table 4.2); therefore, it is unlikely that WS would encounter those species during activities to address bats. During the winter, northern long-eared bats use hibernacula, which include caves and abandoned mines, but they can also use abandoned railroad tunnels, storm sewers, hydroelectric dam facilities, and wells. During the summer, northern long-eared bats commonly roost individually or in small colonies underneath bark or in cavities or crevices of live trees and snags. However, long-eared bats have also been observed roosting in caves, mines, and man-made structures, such as buildings, barns, park pavilions, sheds, cabins, and under the eaves of buildings, behind window shutters, and bat houses, during the summer. In general, the northern long-eared bat is more common in the northern portion of their range than the southern and western portion. In Georgia, winter records of the northern long-eared bat are rare; however, researchers conducting mist net surveys between 2001 and 2011 commonly captured northern long-eared bats during summer mist-net surveys, especially in the northern portion of the State (see 80 FR 17974-18033).

The USFWS has established a species-specific rule for the northern long-eared bat under authority of section 4(d) of the ESA (see 81 FR 1900-1922; 50 CFR 17.40)[17]. The final species-specific rule prohibits purposeful take of northern long-eared bats throughout the species' range, except in instances of removal from human structures, defense of human life (including public health monitoring), and the removal of hazardous trees for the protection of human life and property. The USFWS will not prohibit the incidental take of long-eared bats from otherwise lawful activities in areas not yet affected by white-nose syndrome[18], which is a fungal disease that is currently affecting many hibernating bat species in the United States. The distribution and status of the northern long-eared bat in Georgia is not well known. Although northern long-eared bats could be present in human dwellings, the likelihood of the species

[16]If the USFWS placed the little brown myotis, the tri-colored bat, or any other bat species present in Georgia on the List of Endangered and Threatened Wildlife, the WS program would review those activities that the program in Georgia could conduct associated with bats, if the program implemented this alternative. Based on that review, the WS program would comply with Section 7 of the ESA.

[17]Under section 4(d) of the ESA, the Secretary of the Interior has the discretion to issue such regulations they deem necessary and advisable to provide for the conservation of the species.

[18]The USFWS defined the portion of the northern long-eared bat range considered to be affected by white nose syndrome as that area within 150 miles of the boundary of counties within the United States or Canadian districts where the fungus *Pseudogymnoascus destructans* or white nose syndrome has been detected. In instances where the 150-mile buffer line bisects a county, the entire county is included in the zone (see 81 FR 1900-1922; 50 CFR 17.40). During the development of this EA, the current known locations of white-nose syndrome could be found at https://www.whitenosesyndrome.org/.

being present in a dwelling whose owner or manager requests assistance from WS would likely be minimal.

From FY 2010 to FY 2015, WS responded to 63 requests for technical assistance associated with bats. Those persons requesting assistance reported $10,000 in damages caused by bats, primarily from damage to property. Those requests for assistance were associated with bats that had wandered into the living or working spaces of buildings, or were roosting in various structures. From FY 2010 through FY 2014, the WS program in Georgia did not handle any bats. In FY 2015, WS' personnel live-captured a big brown bat by hand inside a building and subsequently, euthanized the bat because the bat appeared injured. WS primarily addressed requests for assistance associated with bats using technical assistance and the installation of one-way exclusion devices that allow bats to exit a structure but prevent re-entry. Under Alternative 1, WS would continue to handle most requests for assistance through various technical assistance projects or referral to other entities. WS could occasionally provide direct operational assistance associated with bats when a person requests such assistance. Program activities would continue to recommend the use of non-lethal methods, such as exclusion and live capture/release. WS' personnel may install exclusion devices that allow bats to exit a structure but prevent re-entry or conduct structural repairs.

In most cases, a single bat found in a building would be provided an escape route (*e.g.*, opening a door or window) or would be live captured and released outside on site if there was no possibility of an exposure to people or pets. If the bat appeared sick, acted unusually, or if there was a known bite or possible exposure to people or pets, WS' personnel would euthanize the bat and submit the bat for rabies testing. Those bats euthanized by WS for disease testing would likely be those bats that other entities would euthanize and submit for testing in the absence of WS' involvement given the risk to human safety associated with exposure. Therefore, any lethal removal by WS would not be additive to mortality that would likely occur in the absence of involvement by WS.

When providing direct operational assistance to cooperators, WS would attempt to survey the bats to identify the species involved. If WS' personnel identified northern long-eared bats or other threatened or endangered bats associated with a request for assistance, WS would recommend the property owner or manager contact the USFWS or WS' personnel would contact the USFWS directly to determine the appropriate action. Depending on the appropriate action, if WS continued to provide assistance, WS would conduct further consultation with the USFWS or obtain the appropriate permits when required. Therefore, the involvement of WS could benefit the species since WS' personnel would attempt to identify the species of bats before providing direct assistance. If WS anticipated take when providing assistance, further consultation with the USFWS would occur.

To reduce the possibility of adversely affecting a bat maternity colony, WS would implement and recommended to persons receiving technical assistance that all exclusion be conducted from September to early November, when practicable, if no federally listed species were present at the site. In Georgia, the rearing of young would have been completed by September and most bat species would not yet have entered into torpor at winter sites by early November. Therefore, activities conducted after this date would be highly unlikely to disturb maternity colonies of any species during critical young-rearing periods. Conducting exclusionary and other projects during those months would also give bats that overwinter in Georgia, an opportunity to find alternate roost sites before the onset of extremely cold weather.

In Georgia, permits from the GDNR are required to exclude bats between May 1 and August 15; however, exclusions are discouraged during this period to avoid harming non-volant young. If bats must be excluded during this period, it must be done by an experienced and licensed Nuisance Wildlife Control Officer. However, outside this period, people can exclude bats without a permit. If WS received a request to exclude bats after May 1, WS would apply for a permit from the GDNR if no federally listed bat species were present. If the GDNR did not issue a permit, no exclusion would occur until after August. In most cases, WS would recommended and use exclusion after August 15.

Table 4.2 - Bats found in Georgia, their occurrence, and habitat characteristics

Common Name	Scientific Name	Occurrence in Georgia	Roosting/Rearing/Hibernating Habitat	Status in Georgia*
Little Brown Myotis	*Myotis lucifugus*	Statewide	Tree cavities, underneath rocks, piles of wood, crevices, occasionally in caves, and a variety of human-made structures	PN
Southeastern Myotis	*Myotis austroriparius*	Southern and eastern half	Primarily a cave dwelling species, it occasionally roosts in buildings, culverts, wells, natural tree cavities, and bridges	PN
Gray Bat	*Myotis grisescens*	Western half	Occupies caves near permanent water in winter and summer	PN, FE, SE
Northern Long-eared Bat	*Myotis septentrionalis*	Northern half	Summer - tree holes, under exfoliating bark, large culverts, under bridges, buildings. Prefers forested ridges and riparian woodlands. Winter – caves, mines, crevices in walls or ceilings.	FT, ST
Small-footed Myotis	*Myotis leibii*	Northern third of State	Roost in rock bluffs, under shale rock, buildings, between expansion joints on bridges, and turnpike tunnels during the spring and summer. They hibernate during winters in caves and mines, hanging near the opening, or moving deeper as winter temperatures drop.	PN
Indiana Myotis	*Myotis sodalis*	Northern third of State	Hibernates in caves, mostly in tight clusters. In summer, pregnant females form maternity colonies in hollow trees or under exfoliating bark and crevices of trees. Males and juveniles roost in small numbers under the exfoliating bark of trees, in crevices of trees, or in hollow trees.	PN, FE, SE
Silver-haired Bat	*Lasionycteris noctivagans*	Probably found statewide, except for southern Georgia	Probably present as a winter resident, or in spring and autumn migration, but apparently not in summer. In winter, hibernates in a variety of shelters, including buildings, caves, mines, crevices, and hollow trees	PN
Tri-colored Bat	*Perimyotis subflavus*	Statewide	Occupies hollow trees, tree foliage, caves, mines, rock crevices, and buildings.	PN
Big Brown Bat	*Eptesicus fuscus*	Found statewide and common.	Roosts typically in human-made structures, but also in caves, mines, hollow trees, and crevices, or behind loose bark. Commonly inhabits bat houses, attics, and louvered attic vents.	PN

Common Name	Scientific Name	Occurrence in Georgia	Roosting/Rearing/Hibernating Habitat	Status in Georgia*
Eastern Red Bat	*Lasiurus borealis*	Found statewide and common.	Roosts in a variety of trees, hanging amongst the foliage. Hibernate in hollow trees or in leaf litter on the forest floor.	PN
Seminole Bat	*Lasiurus seminolus*	Found statewide	Common in mixed coniferous and deciduous woodlands; often roosting in Spanish moss, clumps of other foliage, under exfoliating bark, or in caves.	PN
Hoary Bat	*Lasiurus cinereus*	Statewide	Roosts in trees or shrubs, usually three to five meters (9-15 feet) above ground	PN
Northern Yellow Bat	*Lasiurus intermedius*	Southern half of State	This relatively large bat inhabits coniferous and deciduous woodlands near permanent water. Often roosts in clumps of Spanish moss, but also in trees.	PN
Evening Bat	*Nycticeius humeralis*	Found statewide	Primary habitat is deciduous forest where it roosts in hollow trees, under loose bark, and in human-made structures, such as outbuildings, churches, belfries, and attics.	PN
Rafinesque's Big-eared Bat	*Corynorhinus rafinesquii*	Found statewide	In summer, roost sites may be behind loose bark, in caves, crevices, and hollow trees, and in unoccupied buildings, abandoned mines and wells, and other human-made structures.	PN; SR
Brazilian Free-tailed Bat	*Tadarida brasiliensis*	Found statewide	In Georgia, occurs only in human-made structures. Essentially non-migratory and does not hibernate, but summer and winter roosts may be in different localities.	PN

*Codes: F = Federal listing, S = State listing, E = Endangered, PN = Protected Non-game, CHD = Critical Habitat Determined, SR=Rare in State

Based on previous requests for assistance and in anticipation of receiving requests for assistance in the future, it is possible that WS could kill up to five bats each year statewide, in any species combination, consisting of big brown bat, Brazilian free-tailed bat, evening bat, little brown myotis, Rafinesque's big-eared bat, silver-haired bat, and the tri-colored bat[19]. If the need arises, WS would consult with a qualified biologist to identify bats positively prior to removing them in order to eliminate any chance of addressing a threatened or endangered species. If WS encountered a threatened or endangered bat, WS would contact the USFWS to determine the appropriate action. WS would continue to provide escape routes or live-capture and release bats in those instances where no human or pet exposure could be assured.

Regionally, some bats species are being adversely impacted by the fungal disease white-nose syndrome, an emerging disease causing unprecedented morbidity and mortality among bats in eastern North America. The disease is characterized by cutaneous infection of hibernating bats by the psychrophilic fungus *Pseudogymnoascus destructans*. However, WS' limited lethal removal of bats would not adversely affect overall populations of bat species in the State. Impacts to bats would be minimal because

[19]If the USFWS placed the little brown myotis, the tri-colored bat, or any other bat species present in Georgia on the List of Endangered and Threatened Wildlife, the take of that species would not occur by WS unless the USFWS authorizes the take.

any bat removal would be localized and limited in scope. In addition, euthanizing and submitting bats for testing would likely occur in the absence of WS' participation due to the risks to human safety.

BEAVER POPULATION INFORMATION AND EFFECTS ANALYSIS

The North American beaver is a semi-aquatic mammal occurring in rivers, streams, lakes, reservoirs, and wetlands across North America. Beaver are large, bulky rodents whose most prominent features include a large scaly, paddle-shaped tail and nearly orange colored incisors (Hill 1982). Most adults weigh from 15.8 to 38.3 kilogram (35 to 50 lbs) with some occasionally reaching more than 45 kilogram (100 lbs), and are the largest North American rodent (Miller and Yarrow 1994). They range throughout most of Canada and the United States, with the exception of portions of Florida and the desert southwest. Beaver are active throughout most of the year and are primarily nocturnal, but they can be active during daylight hours. Beaver living along a river or large stream generally make bank burrows with multiple underwater entrances. Those in quiet streams, lakes, and ponds usually build dams and a lodge (National Audubon Society 2000). Signs that beaver are present in an area include gnawing around the bases of trees and trees that have fallen because of the gnawing. Beaver strip bark, which is a primary source of food for beaver. Beaver are unique in their ability to create and modify their habitat by building dams (Boyles and Owens 2007).

Fur harvesters trapped beaver extensively during the 19th and part of the 20th centuries, and as a result, beaver disappeared from much of their range (Novak 1987). Through translocation efforts of state wildlife agencies and the regulation of harvest to protect beaver from overexploitation, beaver currently occupy most of their former range and have exceeded the social carrying capacity in some areas. Dams built and maintained by beaver may flood stands of commercial timber, highways, and croplands. However, the dams also help reduce erosion, and the ponds formed by dams may create a favorable habitat for many forms of life (Hill 1982, Baker and Hill 2003).

Beaver often occur in family groups that consist of two adult parents with offspring from the current or previous breeding season. The average family group ranges from 3.2 to 9.2 individuals (Novak 1987). Reports of beaver abundance often occur in terms of families per kilometer of stream or per square kilometer of habitat. Densities in terms of families per square kilometer have been reported to range from 0.15 to 4.6 families (Novak 1987), which is the same as 0.4 to 11.9 families per square mile. In streams, Novak (1987) summarized beaver abundance as ranging from 0.31 to 1.5 families per kilometer of stream, which converts to 0.8 to 3.9 families per mile of stream. Novak (1987) stated beaver populations are density dependent, which means that rates of increase generally occur as a population reduction occurs and become less as a population increases toward its carrying capacity[20]. This natural function of many animal populations helps to mitigate population reductions. Logan et al. (1996) indicated that wildlife populations held at a level below carrying capacity could sustain a higher level of harvest because of the compensatory mechanisms that cause higher rates of increase in such populations.

Beaver have a relatively low biotic potential due to their small litter size and a long juvenile development period. Population matrix models show that survival of kits (1st year juveniles) and yearlings (2nd year juveniles) is the most critical factor in population viability. Survival of those age classes is partly dependent on the ability of beaver to successfully disperse and re-colonize habitats. Beaver are strong dispersers, and populations can recover quickly from local reductions when dispersal corridors are maintained (Boyles and Owens 2007).

[20]Carrying capacity is the maximum number of animals that the environment can sustain and is determined by the availability of food, water, cover, and the tolerance of crowding by the species in question.

Coyotes, bobcats, red fox, river otters, mink, black bears (*Ursus americanus*), fishers (*Mustela pennanti*), and large raptors, such as hawks and owls, can prey on beaver (Tesky 1993, Baker and Hill 2003, Jackson and Decker 2004). With the exception of coyote, bear, and bobcat predation, most predation likely occurs to kits, yearlings, and young adults. With little exception, those predator species do not appear to exert significant predation pressure on beaver populations (Baker and Hill 2003).

The current population of beaver in the State is unknown; however, beaver occur statewide wherever suitable habitat exists. Since population estimates are not currently available, the analysis will derive a population estimate based on the best available information for beaver to provide an indication of the magnitude of removal proposed by WS to alleviate damage and threats of damage. Beaver population estimates often use density data for beaver based on the number of beaver families per a linear unit of measure (*e.g.*, stream miles) or per unit of area (*e.g.*, habitat type) (Baker and Hill 2003). In addition, population estimates depend on the number of individual beaver per family (Novak 1987).

Beaver densities per unit of area calculated from other studies in the United States and Canada have ranged from 0.4 beaver families per square mile to a high of 11.9 beaver families per square mile (Novak 1987). Density estimates in the United States and Canada based only on stream miles (*i.e.*, per a linear unit of measure) have ranged from 0.8 beaver colonies per stream mile to 3.9 beaver colonies per stream mile (Novak 1987). According to Hefner et al. (1994) and the United States Geological Survey (1996), Georgia has over 7.7 million acres of wetlands, including an estimated 70,150 miles of rivers and streams (EPA 2012). To evaluate a worst-case scenario, the estimated statewide beaver population will use the lowest beaver colony density per linear measure derived from other studies of 0.8 beaver colonies per stream mile. If all of the stream and river miles in Georgia were suitable beaver habitat and if beaver colonies occupied all of those miles, approximately 56,120 beaver colonies would occur along the 70,150 miles of river and streams in the State, which would not include beaver colonies that inhabit wetlands, lakes, ponds, and other aquatic habitats.

The number of beaver per colony is also required to derive a population estimate. In Georgia, Parrish (1960) estimated the average number of beaver per colony at 5.3 beaver, which is similar to the average of 4.6 beaver per colony in Alabama that Wilkinson (1962) estimated. From other studies, the average size of beaver colonies has ranged from 3.2 beaver to 9.2 beaver per colony (Novak 1987). Therefore, if there were 56,120 beaver colonies along the rivers and streams of the State and if there were 5.3 beaver per colony, the population inhabiting rivers and streams would be 297,436 beaver. If only 50% of the rivers and streams in the State provided suitable beaver habitat, then a beaver population in the State could be approximately 148,718 beaver. The actual statewide population is likely much larger than 148,718 beaver because the calculated estimate used the lowest density information available for beaver. In addition, the population estimate did not include beaver that could inhabit other aquatic habitats or create their own habitats by impounding water in areas associated with water runoff or storage (*e.g.*, drainage ditches, irrigation canals, storm water storage).

The authority for management of resident mammal species in Georgia, including beaver, is the responsibility of the GDNR. The GDNR classifies beaver as nongame animals in Georgia with a continuous open harvest season and no limit on the number of beaver that people can harvest (GDNR 2016*a*). Between 2010 and 2014, trappers have harvested an estimated 31,738 beaver in the State (see Table 4.3), which is an average harvest of 6,348 beaver per year in the State. The number of beaver that hunters harvest in the State is currently unknown. The highest annual harvest by trappers in the State occurred during 2014, when trappers harvested an estimated 8,596 beaver in the State.

Between FY 2010 and FY 2015, WS continued to respond to requests for assistance associated with beaver in which those persons requesting assistance reported or WS verified over $522,668 in damages to resources. Beaver damaged natural resources, such as timber and reclamation sites, agricultural crops, commercial timber, roadways, drainage and irrigation structures, and other property through flooding, damming, and feeding. As part of those requests for assistance, WS lethally removed 1,534 beaver to alleviate damage and threats of damage between FY 2010 and FY 2015, which is an average of 256 beaver lethally removed per year. The highest level of lethal removal by WS occurred during FY 2014 when WS' personnel lethally removed 338 beaver to alleviate damage or threats of damage. In addition, WS breached or removed 924 beaver dams between FY 2010 and FY 2015. Of the 924 beaver dams that WS breached or removed, personnel removed 22 dams using binary explosives and 902 dams using hand tools.

Table 4.3 - Cumulative beaver removal from known sources in Georgia, 2010-2014

Year	Harvest[1]	WS' Removal[2,3]	TOTAL	WS % of Total
2010	5,985	246	**6,231**	4.0%
2011	5,952	205	**6,157**	3.3%
2012	5,904	238	**6,142**	3.9%
2013	5,301	249	**5,550**	4.5%
2014	8,596	338	**8,934**	3.8%
TOTAL	**31,738**	**1,276**	**33,014**	**3.9%**

[1]Based on data from the National Furbearer Harvest Statistics Database (Association of Fish and Wildlife Agencies 2016)

[2]WS' removal is reported by federal fiscal year

[3]WS' removal includes unintentional removal during other damage management activities

If the beaver population has remained relatively stable at 148,718 beaver in Georgia, WS' highest level of annual removal that occurred in FY 2014 would represent 0.2% of the estimated population. The highest level of overall removal from trapper harvest and WS' removal occurred in 2014 when WS and trappers removed at least 8,934 beaver. With an estimated 8,934 beaver removed in 2014 and a stable beaver population, the overall removal of beaver would represent 6.0% of the lowest estimated population in the State. If the statewide beaver population were 297,436 beaver, the cumulative lethal removal of 8,934 beaver would represent 3.0% of the estimated population. The number of beaver removed for damage management by other entities in Georgia is unknown. An allowable harvest level for beaver may be as high as 30% of the population (Novak 1987). The total known removal of beaver in the State has not exceeded 30% of the estimated statewide population of beaver in Georgia.

Based on previous requests for assistance and in anticipation of receiving additional requests for assistance with managing damage caused by beaver in Georgia, WS could lethally remove up to 1,000 beaver annually under all damage management activities. Based on a statewide population estimated at 148,718 beaver, the annual lethal removal by WS of up to 1,000 beaver would represent 0.7% of the population. As indicated previously, the actual statewide population of beaver is likely much larger than 148,718 beaver. Therefore, the proposed removal of up to 1,000 beaver annually by WS would likely be a much lower percentage of the actual statewide population.

Combining the highest number of beaver that trappers harvested in a year of 8,596 beaver that occurred in 2014 with the annual removal that could occur by WS of 1,000 beaver, the cumulative removal of beaver in the State would represent 6.5% of a statewide beaver population estimated at 148,718 beaver. When combining the highest beaver harvest level that occurred in 2014 with the annual removal that could occur by WS, the cumulative removal would not exceed 30% of the statewide beaver population under a worst-case scenario.

As stated previously, beaver inhabit many other types of aquatic habitats within the State besides rivers and streams and likely occur at higher densities than the densities used to derive the estimate; therefore, the statewide beaver population likely exceeds 148,718 beaver. Therefore, the cumulative removal of beaver annually would likely be a much lower percentage of the actual statewide population. Although the number of beaver that property owners remove annually to alleviate damage or threats of damage is unknown, the actual number of beaver removed annually does not likely occur at a level that would increase cumulative effects. The unlimited harvest allowed by the GDNR also provides an indication that the statewide density of beaver is sufficient that overharvest is not likely to occur. Based on the limited removal proposed by WS and the oversight by the GDNR, WS' removal of beaver annually would have no effect on the ability of those persons interested to harvest beaver during the regulated harvest season.

Under this alternative, people could also request WS breach or remove beaver dams to alleviate or prevent flooding damage. In addition, WS could receive requests to install devices to control the water flow through dams to alleviate flooding or install exclusion devices to prevent damming. WS would primarily utilize manual methods (*e.g.*, hands and hand tools) to breach or remove dams. WS anticipates breaching, removing, or installing flow control devices in up to 500 beaver dams annually as part of an integrated damage management program. When breaching or removing a dam, WS' personnel would discard the building material used to create the dam (*e.g.*, sticks, logs, and other vegetative matter) on the bank or would release those materials to flow downstream. Mud and small materials, such as bark and other plant debris, could also escape downstream and would tend to settle out within a short distance of the dam. Small to medium limbs, along with sediments, may drift further distances downstream. Dam breaching and removal would generally be conducted in conjunction with the removal of beaver responsible for constructing the dam since beaver would likely repair and/or rebuild dams quickly if dams were breached or removed prior to the beaver being removed. Therefore, the removal or breaching of beaver dams would not adversely affect beaver populations in the State since WS would conduct those activities in association with removing beaver from the site; therefore, the removal would be included in the estimated annual removal levels of beaver addressed previously.

BOBCAT POPULATION INFORMATION AND EFFECTS ANALYSIS

The bobcat is a medium-sized member of the North American cat family that people sometimes mistake for a large bob-tailed domestic cat. Bobcats are actually two to three times larger than most domestic cats and appear more muscular and fuller in body. Bobcats are capable of hunting and killing prey that range from the size of a mouse to that of a deer. Rabbits, tree squirrels, ground squirrels, wood rats, porcupines, pocket gophers, and woodchucks comprise most of their diet. Bobcats also prey upon opossums, raccoon, grouse, wild turkey, and other ground nesting birds. Occasionally, insects and reptiles can be part of a bobcat's diet. They also resort to scavenging. Bobcats are opportunistic predators, and may feed on livestock and domestic animals, such as poultry, sheep, goats, house cats, small dogs, exotic birds and game animals, and rarely, calves (Virchow and Hogeland 1994). Anderson and Lovallo (2003) reported the cottontail rabbit to be the principal prey of bobcats throughout their range.

Ruell et al. (2009) reported bobcat densities ranged from 0.65 to 1.09 bobcats per square mile (0.25 to 0.42 bobcats per km^2) in coastal southern California in both large open habitat and in habitat surrounded by human development. Lawhead (1984) reported bobcat densities of 0.66 per square mile (0.26 bobcats per km^2) in Arizona with a preference for riparian habitat. Nielsen and Woolf (2001) reported the bobcat density in southern Illinois was 0.70 bobcats per square mile (0.27 bobcats per km^2). Bobcats reach densities of approximately four bobcats per square mile (0.4 bobcats per km^2) on some islands in the Gulf Coast of the southeastern United States. Bobcat densities stabilized at 0.8 bobcats per square mile during bobcat reintroduction efforts on an island off the coast of Georgia (Diefenbach et al. 2006). Densities vary from about two per square mile (0.8 bobcats per km^2) in coastal plains to about 0.3 bobcats per square mile (0.1 bobcat per km^2) in portions of the Appalachian foothills. Mid-Atlantic and Midwestern states usually have scarce populations of bobcats (Virchow and Hogeland 1994). Rates of natural mortality reported for adult bobcats in protected populations appear to be quite low. Crowe (1975) estimated a 3% mortality rate in a protected population, based on a study of bobcats by Bailey (1972) in southeastern Idaho. Causes of natural mortality for adult bobcats include starvation (Hamilton 1982), disease and predation (Lembeck 1978), and injuries inflicted by prey (Fuller et al. 1985).

Bobcats occur statewide in Georgia (GDNR 2007*a*). Bobcats occur throughout the State in a variety of habitats, including mixed forest and agricultural areas (GDNR 2007*a*). Roberts and Crimmins (2010) reported the statewide bobcat population ranged from 209,870 to 249,845 bobcats, with an increasing population status. Roberts and Crimmins (2010) estimated bobcats occupied approximately 57,900 square miles of the State.

Bobcats are classified as both a game animal and a furbearing animal in Georgia and may be harvested during hunting and trapping seasons. During the hunting and trapping season, the GDNR allows an unlimited number of bobcats to be harvested during the length of the season with no possession limit during the length of the season. Table 4.4 shows the estimated number of bobcats that trappers harvested in the State from 2010 through 2014 based on trapper surveys. Hunters likely harvest three to five times as many bobcats as trappers do (GDNR 2007*a*). The actual number of bobcats harvested annually by hunters and trappers is currently unknown.

Table 4.4 - Cumulative bobcat removal from known sources in Georgia, 2010-2014

Year	Harvest[1]	WS' Removal[2,3]	TOTAL	WS % of Total
2010	1,925	21	**1,946**	1.1%
2011	2,454	44	**2,498**	1.8%
2012	2,670	32	**2,702**	1.2%
2013	2,778	29	**2,807**	1.0%
2014	2,990	34	**3,024**	1.1%
TOTAL	**12,817**	**160**	**12,977**	**1.2%**

[1]Based on data from the National Furbearer Harvest Statistics Database (Association of Fish and Wildlife Agencies 2016)

[2]WS' removal is reported by federal fiscal year

[3]WS' removal includes all removal including unintentional removal during other damage management activities

From FY 2010 through FY 2015, WS removed 185 bobcats, which is an average of 31 bobcats removed annually by WS. The WS program also live-captured and released one bobcat during FY 2015. Of the 185 bobcats that WS removed, WS removed one bobcat unintentionally during other activities targeting other animals. The highest annual removal by WS occurred in FY 2011 when WS removed 44 bobcats to alleviate damage or threats of damage. As shown in Table 4.4, WS' removal of bobcats as a percentage of the overall harvest of bobcats by trappers in the State has not exceeded 1.8% between 2010 and 2014. On average, WS' lethal removal of bobcats has represented 1.2% of the annual harvest of bobcats by trappers in the State. As stated previously, the number of bobcats harvested by hunters in the State is currently unknown; therefore, WS' removal of bobcats was likely a lower percentage of the overall harvest of bobcats in the State. In anticipation of additional efforts by WS to alleviate damage, WS could remove up to 100 bobcats annually in Georgia as part of efforts to manage damage to resources and threats to human health and safety, including bobcats that WS' personnel may unintentionally remove during activities targeting other species.

Between 2010 and 2014, trappers harvested an estimated 2,563 bobcats in the State per year during the trapping season. If trappers continued to harvest an average of 2,563 bobcats per year and hunters harvested five times as many bobcats, the highest cumulative annual harvest in the State could reach nearly 15,400 bobcats. If the annual harvest of bobcats in the State reached 15,400 bobcats, the cumulative removal by hunters, trappers, and WS, if WS' removal reached 100 bobcats, would represent 7.4% of a statewide population estimated at 209,870 bobcats.

As stated previously, the GDNR, with management authority over bobcats in the State, places no restrictions on the number of bobcats that hunters and trappers can harvest annually during the length of the hunting and trapping seasons, which provides an indication the statewide density is sufficient that overharvest is unlikely to occur. The proposed removal of bobcats by WS in the State would be of low magnitude when compared to the statewide population estimate and to the number of bobcats harvested by hunters and trappers in the State. Therefore, the activities of WS to alleviate bobcat damage or threats of damage would not limit the ability of people to harvest bobcats in the State.

COYOTE POPULATION INFORMATION AND EFFECTS ANALYSIS

Coyotes are a familiar species of mammal to most people. Their coloration is blended, primarily gray mixed with a reddish tint. The belly and throat are a paler color than the rest of the body (Bekoff 1982). Coyotes have long, rusty or yellowish legs with dark vertical lines on the lower foreleg. They are similar in appearance to gray and red wolves (Bekoff and Gese 2003). Coloration varies greatly from nearly black to red or nearly white in some individuals and local populations. Most have dark or black guard hairs over their back and tail (Green et al. 1994). They sometimes breed with domestic dogs (Bekoff and Gese 2003). The size of coyotes varies from 20 to 40 lbs (9 to 18 kg) (Voigt and Berg 1987). Coyotes often include many items in their diet. Rabbits are one of the most common prey species. Other items in the coyote's diet include carrion, rodents, deer (usually fawns), insects (such as grasshoppers), as well as livestock and poultry. Coyotes readily eat fruits, such as watermelons, berries, persimmons, and other vegetative matter when it is available. In some areas, coyotes feed on human refuse at dumpsites and prey on small domestic pets, such as cats and dogs (Voigt and Berg 1987).

Coyotes are highly mobile animals with home ranges (territories) that vary by sex and age of the animal, food abundance, habitat, and season of the year (Pyrah 1984, Bekoff and Gese 2003). Coyote populations are comprised of territorial and non-territorial individuals. Each territory contains a dominant pair, associated subordinates, and pups. Pre-whelping pack size ranges from two to 10 individuals (Gese et al. 1996, Knowlton et al. 1999). Coyotes breed between January and March and are able to breed prior to reaching one year of age (Kennelly and Johns 1976), but the percentage of yearlings having litters varies from zero to 80% in different populations (Gier 1968). This variation is influenced by a number of factors causing large annual variations in total number of coyotes breeding. In a Texas study, the percentage of females having litters varied from 48% to 81% (Knowlton 1972). Pups are born after a gestation period of 60 to 63 days, with litter sizes varying primarily with prey availability. Each dominant pair can produce a single litter of four to eight pups (Knowlton 1972, Gese et al. 1996). Gier (1968) reported average litter sizes of 4.8 to 5.1 in years with low rodent numbers, but litters of 5.8 to 6.2 during years with high rodent numbers.

Many references indicate that coyotes originally occurred in relatively open habitats, particularly grasslands and sparsely wooded areas of the western United States. The distribution of coyotes in eastern North America began to expand from 1900 to 1920. Now, all eastern states and Canadian provinces have at least a small population of coyotes (Voigt and Berg 1987). Today, coyotes range throughout the United States. Coyotes have adapted to, and now exist in virtually every type of habitat, arctic to tropic, in North America. Coyotes live in deserts, swamps, tundra, grasslands, brush, dense forests, from below sea level to high mountain ranges, and at all intermediate altitudes. High densities of coyotes also appear in the suburbs of major cities (Green et al. 1994).

The coyote is probably the most extensively studied carnivore (Bekoff and Gese 2003), and considerable research has been conducted on population dynamics. However, methods for estimating carnivore populations are crude and often produce estimates with broad confidence intervals (Crawford et al. 1993). Because determinations of absolute coyote densities are frequently unknown (Knowlton 1972), many researchers have estimated coyote populations using various methods (Clark 1972, Knowlton 1972, Camenzind 1978, Pyrah 1984, Knowlton et al. 1999). The cost to determine absolute coyote densities accurately over large areas is prohibitive (Connolly 1992) and the cost would not appear to be warranted given the coyote's overall relative abundance. The presence of unusual food concentrations and the assistance provided to a breeding pair by non-breeding coyotes at the den can influence coyote densities and complicate efforts to estimate abundance (Danner and Smith 1980). Coyote densities are lowest in late winter prior to whelping, highest immediately after whelping, followed by a continued decline to the next whelping season (Parker 1995, Knowlton et al. 1999).

Predator abundance indices suggest that densities of coyotes in North America increase from north to south (Knowlton and Stoddart 1985, Parker 1995, Knowlton et al. 1999). Coyote densities can vary considerably between habitat types and vary based on numerous environmental variables. Coyote densities can range from 0.5 coyotes per square mile to six coyotes per square mile (Voigt and Berg 1987, Knowlton et al. 1999, Bekoff and Gese 2003). Knowlton (1972) concluded that coyote densities might approach a high of five to six coyotes per square mile under extremely favorable conditions. Such an estimate is speculative but represents some of the best available information for estimating coyote populations.

Population modeling information suggests that a viable coyote population can withstand an annual removal of 70% of their population without causing a decline in the population (Connolly and Longhurst 1975, Connolly 1995). The unique resilience of the coyote, its ability to adapt, and its perseverance under adverse conditions is commonly recognized among biologists and land managers. Despite intensive historical damage management efforts in livestock production areas and despite sport hunting and trapping for fur, coyotes continue to thrive and expand their range, occurring widely across North and Central America (Miller 1995). Connolly and Longhurst (1975) determined that, "*...if 75% of the coyotes are killed each year, the population would be exterminated in slightly over 50 years*." However, Connolly and Longhurst (1975) go on to explain that their "*...model suggests that coyotes, through compensatory reproduction, can withstand an annual population mortality of 70%*" and that coyote populations would regain pre-control densities (through recruitment, reproduction, and migration) by the end of the fifth year after control was terminated even though 75% mortality had occurred for 20 years. In addition, other researchers (Windberg and Knowlton 1988) recognized that immigration, (not considered in the Connolly and Longhurst (1975) model) could result in rapid occupancy of vacant territories, which helps to explain why coyotes have thrived in spite of intensive damage management activities (Connolly 1978).

Actual population or density estimates for coyotes in Georgia are not available. Coyotes are common throughout the State and inhabit a variety of habitats. Using the major land resource areas in Georgia, at least six resources areas in the State contain suitable habitat for coyotes. Those resource categories would include the Atlantic Coast Flatwoods, Southern Coastal Plain, Sand Hill, Southern Piedmont, Blue Ridge, and Southern Appalachian resource areas, which are primarily woodland habitats that are intermixed with agricultural cropland (see Table 4.1). Those resources areas encompass approximately 56,000 square miles of the State. If coyotes only occupy 50% of those resource areas in Georgia and the density of coyotes in the State ranged from 0.5 coyotes per square mile to five coyotes per square mile, the statewide population could range from 14,000 coyotes to a high of 140,000 coyotes.

The GDNR classifies coyotes as nongame animals in Georgia with a continuous open harvest season and no limit on the number of coyotes that people can harvest (GDNR 2016*a*). Between 2010 and 2014, trappers have harvested an estimated 37,650 coyotes in the State (see Table 4.5), which is an average harvest of 7,530 coyotes per year in the State. The number of coyotes that hunters harvest in the State is currently unknown. Based on the estimated number of coyotes harvested between 2010 and 2014 during the trapping seasons, the statewide population exceeds 14,000 coyotes. There are no indications that coyote populations in the State are showing rapid declines from overharvest. The GDNR (2016*a*) continues to allow people to remove coyotes in the State at any time with no limit on the number of coyotes that people can harvest.

Table 4.5 - Cumulative coyote removal from known sources in Georgia, 2010-2014

Year	Harvest[1]	WS' Removal[2,3]	TOTAL	WS % of Total
2010	5,467	45	**5,512**	0.8%
2011	6,964	79	**7,043**	1.1%
2012	8,063	47	**8,110**	0.6%
2013	6,813	47	**6,860**	0.7%
2014	10,343	59	**10,402**	0.6%
TOTAL	**37,650**	**277**	**37,927**	**0.7%**

[1]Based on data from the National Furbearer Harvest Statistics Database (Association of Fish and Wildlife Agencies 2016)

[2]WS' removal is reported by federal fiscal year

[3]WS' removal includes all removal including unintentional removal during other damage management activities

Between FY 2010 and FY 2015, WS conducted 136 technical assistance projects associated with damage and threats of damages caused by coyotes. Requests for assistance were primarily associated with threats to human safety and predation of animals. WS also provided direct operational assistance associated with coyotes from FY 2010 through FY 2015, primarily on wildlife management properties for the protection of ground nesting birds. During direct operational assistance projects, WS lethally removed 316 coyotes from FY 2010 through FY 2015, which is an average annual removal of 53 coyotes. Of those 316 coyotes lethally removed by WS from FY 2010 through FY 2015, WS removed two coyotes unintentionally during other damage management activities. In addition, one coyote was live-captured unintentionally but released unharmed. The highest annual lethal removal occurred during FY 2011 when WS removed 79 coyotes to alleviate damage or threats of damage in the State.

Based on the number of requests for assistance received previously and the number of coyotes killed by WS to resolve damage, WS could remove up to 200 coyotes annually under the proposed action to alleviate damage, including coyotes that WS' personnel could remove unintentionally during activities targeting other animals. As stated previously, trappers in the State harvested an average of 7,530 coyotes between 2010 and 2014. If WS had lethally removed 200 coyotes each year from 2010 through 2014, the removal would have represented 2.7% of the average number of coyotes that trappers harvested per year from 2010 through 2014. If the average annual harvest of coyotes by trappers from 2010 through 2014 were representative of future harvest, the cumulative removal of coyotes by trappers and WS would represent 5.5% of a statewide population estimated at 140,000 coyotes. Removal of 5.5% of the estimated population would be below the 70% harvest level required to cause population declines calculated by Connolly and Longhurst (1975) and Connolly (1995). Although the number of coyotes harvested annually by hunters is unknown, the actual number of coyotes harvested is not likely to reach a magnitude that would cause a population decline. The cumulative annual harvest of coyotes would have to reach 98,000 coyotes to represent 70% of a statewide population estimated at 140,000 coyotes. However, the statewide population of coyotes likely exceeds 140,000 coyotes given the parameters used to calculate the estimate. Similar to the other furbearing species, the analysis estimated a statewide coyote population based on coyotes occupying only 50% of some land classifications that is intended to provide a minimum population estimate, which can be used to evaluate the magnitude of the proposed removal by WS under a worst-case scenario.

Although exact population estimates for coyotes in Georgia and annual harvest rates are not available, the unlimited harvest allowed by the GDNR for the species and the continuous open season indicates the species is not at risk of overharvesting. Since the statewide population could reasonably be expected to be higher than 140,000 coyotes, the proposed removal of 200 coyotes annually and the cumulative harvest of coyotes would actually be a smaller percentage of the actual statewide population. The annual removal of coyotes by WS would be of low magnitude compared to the actual statewide population and the number of coyotes people harvest annually in the State. Therefore, the activities of WS to alleviate coyote damage or threats of damage would not limit the ability of people to harvest coyotes in the State.

EASTERN CHIPMUNK POPULATION INFORMATION AND EFFECTS ANALYSIS

The eastern chipmunk is a ground-dwelling animal, typically 13 to 15 centimeters (5 to 6 inches) long and weighing 90 grams (3 oz). Their tail is eight to 10 centimeters (3 to 4 inches) long and hairy, but it is not bushy (Williams and Corrigan 1994). Generally found in forested habitats, chipmunks have large, fur-lined internal cheek pouches for carrying nuts and seeds. They have black and white facial stripes, and five dark stripes separated by four pale ones, on the back and sides of their bodies. Chipmunks cache a great deal of food in the form of seeds, nuts, fruits, and sometimes, green vegetation and insects. They hibernate in the winter, but awaken about every two weeks to feed, since they do not store body fat before hibernation.

They are daytime animals, and are usually most active in early morning and late afternoon. They live mostly on the ground, but their nests may be in an underground burrow, or a hollow tree limb (National Audubon Society 2000). Burrows are often well hidden near objects, such as stumps, woodpiles, brush piles, basements, and garages or other buildings. The burrow entrance is usually about five cm (2 inches) in diameter with no obvious mounds of soil around them (Williams and Corrigan 1994, National Audubon Society 2000). Chipmunks can occur across most of the eastern United States, except the extreme south and along the southeastern seaboard (Williams and Corrigan 1994, National Audubon Society 2000).

Eastern chipmunks have two mating periods that occur during early spring and again during the summer or early fall. There is a 31-day gestation period, producing two to five young (Williams and Corrigan 1994). First year females not breeding in early spring may produce litters in late July or August (National Audubon Society 2000). The young are sexually mature within one year. Adults may live up to three years (Williams and Corrigan 1994).

Population densities of eastern chipmunks typically are five to 10 animals per hectare (2 to 4 per acre) (Burt and Grossenheider 1976), and may be as high as 24 chipmunks per hectare (10 per acre) if sufficient food and cover are available. Home ranges often overlap among individuals and are usually less than 92 m (100 yards) across (Williams and Corrigan 1994).

Throughout their North American range, chipmunks may be minor agricultural pests. Most conflicts with chipmunks are nuisance problems. However, when chipmunks are present in large numbers they can cause structural damage by burrowing under patios, stairs, retention walls, or foundations. They may also consume flower bulbs, seeds, or seedlings as well as birdseed, grass seed, and pet food that is not stored in rodent-proof storage containers (Williams and Corrigan 1994).

Although occasionally found statewide, chipmunks primarily occur in the Piedmont region and the northern portion of the State. No statewide population estimates are currently available for chipmunks. Therefore, the analysis will use the best available information to estimate a statewide population. Chipmunks are most likely to utilize deciduous forest as preferred habitat. There are approximately 25,839 square miles of potential habitat in Georgia in the Piedmont region and the northern portion of the State (see Table 4.1). If only 25% of those land classification supported chipmunks, under a worst-case scenario, with a conservative estimate of one chipmunk per acre, and assuming that only one chipmunk occupied a home range and no home ranges overlapped, the conservative statewide population would be approximately 4.1 million chipmunks. This would be a worst-case scenario since chipmunk populations are likely to inhabit a much larger portion of those lands and they typically occur at much higher densities.

Between FY 2010 and FY 2015, the WS program in Georgia has provided information regarding the alleviation of chipmunk damage during three technical assistance requests. During FY 2015, the WS program in Georgia live-captured one chipmunk intentionally to alleviate damage and released that chipmunk unharmed. The WS program did not receive requests for assistance associated with chipmunks from FY 2010 through FY 2014. Based upon anticipated requests for WS' assistance, it is possible that WS could lethally remove up to 50 chipmunks each year in the State under this alternative. When receiving requests for assistance associated with chipmunks, the WS program in Georgia would follow WS Directive 2.345. Removing 50 chipmunks would represent 0.001% of the estimated statewide population annually and would be of low magnitude when compared to the actual statewide population of chipmunks. WS anticipates the annual removal of up to 50 chipmunks to represent a much smaller percentage of the actual statewide population.

EASTERN COTTONTAIL POPULATION INFORMATION AND EFFECTS ANALYSIS

There are nine species of cottontail rabbits in North America, north of Mexico. The eastern cottontail is the most abundant and widespread of the cottontail rabbit species. Eastern cottontails occur statewide in a wide variety of disturbed, early successional or shrub-dominated habitats (Chapman and Litvaitis 2003). In addition, swamp rabbits (*S. aquaticus*), marsh rabbits (*S. palustris*) and Appalachian cottontails (*S. obscurus*) occur in the State (Chapman and Litvaitis 2003). Swamp rabbits occur in wetland areas nearly statewide, except the southern portion of the State. Marsh rabbits are associated with the wetland habitats along the southern marsh areas of the State while the Appalachian cottontail occurs in the mountainous areas along the northern edge of the State (Chapman and Litvaitis 2003). Eastern cottontails are the most abundant rabbit species found in the State and they are the most widely distributed species.

However, eastern cottontails do not distribute themselves evenly across the landscape, but tend to concentrate in favorable habitats, such as brushy fence rows or field edges, gullies filled with debris, brush piles, areas of dense briars invaded with Japanese honeysuckle, or landscaped backyards where food and cover are suitable. Rabbits rarely occur in dense forest or open grasslands, but fallow crop fields may provide suitable habitat. Within these habitats, they spend their entire lives in an area of 10 acres or less. Occasionally they may move a mile or so from a summer range to winter cover or to a new food supply. In suburban areas, rabbits are numerous and mobile enough to fill any "*empty*" habitat created when other rabbits are removed. Population densities vary with habitat quality, but one rabbit per 0.4 hectares (1 acre) is a reasonable average (Craven 1994). Damage associated with rabbits is almost, without exception, caused by the eastern cottontail (Craven 1994).

The eastern cottontail occurs statewide in Georgia and the most common rabbit throughout the State (GDNR 2005*b*). Eastern cottontails are also the most abundant rabbit species with the widest distribution in the State (GDNR 2005*b*). The statewide population of cottontail rabbits is currently unknown. Therefore, the analysis will use the best available information to estimate a statewide population. The land cover classifications in the State most likely to encompass suitable cottontail rabbit habitat are the Southern Coastal Plain, Southern Piedmont, Sand Hills, Atlantic Coast Flatwoods, and the Tidewater Area, which cumulatively total approximately 53,431 square miles in Georgia (see Table 4.1). However, the entire cumulative land area encompassing suitable rabbit habitat likely does not contain suitable habitat for rabbits. Of the likely rabbit habitat in the State, approximately 10,736 square miles consist of croplands and grasslands, which equates to nearly 6.9 million acres. If only 25% of those lands supported cottontails, under a worst case scenario, with a conservative estimate of one rabbit per acre, and assuming that only one rabbit occupied a home range and no home ranges overlapped, the conservative statewide populations could be estimated at nearly 1.7 million rabbits. This would be a worst-case scenario since rabbit populations are likely to inhabit a much larger portion of those lands, and rabbits typically occur at much higher densities.

The average lifespan of a rabbit in the wild is 15 months (Chapman et al. 1980), yet they make the most of the time available reproductively. They can raise as many as eight litters per year of one to 12 young (usually three to six), having a gestation period of 25 to 35 days with a mean of 28 days (Chapman and Litvaitis 2003).

The GDNR considers eastern cottontails to be a game animal with a regulated hunting season. During the development of this EA, hunters could harvest 12 rabbits each day with no limit on the number of rabbits that can be in possession during the length of the season (GDNR 2016*a*). During the 2002-2003 hunting season, hunters harvested an estimated 325,757 rabbits in the State (GDNR 2005*b*). However, the current number of rabbits harvested annually in the State during the hunting season is unknown.

Between FY 2010 and FY 2015, the WS program in Georgia did not receive requests for direct operational assistance associated with eastern cottontails. However, WS could receive requests for assistance associated with cottontails in the State, primarily at air facilities where rabbits can act as an attractant for avian and mammalian predators that pose strike hazards to aircraft. In anticipation of efforts to address requests for assistance associated with rabbits, WS could lethally remove up to 50 rabbits annually. WS could also capture cottontails unintentionally during activities targeting other animals. Between FY 2010 and FY 2015, WS lethally removed seven cottontails unintentionally during activities targeting other animals. In addition, 36 cottontails were live-captured unintentionally during other damage management activities but personnel released those rabbits unharmed. However, WS does not anticipate intentional and unintentional removal of cottontail rabbits to exceed 50 rabbits annually.

If the population of cottontail rabbits in the State remained at least stable, WS' removal of up 50 cottontails annually would represent 0.003% of the minimum statewide population of 1.7 million rabbits. However, WS anticipates that removal of up to 50 rabbits annually would represent a much smaller percentage of the actual statewide population since the population is likely much higher than 1.7 million rabbits. If WS removed 50 rabbits annually and the harvest of 325,757 rabbits during the 2002-2003 hunting season was representative of future harvest levels, WS' removal would represent 0.02% of the estimated harvest of rabbits in the State.

Studies show that even if hunters harvest as many as 40% of the rabbits available in autumn, the rabbit population the following year would not be adversely affected because of the tremendous reproductive potential of rabbits (Fergus 2006). Given the low magnitude of potential removal by WS when compared to the statewide population and the number of rabbits that people harvest in the State annually, WS' proposed removal would not adversely affect the ability to harvest rabbits during the annual regulated hunting season in the State.

FALLOW DEER POPULATION INFORMATION AND EFFECTS ANALYSIS

Fallow deer range in color from black to cream; however, they are usually brown with white spots in the summer months and grayish-brown without spots during the winter (Feldhamer et al. 1988, National Audubon Society 2000). Adult males may weigh between 100 and 180 pounds (46-80 kg) while females may weigh between 70 and 115 pounds (32-52 kg) (Feldhamer et al. 1988, National Audubon Society 2000). Males, or bucks, will grow branched antlers that are palmate and can reach lengths of 28 inches (70 cm) (Feldhamer et al. 1988). During the breeding season, males will make scrapes on the ground clearing out areas as large as 3 feet. Females, or does, will visit these scrapes during the breeding season. Breeding commonly takes place near these scrapes. Bucks are polygamous and they will fight with each other during the breeding season. Breeding typically occurs during October and November. After a gestation period of six to seven months, a single fawn is born (Feldhamer et al. 1988, National Audubon Society 2000).

Fallow deer are generally gregarious throughout the year and can occur in groups of 150 to 175 deer; however, adult males tend to be solitary, except during the breeding season (Feldhamer et al. 1988, National Audubon Society 2000). They tend to graze in the open during the summer while feeding more on woody browse and mast during the fall and winter months. Home range size can vary greatly depending on habitat type. In England, the home ranges of females are between 50 and 123 acres while males are between 100 and 172 acres. This is considered small with home ranges in other areas probably larger (Pellew 1999). Fallow deer tend to run with a distinct stiff legged bounce. When nervous, they produce a sound similar to a dog's bark. Even though fallow deer are typically wary of people, they can become semi-domesticated in areas like parks with human activity and no hunting pressure (National Audubon Society 2000).

Fallow deer are likely native to Asia Minor and the Middle East but people have a long history of introducing this species to other parts of the world, including areas within the United States (Chapman and Chapman 1980). The earliest known release of fallow deer into the United States occurred in 1878 (Chapman and Chapman 1980). People have released fallow deer to free-range in areas, primarily as a source of food and to increasing hunting opportunities in those areas. People have also released fallow deer into enclosures, primarily for hunting purposes. In some cases, fallow deer have escaped or been intentionally released from enclosures and they have become established in surrounding areas. Chapman and Chapman (1980) indicate fallow deer are the most widely introduced exotic ungulate in the United States. Today, free-ranging fallow deer may occur in Kentucky, Maryland, Georgia, Alabama, Oklahoma, Texas, and California (Chapman and Chapman 1980, National Audubon Society 2000).

In Georgia, the first introductions of fallow deer likely occurred on Little Saint Simons Island, which is an approximately 11,000-acre island located on the coast of Georgia. Little Saint Simons Island consists of approximately 3,000 acres of upland habitat and 8,000 acres of salt marsh. Introduction of fallow deer to the island for hunting may have occurred as early as 1909 (The Lodge on Little Saint Simons Island 2016). Although the total number of fallow deer brought to the island is unknown, Morse (2008) indicates the property owner released six fallow deer (4 male and 2 female) in 1923. By 1974, Chapman and Chapman (1980) indicated the population on the Island was between 500 and 600 deer. By the early 1980s, the population on the island was over 1,000 fallow deer (Morse 2008). Fallow deer are also capable of swimming and they have left Little Saint Simons Island to establish populations on nearby Saint Simons Island and the nearby mainland. In 1957, entities also released fallow deer near Tocoa, Georgia in the northeastern part of the State but predation by dogs and poaching eliminated those deer within a year (Chapman and Chapman 1980). The current statewide population of free-ranging fallow deer is unknown.

As with many non-native species, the primary concern associated with populations of fallow deer is competition with native species. Morse and Miller (2009) speculated that white-tailed deer were present on Little Saint Simons Island when the property owner first introduced fallow deer since white-tailed deer have been and are currently present on islands surrounding Little Saint Simons Island and they are present on the adjacent mainland. Over time, Morse and Miller (2009) further speculated that fallow deer likely displaced white-tailed deer from Little Saint Simon Island as the fallow deer population increased. Although the status of white-tailed deer on Little Saint Simons Island is unknown prior to the introduction of fallow deer, sightings of white-tailed deer on the island are rare with no sighting occurring from 2002 through 2006 (Morse et al. 2009). There has also been some speculation that fallow deer densities on Little Saint Simon Island are above the ecological carrying capacity and may be adversely affecting the plant communities (Morse 2008, Morse and Miller 2009).

In Georgia, with an appropriate license, people can farm non-native deer, such as fallow deer, in approved facilities for the commercial production of food and fiber. Although deer in those approved facilities occur within fenced enclosures, deer may occasionally escape the enclosure or people may intentionally release fallow deer from those enclosures.

During FY 2015, WS conducted two technical assistance projects involving fallow deer in the State. WS has not provided direct operational assistance previously associated with fallow deer in the State. However, WS could receive requests for direct operational assistance involving fallow deer in the State. In anticipation of receiving requests for assistance associated with fallow deer, WS could lethally remove up to 150 fallow deer annually if WS implemented Alternative 1. WS could receive requests for assistance with managing free-ranging fallow deer when they cause damage or when removal of a local population could reduce competition with native species and damage to vegetation. WS may also receive requests from the GDNR and/or the GDA to assist with sampling and managing the spread of diseases found in free-ranging and/or captive fallow deer populations. If a disease outbreak occurred, WS could receive requests to remove fallow deer for sampling and/or to prevent further spread of diseases.

If requested, WS could assist with sampling and removing deer from captive facilities where people confine deer inside a perimeter fence. The detection of a disease at a captive facility often raises concerns for the potential spread of diseases to free-ranging herds. The risk of spreading diseases among deer inside those facilities can increase due to their close contact with one another. Often, once someone detects a disease in a confined deer herd, the destruction of the entire herd occurs to ensure the containment of the disease. Any involvement with the depopulation of fallow deer confined inside a perimeter fence by WS would be at the request of the GDNR and/or the GDA. However, WS' total annual removal would not exceed 150 fallow deer annually if WS implemented this alternative.

Fallow deer are not native to Georgia and when held under the appropriate license, the GDNR and the GDA consider fallow deer to be a farmed animal (*i.e.*, livestock). The GDNR considers free-ranging fallow deer to be non-native species in the State and people can harvest those deer at any time (C. Killmaster, GDNR, pers. comm. 2016). As indicated previously, the current statewide population of free-ranging fallow deer is unknown.

Executive Order 13112 directs federal agencies to address invasive species to the extent practicable and permitted by law. WS Directive 2.320 provides guidelines for WS' actions in the management of invasive species in fulfillment of Executive Order 13112. If WS implemented this alternative, any activities conducted by WS would involve local populations of free-ranging fallow deer, deer confined inside an enclosure, or deer that have escaped an enclosure.

Any damage management activities involving the use of lethal methods by WS to remove fallow deer would involve local populations of fallow deer where the property owner, property manager, or another appropriate authority requests assistance. Therefore, the removal of fallow deer by WS could reduce or eliminate the presence of fallow deer in localized areas and/or inside enclosures. In those cases where fallow deer were causing damage or they posed a threat to natural resources and complete removal of the local population occurred, the removal could provide some benefit to the natural environment since fallow deer are not part of the native ecosystem.

FERAL AND FREE-RANGING CAT POPULATION INFORMATION AND EFFECTS ANALYSIS

Feral cats and free-ranging cats are domesticated cats living in the wild or allowed to range freely in the wild. They are generally small in stature, weighing from three to eight pounds (1.4 to 3.6 kg), standing eight to 12 inches (20 to 30.5 cm) high at the shoulder, and 14 to 24 inches (35.5 to 61 cm) long. The tail adds another 20 to 30.5 centimeters (8 to 12 inches) to their length. Colors range from black to white to orange, and a variety of combinations of those colors. Other hair characteristics also vary greatly (Fitzwater 1994).

Feral and free-ranging cats can occur in commensal relationships wherever people occur. In some urban and suburban areas, cat populations can equal human populations. In many suburban and eastern rural areas, feral cats may be the most abundant predators. They are opportunistic predators and scavengers that feed on rodents, rabbits, shrews, moles, birds, insects, reptiles, amphibians, fish, carrion, garbage, vegetation, and leftover pet food (Fitzwater 1994).

Feral cats can produce two to 10 kittens during any month of the year. An adult female may produce three litters per year where food and habitat are sufficient. Cats may be active during the day but typically are more active during twilight or at night. House cats may live up to 27 years, but feral and free-ranging cats probably average only three to five years. They are territorial and move within a home range of roughly four square kilometers (1.5 mi^2). After several generations, feral cats are wild in habits and temperament (Fitzwater 1994).

Feral and free-ranging cats can have an impact on wildlife populations in suburban and rural areas directly by predation and indirectly by competition for food (Coleman and Temple 1989). In the United Kingdom, one study determined that house cats might take an annual toll of some 70 million animals and birds (Churcher and Lawton 1987). American birds face an estimated 117 to 157 million exotic predators in the form of free-ranging domestic cats, which may kill at least one billion birds every year in the United States. Cats have contributed to declines and extinctions of birds worldwide, with feral cats considered one of the most important drivers of global bird extinctions (Dauphine and Cooper 2009).

Feral and free-ranging cats also pose a health and safety threat to household pets. Feral and stray cats are at increased risk of feline immunodeficiency virus, feline leukemia, feline panleukopenia virus, also known as feline distemper, and rabies. Feral and free-ranging cats can transmit all of those diseases to unvaccinated pet owners allow their cats to free-range. The feline panleukopenia virus is highly contagious and the virus may survive in the environment for up to a year. In addition, people can transmit the virus to indoor cats through indirect routes, such as on shoes (Berthier et al. 2000, Truyen et al. 2009). Feral and free-ranging cats can serve as a reservoir for animal and human diseases, including cat scratch fever, histoplasmosis, leptospirosis, mumps, plague, rabies, ringworm, salmonellosis, toxoplasmosis, tularemia, and various parasites (Fitzwater 1994).

The number of feral and free-ranging cats in Georgia is unknown. Many wildlife biologists and ornithologists consider feral and free-ranging cats to be a detriment to native wildlife species. Feral and free-ranging cats prey upon native wildlife species and compete with native predators for prey. Thus, removing feral cats could provide some benefit to the natural environment by eliminating predation and competition from an introduced species.

Requests for assistance received by WS involving feral and free-ranging cats have primarily been associated with human safety threats and damage to property. During direct operational assistance projects conducted by WS from FY 2010 through FY 2015, WS lethally removed 139 feral cats intentionally across the State. In addition, 67 feral or free-ranging cats were intentionally live-captured and released unharmed or were relinquished to a local animal control facility for care and to determine their adoptability. Between FY 2010 and FY 2015, 135 cats were unintentionally live-captured by WS across the State during other damage management activities, primarily activities associated with the ORV program (USDA 2009*a*). Those cats unintentionally live-captured were released unharmed or relinquished to a local animal control facility. WS also lethally removed two feral or free-ranging cats unintentionally during other damage management activities conducted from FY 2010 through FY 2015.

Under the proposed action alternative, those people requesting assistance could request that WS employ live-capture methods to alleviate damage or threats of damage associated with feral or free-ranging cats. Once live-captured, WS would transfer custody of the cats to a local animal control facility. After relinquishing the feral or free-ranging cats to a local animal control facility, the care and the final disposition of the cat would be the responsibility of the animal control facility. However, in some cases, people may request that WS lethally remove feral cats to alleviate damage or threats. WS could lethally remove up to 200 feral cats annually in anticipation of receiving requests to remove feral cats. WS could also lethally remove feral cats unintentionally during other damage management activities; however, WS does not anticipate the cumulative lethal removal of feral cats to exceed 200 cats annually. Based upon the above information, WS' limited removal of feral cats would have minimal effects on local or statewide populations in Georgia. Removing feral cats could temporarily reduce a population at a local site. In those cases where feral cats were causing damage or were creating a nuisance and WS could achieve complete removal of the local population, this could be considered as providing some benefit to the natural environment since feral and free-ranging cats are not considered part of the native ecosystem.

FERAL AND FREE-RANGING DOG POPULATION INFORMATION AND EFFECTS ANALYSIS

Like domestic dogs, feral and free-ranging dogs can manifest themselves in a variety of shapes, sizes, colors, and even breeds. McKnight (1964) noted German shepherds, Doberman pinschers, and collies as breeds that often become feral. Most feral dogs today are descendants of domestic dogs that appear similar to dog breeds that are locally common (Green and Gipson 1994). The primary feature that distinguishes feral from domestic dogs is the degree of reliance or dependence on people, and in some respect, their behavior toward people. Feral dogs survive and reproduce independently of human intervention or assistance. While it is true that some feral and free-ranging dogs use human garbage for food, others acquire their primary subsistence by hunting and scavenging like other wild canids.

Feral and domestic dogs often differ markedly in their behavior toward people. Scott and Causey (1973) based their classification of those two types by observing the behavior of dogs while confined in cage traps. Domestic dogs usually wagged their tails or exhibited a calm disposition when people approached; whereas, most feral dogs showed highly aggressive behavior, growling, barking, and attempting to bite. Some dogs were intermediate in their behavior and Scott and Causey (1973) could not classify those dogs as either feral or domestic based solely on their reaction to people. The aggressive behavior of feral dogs toward people is not surprising since people have pursued, shot at, or trapped many feral dogs. For example, a feral dog caught in Arkansas had numerous lead pellets imbedded under the skin, which Gipson (1983) indicated was likely a testament to the relationship between some people and feral dogs.

Feral dogs are usually secretive and wary of people. Thus, they are active during dawn, dusk, and at night, much like other wild canids. They often travel in packs or groups and may have rendezvous sites, similar to wolves. Travel routes to and from gathering sites or den sites may be well defined. Food scraps and other evidence of concentrated activity may occur at gathering sites.

The appearance of tracks left by feral and free-ranging dogs varies with the size and weight of the animal. Generally, dog tracks are more round and show more prominent nail marks than those of coyotes, and they are usually larger than the tracks of fox. Since a pack of feral dogs likely consists of animals in a variety of sizes and shapes, the tracks from a pack of dogs will vary correspondingly, unlike the tracks of a group of coyotes (Green and Gipson 1994).

Feral and free-ranging dogs may occur where people permit their dogs to roam free or where people abandon unwanted dogs. Feral and free-ranging dogs probably occur in all of the 50 states, Canada, and Central and South America. They are also common in Europe, Australia, Africa, and on several remote ocean islands, such as the Galapagos. Home ranges of feral and free-ranging dogs vary considerably in size, with size likely influenced by the availability of food. Dog packs that are primarily dependent on garbage may remain in the immediate vicinity of a landfill, while other packs that depend on livestock or wild game may forage over an area of 130 square kilometers (50 mi^2) or more (Green and Gipson 1994).

Some people will not tolerate feral dogs in close proximity to human activity; thus, they take considerable effort to eliminate them in such areas. Feral dogs may occur on lands where human access is limited, such as military reservations and large airports. They may also live in remote sites, where they feed on wildlife and native fruits. The only areas that do not appear to be suitable for feral dogs are places where food and escape cover are not available, or where large native carnivores, particularly wolves, are common and prey on dogs (Green and Gipson 1994).

Like coyotes, feral and free-ranging dogs are opportunistic feeders. They can be efficient predators, preying on small and large animals, including domestic livestock. Many rely on carrion, particularly road-killed animals, crippled waterfowl, green vegetation, berries, and other fruits, and refuse at garbage dumps (Green and Gipson 1994).

Feral and free-ranging dogs are highly adaptable, social carnivores. Gipson (1983) suggested that family groups of feral and free-ranging dogs are more highly organized than previously believed. Several members of a pack may share pup rearing. Pups born during autumn and winter often survive, even in areas with harsh winter weather. Gipson (1983) found that only one female in a pack of feral dogs studied in Alaska gave birth during two years of study, even though other adult females were present in the pack. The breeding female gave birth during late September or early October during both years. Gipson (1983) indicated that all pups from both litters had similar color markings, suggesting that the pups had the same father. Adult males of different colors were present in the pack.

Nesbitt (1975) commented on the rigid social organization of a pack of feral dogs where nonresident dogs were excluded, including females in estrus. In one instance, Nesbitt (1975) used three separate female dogs in estrus as bait (dogs were chained in the back of a corral-type trap) over a 59-day period and captured no feral dogs. Nesbitt (1975) then baited the same trap with carrion, and a pack of feral dogs, including four adult males, entered the trap within one week (Green and Gipson 1994).

Hybridization between feral dogs and other wild canids can occur, but non-synchronous estrus periods and pack behavior (that is, excluding non-resident canids from membership in the pack) may preclude much interbreeding. Dens may be burrows dug in the ground or sheltered spots under abandoned buildings or farm machinery. Feral dogs commonly use former fox or coyote dens (Green and Gipson 1994).

Feral dogs can cause damage by preying on livestock, poultry, house cats, or domestic dogs. They may also feed on fruit crops including melons, berries, grapes, and native fruit. They may also attack people, especially children. This is especially true where they feed at and live around landfills near human dwellings (Green and Gipson 1994). In some locales, they may present a serious threat to deer (Lowry 1978) and other valuable wildlife (Green and Gipson 1994).

WS provided technical assistance to requesters associated with dogs during 14 projects from FY 2010 through FY 2015. WS referred most requests for assistance to a local animal control facility since requesters were usually unable to determine if a dog was feral or a free-ranging pet. From FY 2010 through FY 2015, WS lethally removed 50 feral dogs during damage management activities in Georgia. In addition, the WS program live-captured and released 60 feral dogs between FY 2010 and FY 2015. Between FY 2010 and FY 2015, the WS program relinquished most of those feral dogs live-captured to a local veterinarian. The veterinarian determined the fate of the animals relinquished by WS. WS also dispersed one feral dog during damage management activities conducted from FY 2010 through FY 2015.

In addition, WS live-captured eight feral dogs unintentionally between FY 2010 and FY 2015, which WS released unharmed. Based on previous requests for assistance and in anticipation of additional efforts, WS could lethally remove up to 50 feral or free-ranging dogs per year under this alternative. WS could also unintentionally remove feral or free-ranging dogs during other damage management activities; however, WS does not anticipate the cumulative lethal removal of feral or free-ranging dogs to exceed 50 dogs annually.

In most cases, WS would employ live-capture methods to alleviate damage or threats of damage associated with dogs. Once live-captured, WS would transfer custody of the dogs to a local animal control facility or veterinarian. After relinquishing the dogs to a local animal control facility, the care and the final disposition of the dog would be the responsibility of the animal control facility. Activities associated with feral or free-ranging dogs would comply with WS Directive 2.340.

Based upon the above information, WS' limited lethal removal of feral or free-ranging dogs should not adversely affect the overall dog population in Georgia. Any activities involving lethal methods by WS would be restricted to isolated individual sites, which could temporarily reduce a local population because of removals aimed at reducing damage at a local site. In those cases where feral or free-ranging dogs were causing damage or posing as a nuisance and WS could completely remove a local population, the reduction in the local population could provide some benefit to the natural environment since feral or free-ranging dogs are not considered part of the native ecosystem.

FERAL SWINE POPULATION INFORMATION AND EFFECTS ANALYSIS

Feral swine, also known as "*wild pigs*", "*wild boars*", and "*feral hogs*", are medium-sized hoofed mammals that look similar to domestic pigs. They usually have coarser and denser coats than their domestic counterparts and exhibit modified canine teeth called "*tusks*" that are usually 7.5 to 12.5 centimeters (3 to 5 inches) long but may be up to 23 centimeters (9 inches) long. These tusks curl out and up along the sides of the mouth. Lower canines are also prominent but smaller. Adults of the species average 90 centimeters (3 feet) in height and 1.32 to 1.82 meters (4 feet 6 inches to 6 feet). Males may attain a weight of 75 to 200 kilograms (165 to 440 lbs), while females may weigh 35 to 150 kilograms (77 to 330 lbs).

Feral swine are one of the most prolific wild mammals in North America (Barrett and Birmingham 1994). Feral swine can breed throughout the year with peak breeding periods occurring in January and February as well as early summer. Litters sizes usually range from one to 13 piglets, with female swine generally producing two litters per year (Barrett and Birmingham 1994, National Audubon Society 2000, Mayer and Brisbin 2009). Given adequate nutrition, a feral swine population can reportedly double in just four months (Barrett and Birmingham 1994). Feral swine may begin to breed as young as four months of age and sows can produce two litters per year (Mayer and Brisbin 2009). Young feral swine have pale longitudinal stripes on the body until they are six weeks of age.

Feral swine occur in variable habitats but groups of swine usually cluster around areas with ample food and water supplies. Evidence of the presence of feral swine may be rooted up earth, tree rubs at ground level to 900 cm (36 inches) high, with clinging hair or mud, and muddy wallows. Damage in areas supporting feral swine populations is sometimes a serious natural resource management concern for land managers. Substantial damage has occurred to natural resources, including destruction of fragile plant communities, killing tree seedlings, and erosion of soils (Barrett and Birmingham 1994). Food sources for feral swine includes acorns, hickory nuts, pecans, beech nuts, and a wide variety of vegetation including roots, tubers, grasses, fruit, and berries, but feral swine also eat crayfish, frogs, snakes, salamanders, mice, eggs and young of ground-nesting birds, young rabbits, and any other easy prey or carrion encountered. Feral swine can also kill and eat deer fawns (National Audubon Society 2000).

They may also kill considerable numbers of domestic livestock, especially young animals, in some areas (Barrett and Birmingham 1994). Several diseases are associated with feral swine populations (see Table 1.4).

Pimentel (2007) estimated the feral swine population in the United States to be 5 million swine. The total feral swine population in Georgia is unknown; however, they occur in 95% of the counties within the State (Wild Hog Working Group 2012). Appendix F shows the current estimated distribution of feral swine in the State. Feral swine populations in Georgia likely will continue to increase due to their prolific breeding behavior, adaptability, and people illegally releasing additional into the wild. In response to damage that feral swine cause, there is no closed season for feral swine in the State on private property and people can remove feral swine at any time, including at night, using legally available methods, except cable devices.

WS could provide assistance with managing feral swine damage in response to requests by federal agencies, state agencies, or the public in Georgia. Agricultural producers may request assistance with managing damage to standing crops or disease threats to domestic livestock. Natural resource managers may request assistance to protect natural areas, parks or recreation areas, or T&E species. Public health agencies may request assistance in reducing feral swine densities where disease threats to people may be present. WS may use any legal methods among those outlined by Barrett and Birmingham (1994), West et al. (2009), and Hamrick et al. (2011) as suitable for feral swine damage management, including the use of aircraft to shoot feral swine (see Appendix B).

Between FY 2010 and FY 2015, WS conducted 109 technical assistance projects associated with feral swine in Georgia. Those persons requesting assistance reported damage to agricultural crops, natural resources, landscaping, turf, and golf courses. Damages occur primarily from the rooting and wallowing behaviors of feral swine. From FY 2010 through FY 2015, WS removed 2,095 feral swine in Georgia, which is an average annual removal of 349 feral swine. Removal of a small number of feral swine or a single individual will sometimes reduce damage considerably where natural resources, agriculture, or property is affected (Barrett and Birmingham 1994). However, damage may increase dramatically in areas where feral swine have ample resources and opportunity to expand.

Based on previous requests for assistance and the likely continued spread of feral swine in Georgia, WS anticipates the program could lethally remove up to 5,000 feral swine annually in the State to alleviate damage associated with requests for assistance and for disease surveillance. However, WS does not expect such population reduction to affect the overall statewide population of feral swine because of the high reproductive rates exhibited by these animals (Barrett and Birmingham 1994). For example, Timmons et al. (2012) was able to model population growth rates for the feral swine population in Texas using demographic parameters gathered from feral swine in the southeastern United States. Using those demographic parameters, Timmons et al. (2012) estimated an average annual growth rate of 21% for feral swine populations in Texas. If the average annual harvest of feral swine in Texas represented 28% of the population, Timmons et al. (2012) expected the statewide population in Texas to double every five years. If annual harvest rates reached 41% of the statewide population in Texas, Timmons et al. (2012) predicted the population would continue to increase at a rate of 12% per year. The model determined that an annual harvest of 66% of the population was needed to hold the population stable in Texas (Timmons et al. 2012). In another example, the South Carolina Wild Hog Task Force (2012) estimated that 50 to 75% of the statewide feral swine population in South Carolina would have to be removed annually to stabilize or reduce the population in that State.

The total number of feral swine harvested in the State to alleviate damage and during other hunting activities is not currently known. Based on recent findings by Stevens (2010) and the Wild Hog Working Group (2012), current cumulative harvest levels in the State have not been sufficient to reduce feral swine populations in the State. Damage management activities associated with feral swine would target single animals or local populations of feral swine at sites where their presence was causing unacceptable damage or threats to agriculture, human health and safety, natural resources, or property. Based on the findings of the South Carolina Wild Hog Task Force (2012) and Timmons et al. (2012), the cumulative harvest of feral swine would likely not reach a magnitude that would cause a decline in the statewide feral swine population. Although the actual cumulative harvest of feral swine is unknown in the State, the combined harvest is not likely to reach a level where statewide population declines would occur based on the reproductive potential of swine. The annual removal of feral swine by WS would be of low magnitude compared to the actual statewide population and the number of feral swine people harvest annually in the State. Therefore, the activities of WS to alleviate feral swine damage or threats of damage would not limit the ability of people to harvest feral swine in the State.

Feral swine are not native to North America, including Georgia. Lowe et al. (2000) ranked feral swine as one of the 100 worst invasive species in the world. The National Invasive Species Council specifically lists feral swine as an invasive species pursuant to Executive Order 13112. Executive Order 13112 directs federal agencies to address invasive species to the extent practicable and permitted by law. WS Directive 2.320 provides guidelines for WS' actions in the management of invasive species in fulfillment of Executive Order 13112.

Any damage management activities involving lethal methods by WS would be restricted to isolated individual sites. Some local populations may be temporarily reduced because of damage management activities aimed at reducing damage at a local site. In those cases where feral swine were causing damage or they posed a threat of damage and complete removal of the local population could be achieved, this could be considered as providing some benefit to the natural environment since feral swine are not considered part of the native ecosystem.

GRAY FOX POPULATION INFORMATION AND EFFECTS ANALYSIS

The gray fox is common in many parts of the United States where deciduous woodlands provide habitat; yet, the secretive grey fox is seldom observed in the wild. The gray fox is somewhat smaller in stature than the red fox, having shorter legs and extremities. Gray fox exhibit striking pelage, which has grizzled upper parts resulting from individual guard hairs being banded with white, gray, and black. A predominance of black-tipped hairs in the middle of the back forms a dark longitudinal stripe that extends into a conspicuous black mane of coarse hair at the top of the black-tipped tail. Portions of the neck, sides, and limbs are cinnamon-colored. The ventral areas of a gray fox are buff colored. White shows on the ears, throat, chest, belly, and back legs, and the black, white, and reddish facial markings provide distinctive accents (Fritzell 1987).

Gray fox adults weigh from three to seven kilograms (6.5 to 15 lbs), with males being slightly larger than females. Generally, adult gray fox measure 80 to 113 centimeters (31.5 to 44 inches) from the tip of the nose to the tip of the tail. They inhabit wooded, brushy, and rocky habitats from extreme southern Canada to northern Venezuela and Colombia, excluding portions of the mountainous northwestern United States, the Great Plains, and eastern Central America. Gray fox occur over most of the eastern and southwestern United States along with most of California and western Oregon (Fritzell 1987, Cypher 2003).

Gray fox prefer habitat with dense cover, such as thickets, riparian areas, swampland, or rocky pinyon-cedar ridges. In eastern North America, gray fox are closely associated with edges of deciduous forest. They can also occur in urban areas where suitable habitat exists (Phillips and Schmidt 1994, Cypher 2003).

Gray fox mate from January through April and produce litters of one to ten kits after a gestation period of 53 days (Cypher 2003). Gray fox rear young in a maternity den, commonly located in woodpiles, rocky outcrops, hollow trees, or brush piles (Phillips and Schmidt 1994, Cypher 2003). The male parent helps tend to the young but does not stay in the den with them. The young are weaned at three months and hunt for themselves at four months. Rabies and distemper are associated with this species (Cypher 2003).

Accurate estimates of carnivore populations are rare and those for gray fox populations are no exception. Published estimates of gray fox density vary from 1.2 to 2.1 per square kilometer (3.1 to 5.4 per mi^2) depending on location, season, and method of estimation (Errington 1933, Gier 1948, Lord 1961, Trapp 1978). Over areas larger than 5,000 square kilometers (1,930 mi^2), in which habitat quality varies, densities are likely lower. However, exceptionally high fox densities have been recorded in some situations (Grinnell et al. 1937, Hallberg and Trapp 1984).

Home ranges for gray fox vary throughout the year. Both males and females travel over larger areas during fall and winter, probably in response to increased energy demands and a declining food base (Follmann 1973, Nicholson 1982). During April, when young fox require regular feeding, a female's home range is less extensive than it is without the demands of those young (Follman 1973). Although exceptions exist, eastern gray fox generally have larger home ranges than western animals (Fritzell 1987). For instance, 16 adult fox were tracked for more than one month in Alabama (Nicholson 1982) and Missouri (Haroldson and Fritzell 1984) and it was determined that they all had home ranges larger than 200 hectares (500 acres), and many exceeded 500 hectares (1,235 acres).

Gray fox feed on a wide variety of plant and animal matter, but feed on a wider variety of plant and animal matter than other North American canids (Fritzell 1987, Cypher 2003). Although active primarily at twilight and at night, the gray fox is sometimes seen foraging by day in brush, thick foliage, or timber. The only American canid with true climbing ability, gray fox occasionally forage in trees and often takes refuge in them, especially leaning or thickly branched trees. The gray fox feeds heavily on cottontail rabbits, mice, voles, other small mammals, birds, insects, and plant material, including corn, apples, persimmons, nuts, cherries, grapes, pokeweed fruit, grass, and blackberries. Grasshoppers and crickets are often a very important part of the diet in late summer and autumn (Cypher 2003).

Gray fox occur statewide and are common in forested areas of Georgia (GDNR 2004*a*); however, current population and density estimates are not available. Given the habitat preferences of gray fox, the most likely land cover types that would support gray fox are deciduous forest and mixed forests. The cumulative area of those classifications in Georgia is approximately 56,243 square miles (see Table 4.1). If gray fox only occupied 50% of those land classifications in the State and the density of gray fox in the State were 3.1 gray fox per square mile, the statewide population would be approximately 87,200 gray fox. Gray fox can occur in a variety of habitats, including urban areas, so gray fox occupying only 50% of the suitable land area of the State is unlikely. However, similar to the other furbearing species, the analysis used gray fox occupying only 50% of the suitable land area to provide a minimum population estimate to evaluate the magnitude of the proposed removal by WS. Based on reports by trappers, the gray fox population is stable with local populations showing cyclic trends on a local scale (G. Waters, GDNR, pers. comm. 2015).

The GDNR (2016*a*) classifies gray fox as both a small game animal and a furbearing animal in Georgia with annual hunting and trapping seasons. Hunters and trappers can harvest gray fox during annual hunting and trapping seasons with no limit on the number of fox that people can harvest during the length of those seasons. Table 4.6 shows the number of gray fox that trappers harvested annually in the State from 2010 through 2014. The number of gray fox that hunters harvest annually in the State is unknown. Between 2010 and 2014, trappers have harvested an estimated 27,781 gray fox in the State, which is an average annual harvest of 5,556 fox.

Table 4.6 - Cumulative gray fox removal from known sources in Georgia, 2010-2014

Year	Harvest[1]	WS' Removal[2,3]	TOTAL	WS % of Total
2010	3,986	28	**4,014**	0.7%
2011	4,502	38	**4,540**	0.8%
2012	7,508	35	**7,543**	0.5%
2013	5,679	28	**5,707**	0.5%
2014	6,106	13	**6,119**	0.2%
TOTAL	**27,781**	**142**	**27,923**	**0.5%**

[1]Based on data from the National Furbearer Harvest Statistics Database (Association of Fish and Wildlife Agencies 2016)

[2]WS' removal is reported by federal fiscal year

[3]WS' removal includes all removal including unintentional removal during other damage management activities

Between FY 2010 and FY 2015, WS has lethally removed 163 gray fox during damage management activities. Of those 163 gray fox, WS lethally removed two gray fox unintentionally during other damage management activities. In addition, six gray fox were live-captured unintentionally by WS between FY 2010 and FY 2015 during activities targeting other animals but WS released those gray fox unharmed. WS' highest annual removal of gray fox occurred in FY 2011 when WS lethally removed 38 gray fox, which represented 0.8% of the number of gray fox that trappers harvested during 2011. WS' lethal removal of gray fox has not exceeded 0.8% of the annual harvest of gray fox by trappers in the State between 2010 and 2014. On average, the annual lethal removal of gray fox by WS has represented 0.5% of gray fox that trappers have harvested in the State between 2010 and 2014. Requests for assistance associated with gray fox received by WS have been primarily associated with disease threats and threats to aviation.

Based on previous requests received by WS to reduce damage and in anticipation of additional efforts, WS could remove up to 200 gray fox annually under Alternative 1 to address requests to alleviate damage and threats of damage. WS could also lethally remove gray fox unintentionally during activities targeting other animals; however, WS does not anticipate the cumulative lethal removal of gray fox by WS to exceed 200 fox annually. Using the population estimate of 87,200 fox, the removal of 200 gray fox by WS would represent 0.2% of the estimated statewide population. In addition, the removal of up to 200 gray fox annually by WS would represent 3.6% of the average number of fox harvested during the trapping season. If the average annual harvest during the trapping season was representative of harvest that could occur in the future, the cumulative removal by trappers and WS, if WS' annual removal reached 200 fox, would represent 6.6% of a statewide population estimated at 87,200 gray fox. The highest estimated harvest of gray fox occurred in 2012 when trappers harvested 7,508 gray fox. If WS had lethally removed 200 gray fox during FY 2012, the cumulative removal of gray fox by trappers and WS would have represented 8.8% of a statewide population estimated at 87,200 gray fox. Although the number of gray fox that hunters harvest in the State is unknown, the cumulative harvest of gray fox is not likely to reach a magnitude where population declines would occur.

Since the statewide population of gray fox is likely higher than 87,200 fox, WS' annual removal of gray fox and the cumulative harvest would represent a lower percentage of the actual statewide population. Like other mammal species addressed in this EA, the unlimited number of fox that the GDNR allows people to harvest annually during the hunting and trapping seasons provides an indication the gray fox population maintains sufficient densities within the State to sustain unlimited harvest and that overharvest is unlikely. The annual removal of gray fox by WS would be of low magnitude compared to the actual statewide population and the number of gray fox people harvest annually in the State. Therefore, the activities of WS to alleviate gray fox damage or threats of damage would not limit the ability of people to harvest fox in the State.

GRAY SQUIRREL POPULATION INFORMATION AND EFFECTS ANALYSIS

Gray squirrels occur throughout most of the eastern United States, including Georgia. They inhabit mature hardwood and mixed hardwood forests, especially those containing nut trees, such as oak and hickory. Although habitats for the squirrel species found in Georgia overlap, gray squirrels are most common in mature hardwoods that have a well-developed hardwood mid-story (GDNR 2002, GDNR 2005*c*). Gray squirrels are also common in developed areas, such as parks and residential areas, where densities can be quite high (GDNR 2005*c*). While people commonly refer to them as tree squirrels, they spend quite a bit of time on the ground foraging. Squirrels feed on a wide variety of foods and adapt quickly to unusual food sources. Typically, they feed on wild tree fruits and nuts in fall and early winter. Acorns, hickory nuts, walnuts, and Osage orange fruits are favorite fall foods. Squirrels will often cache nuts for later use. In late winter and early spring, they prefer tree buds. In summer, they eat fruits and succulent plant materials. They also eat fungi, corn, and cultivated fruits when available. They may also chew bark during high population peaks, when food is scarce and may eat insects and other animal matter (Jackson 1994*a*).

In Georgia, squirrels generally have two distinct reproductive periods that occur in December and early January followed by a second in June and early July (GDNR 2002). Older adults may produce two litters per year (Burt and Grossenheider 1976, Jackson 1994*a*). The gestation period is approximately 45 days with litter sizes ranging from one to five, with an average of three young per litter (GDNR 2002, GDNR 2005*c*). Young begin to explore outside the nest at about 10 to 12 weeks of age (Jackson 1994*a*). Home ranges of squirrels range from 1.2 to over 40 acres in size (Flyger and Gates 1982) with gray squirrels generally occupying home ranges up to seven acres and fox squirrels occupying areas from seven to 40 acres in size. In south Alabama, the average home range of fox squirrels was found to be 68 acres, with the average home range for males being 94 acres and the average home range for females being 29 acres (Alabama Department of Conservation and Natural Resources 2014).

The life expectancy of a squirrel in the wild is only one to two years (GDNR 2002, GDNR 2005*c*). A wild squirrel over four years old is rare, while captive individuals may live 10 years or more (Jackson 1994*a*). Approximately 50% of the squirrel population is lost to predation, disease, and accidents each year (Jackson 1994*a*, GDNR 2005*c*). Hawks, owls, snakes, bobcats, coyotes, and fox prey upon squirrels; however, predation is not likely a major mortality factor for squirrels given their reproductive potential (Jackson 1994*a*, GDNR 2002, GDNR 2005*c*). Mites, ticks, mange flies, fleas, roundworms, and tapeworms sometimes infest squirrels but are not major mortality factors (Jackson 1994*a*, GDNR 2002, GDNR 2005*c*). An outbreak of mange or scabies (sever skin conditions caused by mites) can cause localized mortality in squirrels (GDNR 2005*c*).

Squirrel hunting has strong traditional ties in Georgia (GDNR 2002, GDNR 2005*c*). Gray squirrels are game animals in Georgia that have an annual hunting season. In terms of the number of hunters and harvest, squirrels are second to only mourning doves (*Zenaida macroura*) in annual hunters and harvest in Georgia (GDNR 2002, GDNR 2005*c*). During the hunting season, hunters may harvest up to 12 squirrels per day on private lands with no limit on the number of squirrels that hunters can possess during the length of the hunting season (GDNR 2016*a*). During the 2002-2003 hunting season, the GDNR (2002) estimated that hunters harvested approximately 803,000 squirrels[21] in the State. Current harvest data for gray squirrels is not available. Hunters harvest approximately 10 to 20% of the population each year (GDNR 2005*c*).

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[21]Harvest data estimates the gray squirrel and fox squirrel harvest combined. Harvest totals that only represent gray squirrels are not currently available.

Gray squirrel densities fluctuate based on available food sources but long-term densities tend to be stable (Gurnell 1987). Manski et al. (1981) found gray squirrel densities were typically less than 1.2 squirrels per acre in continuous areas of woodlands in North Carolina. Doebel and McGinnes (1974) found gray squirrel densities in small woodlots of less than 10 hectares in area could be as high as 16 squirrels per hectare. In urban parks, Manski et al. (1981) found gray squirrel densities could be more than 8.4 squirrels per acre. A three-acre park in Washington, D.C. had a density of 50 squirrels per hectare (20 per acre) (Hadidian et al. 1987).

The gray squirrel occurs statewide; however, a statewide population estimate for the gray squirrel is currently not available. To determine a statewide population, the evaluation will use the best available information to estimate a statewide population. The rural land cover classifications most likely to encompass suitable squirrel habitats are deciduous and mixed forests, which cumulatively total approximately 56,243 square miles in Georgia (see Table 4.1). If only 50% of those land classes supported gray squirrels, under a worst-case scenario, with an estimate of one gray squirrel per every 7 acres, the conservative statewide populations could be approximately 2.6 million gray squirrels in Georgia if only one squirrel occupied a home range and no home ranges overlapped. This would be a worst-case scenario since gray squirrel populations are likely to inhabit a much larger portion of the land classes in the State and squirrels typically occur at much higher densities. Although the actual number of gray squirrels harvested annually is unknown, if half of the squirrels harvested during the 2002-2003 harvest season were gray squirrels, and if hunters harvest 10 to 20% of the statewide population annually, the population during the 2002-2003 harvest season could have ranged from two to four million gray squirrels. However, the gray squirrel is the most common squirrel species in Georgia (GDNR 2002); therefore, the percentage of gray squirrels harvested during the 2002-2003 harvest season was likely higher than 50% of the total harvest.

Between FY 2010 and FY 2015, WS conducted 62 technical assistance projects associated with gray squirrels. WS did not provide direct operational assistance to alleviate damage associated with gray squirrels from FY 2010 through FY 2012. In FY 2013, WS lethally removed 134 gray squirrels to alleviate damage in the State. In addition, WS' personnel live-captured and released one gray squirrel to alleviate damage during FY 2013. In FY 2014, WS lethally removed 81 gray squirrels to alleviate damage. Despite WS' efforts to reduce the risks of capturing non-target animals, gray squirrels are occasional captured unintentionally by WS' personnel during activities that are targeting other animals. During FY 2014, WS' personnel lethally removed one gray squirrel unintentionally during activities targeting other animal species. In addition, WS' personnel live-captured 18 gray squirrels unintentionally during activities targeting other animal species between FY 2010 and FY 2015 but personnel released those squirrels unharmed.

Based on efforts that could occur from requests for direct operational assistance, WS could lethally remove up to 500 gray squirrels annually under this alternative, including those squirrels that WS could lethally remove unintentionally during other damage management activities. When receiving requests for assistance associated with gray squirrels, the WS program in Georgia would follow WS Directive 2.345.

If WS removed up to 500 gray squirrels annually, the lethal removal would represent 0.03% of the estimated gray squirrel population in the State of two million squirrels. Harvesting squirrels has little impact on overall squirrel populations, except on small woodland tracts that hunters hunt heavily (GDNR 2005*c*). Therefore, the annual harvest of squirrels in the State combined with the annual removal that could occur by WS, which would be of low magnitude compared to the harvest, would not likely result in population declines from overharvest. In addition, the GDNR currently allows hunters to harvest squirrels with no limit on the number of squirrels a hunter can harvest during the length of the hunting season, which provides an indication that overharvest is not likely to occur. The annual removal of gray squirrels by WS would be of low magnitude compared to the actual statewide population and the number of squirrels people harvest annually in the State. Therefore, the activities of WS to alleviate squirrel damage or threats of damage would not limit the ability of people to harvest squirrels in the State.

MINK POPULATION INFORMATION AND EFFECTS ANALYSIS

Mink are a member of the weasel family and are about 46 to 61 centimeters (18 to 24 inches) in length, including the somewhat bushy tail. These animals weigh about 0.7 to 1.4 kilograms (1.5 to 3 lbs). Females are about three-fourths the size of males. Both sexes are a rich chocolate-brown color, usually with a white patch on the chest or chin, and scattered white patches on the belly. The fur is relatively short with the coat consisting of a soft, dense under-fur concealed by glossy, lustrous guard hairs. Mink also have anal musk glands common to the weasel family, and can discharge a disagreeable musk if frightened or disturbed (Boggess 1994*a*). They also mark their hunting territory with this fetid musk, which is as malodorous as a skunk's musk, although it does not carry as far (National Audubon Society 2000).

Mink occur throughout North America, with the exception of the desert southwest and tundra areas (Eagle and Whitman 1987, Larivière 2003). They are shoreline dwellers and their one basic habitat requirement is a suitable permanent water area. This may be a stream, river, pond, marsh, swamp, or lake. Mink often make their dens in bank burrows, holes, crevices, logjams, and abandoned muskrat houses or beaver lodges. They are active mainly at night and are active throughout the year, except for brief intervals during periods of low temperature or heavy snow (Boggess 1994*a*, Larivière 2003). However, they may adjust hunting times to prey availability (Larivière 2003).

Eagle and Whitman (1987) indicated mink population densities varied spatially based on habitat, and weather, trapping, and intraspecific aggression can influence densities temporally. Generally, densities of mink are highest in those areas with abundant, stable aquatic habitat. In Louisiana, Linscombe et al. (1982) found mink densities were highest in swamps, followed by marshes, and drained bottomlands. In Montana, Mitchell (1961) estimated that 280 mink inhabited a 33 square kilometer (12.8 mi^2) area, resulting in a density of one mink per 11.8 ha (29.2 acres). However, the following year, Mitchell (1961) estimated that there were only 109 mink in the area, a density of one mink per 30.3 hectare (74.7 acres). Using mink tracks in snow, Marshall (1936) found 0.6 females in one square kilometer (1.5/mi^2) of riverbank with a 1:1 sex ratio following heavy trapping in Michigan. Errington (1943) found one to five mink families occupying a 180-hectare (450 acres) marsh in Iowa from 1933 to 1938. In 1939, Errington (1943) found no families in the same marsh. Errington (1943) suggested that over-trapping was responsible for the low numbers. Errington (1943) also suggested that intraspecific aggression was responsible for the upper limit of mink inhabiting the marsh.

At a refuge in Wisconsin, McCabe (1949) estimated 24 mink inhabited 446 hectares (1,100 acres) in 1944, which resulted in a density of one mink per 18.8 hectare (46.3 acres). Over the next four years (1945 to 1948), McCabe (1949) found the number of mink ranged from seven to 10 individuals at the refuge. McCabe (1949) also suggested that the lower population estimates found after the initial year of the study in 1944 were due to higher levels of mink trapping and excessive poaching along the refuge borders. The number of mink observed during the study conducted by McCabe (1949) at the refuge was inversely related to the duration and depth of snow cover; however, the number observed was poorly related to food availability (rabbits [*Sylvilagus* spp.] and mice [*Peromyscus* spp.]). During a two-year study in Sweden, Gerell (1971) estimated the number of mink present in a 10,000-hectare (25,000 acres) area at 11 and 16 mink, respectively, which resulted in a density of one mink per 909 hectares (2,245 acres) during the first year of the study and one mink per 625 hectare (1,545 acres) in the second year. Along 1.9 kilometers (1.2 miles) of stream in British Columbia, Ritcey and Edwards (1956) caught 11, six, and five mink over three years, respectively, which were similar densities of 1.5 to 3 mink per kilometer (2.5 to 5 mink per mile) found along the coastal shoreline on Vancouver Island reported by Hatler (1976).

Mink are associated with rivers, streams, creeks, beaver ponds, lakes, and marshes; however, the availability of den sites can limit mink distribution (GDNR 2005*d*). Mink are most common in the Piedmont, Ridge and Valley, Blue Ridge Mountains, and Atlantic Coast regions of the State (GDNR 2005*d*). No population estimates or density estimates were available for mink in Georgia. Therefore, the best available information was used to estimate a statewide population. There are approximately 70,150 miles of perennial and intermittent streams and rivers in Georgia along with 425,382 acres of lakes, reservoirs, and ponds (EPA 2012), with 7.7 million acres of wetlands (Hefner et al. 1994). If only 50% of the 7.7 million acres of wetlands present in the State supported mink and if the population density of mink in the State was one mink per 74.7 acres, the number of mink inhabiting wetlands in the State would be 51,500 mink. If only 50% of the 70,150 miles of streams in the State supported mink and if the population density of mink were five mink per 1.2 miles of stream, the population inhabiting the shoreline would be approximately 146,100 mink. Combining the number of mink inhabiting wetlands and streams, the total statewide mink population could be approximately 197,600 mink.

The GDNR (2016*a*) classifies mink as furbearing animals in Georgia with a regulated trapping season. During the open trapping season, there is no limit on the number of mink that people can harvest (GDNR 2016*a*). From 2010 through 2014, trappers reported harvesting 166 mink in the State during the trapping season (Association of Fish and Wildlife Agencies 2016), which is an average annual harvest of 33 mink. The highest annual harvest of mink between 2010 and 2014 occurred in 2011 when trappers harvested 38 mink.

To alleviate damage or threats of damage associated with mink, WS live-captured and released one mink intentionally from FY 2010 through FY 2015. In addition, one mink was live-captured unintentionally and released during other damage management activities between FY 2010 and FY 2015. Based upon additional efforts that could occur, WS would kill up to five mink each year to address damage or threats of damage. Removal of up to five mink by WS would represent 0.003% of the estimated statewide population of 197,600 mink in Georgia. WS could also lethally remove mink unintentionally during other damage management activities; however, WS does not anticipate the cumulative lethal removal of mink to exceed five mink annually.

If the average annual harvest during the trapping season was representative of harvest that could occur in the future, the cumulative removal by trappers and WS, if WS' annual removal reached five mink, would represent 0.02% of a statewide population estimated at 197,600 mink. The highest estimated harvest of mink occurred in 2011 when trappers harvested 38 mink. If WS had lethally removed five mink during FY 2011, the cumulative removal of mink by trappers and WS would have represented 0.02% of a statewide population estimated at 197,600 mink.

Activities conducted under the proposed action alternative would target individual mink or local populations of mink at sites where they were causing damage to agriculture, human health or safety, natural resources, or property. WS' activities may temporarily reduce some local populations aimed at reducing damage at a local site. The unlimited harvest levels allowed by the GDNR during the trapping season provides an indication that mink densities within the State are sufficient that overharvest from the trapping season and activities to alleviate damage would not likely occur. The annual removal of mink by WS would be of low magnitude compared to the actual statewide population and the number of mink people harvest annually in the State. Therefore, the activities of WS to alleviate mink damage or threats of damage would not limit the ability of people to harvest mink in the State.

MUSKRAT POPULATION INFORMATION AND EFFECTS ANALYSIS

Muskrats are fairly large rodents with dense, glossy fur, dark brown above, lighter on the sides, paler below, to nearly white on the throat. They have long scaly tails that are nearly naked and laterally flattened, tapering to a point but not paddle shaped as the beaver. The muskrat spends its life in aquatic habitats and is well adapted for swimming. Its large hind feet are partially webbed, stiff hairs align the toes, and its laterally flattened tail is almost as long as its body. The muskrat has a stocky appearance, with small eyes and very short, rounded ears. Its front feet, which are much smaller than its hind feet, are adapted primarily for digging and feeding (Miller 1994).

Muskrats build houses, or lodges of aquatic plants, especially cattails, up to 2.4 meters (8 feet) in diameter and 1.5 meters (5 feet) high. Muskrats usually build those structures atop piles of roots, mud, or similar support in marshy areas, streams, lakes, or along water banks. They also burrow in stream or pond banks with entrances often above the water line. Another sign of the presence of muskrats includes are feeding platforms that muskrats build out of cut vegetation in water or on ice. These feeding platforms are marked by discarded or uneaten grasses or reed cuttings and floating blades of cattails, sedges, and similar vegetation located near the banks. This species is most active at dusk, dawn, and at night, but may be seen at any time of the day in all seasons, especially spring. Muskrats are excellent swimmers and spend much of their time in the water. They inhabit fresh, salt, and brackish waters throughout most of Canada and the United States, except for the Arctic regions (National Audubon Society 2000). They can occur in marshes, ponds, sloughs, lakes, ditches, streams, and rivers (Boutin and Birkenholz 1987).

Muskrats are prolific and produce three to four litters per year that average five to eight young per litter (Wade and Ramsey 1986), which makes them relatively immune to overharvest (Boutin and Birkenholz 1987). Gestation period varies between 25 and 30 days. Young muskrats can reproduce the spring after their birth. Harvest rates of three to eight animals per acre have been reported to be sustainable in muskrat populations (Boutin and Birkenholz 1987). Muskrat home ranges have been shown to vary from 529 square feet to 11,970 square feet (0.1 to 0.25 acres), with the size of home ranges occupied by muskrats dependent upon habitat quality and population density (Boutin and Birkenholz 1987).

Young muskrats are especially vulnerable to predation. Adult muskrats may also be subject to predation, but rarely in numbers that would lower populations. Predation cannot be relied upon to solve damage problems caused by muskrats (Miller 1994). Predators of muskrat include great horned and barred owls, red-tailed hawks, bald eagles, raccoons, mink, river otter, red fox, gray fox, coyotes, bobcat, Northern pike (*Esox lucius*), largemouth bass (*Micropterus salmoides*), snapping turtles (*Chelydra serpentine*), and bullfrogs (*Rana catesbeiana*). Adult muskrats also occasionally kill young (Miller 1994).

No population estimates are available in Georgia for muskrats; however, muskrats can occur in the northern two-thirds of the state in suitable habitat (National Audubon Society 2000, Erb and Perry 2003). As stated previously, wetlands in Georgia exceed 7.7 million acres (Hefner et al. 1994, United States Geological Survey 1996) including an estimated 70,150 miles of rivers and streams (EPA 2012).

Since population estimates are not currently available, the analysis will derive a population estimate based on the best available information for muskrats to provide an indication of the magnitude of removal proposed by WS to alleviate damage and threats of damage. Using the lowest acreage of wetlands in Georgia of 7.7 million acres and using a single muskrat home range of 0.25 acres and assuming only one muskrat occupies a home range with no overlap of ranges, a statewide population could be estimated at 30 million muskrats. However, muskrats only occur in the northern two-thirds of the state and not all wetlands likely provide suitable habitat for muskrats. If only 10% of the wetland acreage in the State were suitable habitat for muskrats, the population would be approximately 3 million muskrats.

The GDNR (2016*a*) classifies muskrats as furbearers in Georgia with an annual trapping season. Like other wildlife in the State, the GDNR is responsible for determining the seasons and limits for harvest of muskrats. People can harvest muskrats during annual trappings seasons in the State with no limit on the number of muskrats that people can harvest. From 2010 through 2014, trappers reported harvesting 7,862 muskrats in the State during the trapping season, which is an average annual harvest of 1,572 muskrats (Association of Fish and Wildlife Agencies 2016). The highest annual harvest occurring between 2010 and 2014 occurred in 2011 when trappers harvested 2,941 muskrats.

Between FY 2010 and FY 2015, the WS program in Georgia conducted eight technical assistance projects involving muskrats. Damages occurred to earthen dams and turf from the burrowing activities of muskrats. However, the WS program in Georgia did not receive requests for direct operational assistance associated with muskrats. During activities that WS conducted between FY 2010 and FY 2015, WS' personnel lethally removed 15 muskrats unintentional during activities targeting other animals, primarily activities targeting beaver. On average, WS has lethally removed three muskrats per year unintentionally between FY 2010 and FY 2015. If the program implements this alternative and if the WS program in Georgia receives requests for direct operational assistance, WS anticipates that personnel could lethally remove up to 100 muskrats annually to alleviate damage or threats of damage. In addition, personnel could lethally remove muskrats unintentionally during activities targeting other animal species. However, the WS program in Georgia does not anticipate the number of muskrats lethally removed by the WS program to exceed 100 muskrats annually, including muskrats that personnel could lethally remove unintentionally as non-target animals.

Using a population estimated at 3 million muskrats, the lethal removal of up to 100 muskrats annually would represent 0.003% of the statewide population. If WS removed 100 muskrats, the lethal removal would have represented 3.4% of the estimated statewide harvest of muskrats during the trapping season in 2011 and would represent 6.4% of the average annual number of muskrats harvested during the trapping season from 2010 through 2014.

The cumulative removal of muskrats is not likely to reach a magnitude where adverse effects would occur to the muskrat population. The unlimited harvest allowed by the GDNR provides an indication that the statewide density of muskrats is sufficient that overharvest is not likely to occur. In addition, requests for assistance received by WS associated with muskrats would likely occur in areas where little or no trapping occurs by fur harvesters. Damage management activities associated with muskrats would target single animals or localized populations at sites where their presence was causing unacceptable damage to agriculture, human health and safety, natural resources, or property. The annual removal of muskrats by WS would be of low magnitude compared to the actual statewide population and the number of muskrats people harvest annually in the State. Therefore, the activities of WS to alleviate muskrat damage or threats of damage would not limit the ability of people to harvest muskrats in the State.

NINE-BANDED ARMADILLO POPULATION INFORMATION AND EFFECTS ANALYSIS

The nine-banded armadillo is easily recognized due to its unique appearance. An opossum-sized animal, the armadillo has a "*shell*", which is composed of ossified dermal plates covered by a leathery epidermis (Whitaker, Jr. and Hamilton, Jr. 1998). The armadillo is the only North American mammal that has heavy bony plates (National Audubon Society 2000). Female armadillos produce one litter of young per year, which are genetically identical quadruplets (National Audubon Society 2000).

Originally thought to occur in Central and South America, including Mexico, the nine-banded armadillo has undergone a northward and eastward expansion into the United States since the late-1800s, likely through natural dispersal from Mexico and release of captive armadillos (Layne 2003). Today, the armadillo can be found across the southern portion of the United States with additional dispersal northward and eastward in the United States likely in the future (Layne 2003). Range expansion is likely only limited by the reduced food availability and the colder temperatures experienced during the winter months.

Armadillos do not tolerate extended periods of cold weather, which may limit their expansion northward. Armadillos do not hibernate and must feed every couple of days during winter months since they do not store food nor accumulate efficient amounts of body fat to survive through the winter. The presence of snow or frozen soils limits the availability of food sources, primarily the availability of insects, during winter months. The lack of food available often causes armadillos to starve during winter months. However, in Georgia, winter temperatures are relatively sufficient to maintain armadillo populations; however, periods of extreme cold or prolonged periods of cold temperatures may temporarily affect populations.

Armadillos can occupy and exploit a variety of natural and human-modified terrestrial habitats in the United States and across their range, including those armadillos found in Georgia. Layne (2003) summarizes the natural habitat types occupied by armadillos throughout their range as "*...pine-oak woodlands, oak-elm woodlands, pine forests, mixed pine-hardwood forests, bottomland forests, riparian woodlands, mesic hardwood forests, scrub, chaparral-mixed grass, inland and coastal prairies, salt marsh, coastal dunes, and coastal strand*." Human-modified habitats where armadillos can be found has been summarized by Layne (2003), which included "*...pastures, parkland, cemeteries, golf courses, citrus groves, pine plantations, plant nurseries, cut-over pineland, and various croplands*." The ability of armadillos to exploit a wide variety of habitat types is likely one of the main components facilitating the range expansion of the armadillo into and across the United States (Layne 2003). Habitat suitability is likely more of a function of soil substrate rather than vegetative type due to the foraging and digging behavior of armadillos (Layne 2003).

Armadillos are opportunistic feeders and will often forage by digging and probing the soil, leaf litter, and decaying wood for invertebrates, primarily insects. One study found at least 488 different food items in the stomachs of 281 armadillo with insects and other invertebrates comprising 92% of the stomach contents (Kalmbach 1943). Armadillos can also forage on plant material and small vertebrates with food preferences often driven by the availability of food sources (Layne 2003).

The other limiting factor in armadillo expansion and for maintaining populations is the presence of sandy or clay soils. Armadillos are prolific diggers and damages attributed to armadillos are often associated with their digging behavior. Armadillos will dig out shelters and dig while rooting out invertebrates in the soil and leaf litter. This digging and rooting behavior are the most common complaints from resource owners in Georgia. Damage to landscaping is the most common resource being damaged by armadillos in Georgia. Sandy soils are conducive to digging and armadillos can occur in those areas in Georgia where sandy soils are present.

Population estimates for armadillos in the United States range from 30 to 50 million individuals (Gilbert 1995). However, population estimates in Georgia are not currently available. Armadillos can occur nearly statewide in Georgia but are more common in the southern portion of the State and are showing a generally increasing trend based on trappers reports (G. Waters, GDNR, pers. comm. 2015). The GDNR allows people to remove armadillos at any time with no limit on the number that people can remove (GDNR 2016*a*). However, the number of armadillos that other entities remove annually is unknown.

Since a statewide population estimate for armadillos is not currently available, the analysis will derive a population estimate based on the best available information for armadillos to provide an indication of the magnitude of removal proposed by WS to alleviate damage and threats of damage. Population densities for armadillos can range from 0.004 to 1.4 armadillos per acre with an average of 0.25 armadillos per acre

(Mengak 2005). Based on the natural habitat types occupied by armadillos throughout their range summarized by Layne (2003), the cumulative area of those classifications in Georgia is about 31,000 square miles (see Table 4.1). Using a population density estimated at 0.004 to 1.4 armadillos per acre and if armadillos only inhabited 25% of those land classifications in the State, the statewide population could range from approximately 20,000 armadillos to nearly 7 million armadillos. With an average of 0.25 armadillos per acre, the statewide population would be approximately 1.2 million armadillos. As stated previously, the actual number of armadillos in the State is currently unknown.

Between FY 2010 and FY 2015, the WS program in Georgia has conducted 79 technical assistance projects associated with armadillos. During those projects, people reported landscaping damages occurring to turf/flowers in yards and damage to golf courses. To address requests for assistance associated with armadillos, WS employed lethal methods to remove 245 armadillos from FY 2010 through FY 2015.

Based on previous requests for assistance received by WS and in anticipation of additional efforts, WS could lethally remove up to 300 armadillos annually in the State as part of efforts to alleviate and prevent damage. Given the range of population estimates in the State, the removal of 300 armadillos by WS annually would represent 1.5% of the statewide population based on a population estimated at 20,000 armadillos if the overall population remains at least stable. WS could also lethally remove armadillos unintentionally during other damage management activities conducted by WS; however, WS does not anticipate the cumulative lethal removal of armadillos to exceed 300 armadillos annually. Although the number of armadillos lethally removed by other entities in the State to alleviate damage is unknown, the cumulative removal of armadillos, including the proposed removal of up to 300 armadillos annually by WS, is likely of low magnitude when compared to the actual statewide population of armadillos.

RACCOON POPULATION INFORMATION AND EFFECTS ANALYSIS

The raccoon is a stocky mammal ranging from 61 to 91 centimeters (2 to 3 feet) long, weighing 4.5 to 13.5 kilograms (10 to 30 lbs). It is distinctly marked, with a prominent black mask over the eyes and a heavily furred, ringed tail. The animal is a grizzled salt-and-pepper gray and black above, although some individuals are strongly washed with yellow (Boggess 1994*b*).

Raccoons are omnivorous and they will eat carrion, garbage, birds, mammals, insects, crayfish, mussels, other invertebrates, and a wide variety of grains, various fruits, and other plant materials. They also eat most foods prepared for human or animal consumption (Sanderson 1987). They occasionally kill poultry (Boggess 1994*b*).

The raccoon is found throughout most of the United States, with the exception of the higher elevations of mountainous regions and some areas of the arid southwest (Boggess 1994*b*, Gehrt 2003). Raccoons are more common in the wooded eastern portions of the United States than in the more arid western plains (Boggess 1994*b*), and are frequently found in cities or suburbs, as well as rural areas (Gehrt 2003). Movements and home ranges of raccoons vary according to sex, age, habitat, food sources, season, and other factors. In general, males have larger home ranges than females. Home ranges of raccoons likely range from 50 to 300 hectares (124 to 742 acres) (Gehrt 2003).

Absolute raccoon population densities are difficult or impossible to determine because of the difficulty in knowing what percentage of the population someone has already counted or estimated. In addition, it can be difficult to determine how large an area the raccoons are using (Sanderson 1987). Due to their adaptability, raccoon densities reach higher levels in urban areas than that of rural areas. People have inferred relative raccoon population densities that they based on removal of animals per unit area. For example, Twichell and Dill (1949) reported removing 100 raccoons from tree dens in a 41-hectare (101 acres) waterfowl refuge area, while Yeager and Rennels (1943) studied raccoons on 881 hectares (2,177 acres) in Illinois and reported trapping 35 to 40 raccoons in 1938-1939, 170 in 1939-1940, and 60 in 1940-1941. Slate (1980) estimated one raccoon per 7.8 hectares (19.3 acres) in predominantly agricultural land on the inner coastal plain of New Jersey. Kennedy et al. (1991) estimated 13 raccoons per 100 ha (1 raccoon per 19 acres) of lowland forest in Tennessee. Around abundant food sources, Kern (2002) found raccoon densities could reach 100 raccoons per square mile (1 raccoon per 6.4 acres). Riley et al. (1998) summarized rural raccoon densities based on published literature that ranged from two to 650 per square mile in rural habitats, with an average of 10 to 80 raccoons per square mile.

In Georgia, raccoons can cause damage to gardens, residential and non-residential buildings, fish, domestic fowl, and pets, as well as general property damage. Results of their feeding may be the total loss of ripened sweet corn in a garden. Damage to buildings generally occurs when they seek to gain entry or begin denning in those structures. Raccoons may den in uncapped chimneys, or may tear off shingles or fascia boards to gain access to attics or wall spaces. They may also damage or destroy sod by rolling it up in search of earthworms and other invertebrates (Boggess 1994*b*).

The public are also concerned about health and safety issues associated with raccoons, primarily associated with the risk of disease transmission. Those diseases include, but are not limited to, canine distemper and rabies, and the roundworm *Baylisascaris procyonis*, the eggs of which survive for extremely long periods in raccoon feces and soil contaminated by them. Ingestion of those eggs can result in serious or fatal infections in other animals as well as people (Davidson 2006) (see Table 1.4).

Raccoons can occur throughout the State and are common in a variety of habitats, including rural, suburban, and urban areas (GDNR 2007*b*). Raccoons are closely associated with aquatic habitats, such as coastal marshes, swamps, rivers, lakes, and streams, as well as areas with mature hardwood trees (GDNR 2007*b*). However, the statewide population of raccoons is currently unknown. Therefore, the analysis will use the best available information to estimate a statewide population. If raccoons only inhabited the Southern Coastal Plain, the Southern Piedmont, the Carolina and Georgia Sand Hills, the Atlantic Coast Flatwoods, and the tidewater area of the State, raccoons could be found on approximately 53,431 square miles of the land area in Georgia (see Table 4.1). If only 50% of those land classifications supported raccoons, under a worst-case scenario, and using the average density reported by Riley et al. (1998) of 10 to 80 raccoons per square mile, the statewide population could range from 267,200 to 2.1 million raccoons. This would be a worst-case scenario since raccoon populations are likely to inhabit a much larger portion of those land classifications. Similar to estimates derived for the other mammal species addressed in this EA, estimating that raccoons inhabit only 50% of certain land classifications in the State is intended to determine a minimum population estimate to compare the potential effects of WS' proposed removal of raccoons and to determine the magnitude of WS' proposed removal.

The GDNR (2016*a*) classifies raccoons as a small game species and a furbearing animal with regulated hunting and trapping seasons. The GDNR currently allows hunters and trappers to harvest an unlimited number of raccoons during the length of the hunting and trapping seasons on private lands. As shown in Table 4.7, trappers harvested 59,638 raccoons in the State from 2010 through 2014, which is an average of 11,928 raccoons harvested each year. The highest annual harvest occurred in 2014 when trappers harvested 15,201 raccoons. The number of raccoons harvested by hunters in the State is currently unknown.

As with other furbearing species, people and nuisance animal trappers can apply for permits to lethally remove raccoons to alleviate damage or threats of damage. The total number of raccoons lethally removed annually in the State to alleviate damage or threats of damage is currently unknown. WS continues to provide assistance in efforts to contain the spread of the raccoon variant of rabies in Georgia as part of the national rabies barrier program (USDA 2009*a*). Activities involving raccoons conducted under the ORV program were addressed in a separate EA (USDA 2009*a*) but those activities will also be evaluated in this EA as part of the cumulative impact analyses.

Table 4.7 - Cumulative raccoon removal from known sources in Georgia, 2010-2014

Year	Harvest[1]	WS' Removal[2,3]	TOTAL	WS % of Total
2010	9,325	108	**9,433**	1.2%
2011	9,787	252	**10,039**	2.5%
2012	11,774	214	**11,988**	1.8%
2013	13,551	174	**13,725**	1.3%
2014	15,201	198	**15,399**	1.3%
TOTAL	**59,638**	**946**	**60,584**	**1.5%**

[1]Based on data from the National Furbearer Harvest Statistics Database (Association of Fish and Wildlife Agencies 2016)
[2]WS' removal is reported by federal fiscal year
[3]WS' removal includes all removal including unintentional removal during other damage management activities

During all damage management activities conducted by WS from FY 2010 through FY 2015, WS lethally removed 1,345 raccoons in Georgia, which is an annual average removal of 224 raccoons. During FY 2015, WS removed 399 raccoons in Georgia, which represented the highest annual removal by WS from FY 2010 through FY 2015. Of those raccoons lethally removed from FY 2010 through FY 2015, WS removed 25 raccoons unintentionally during other damage management activities, which is an average annual removal of four raccoons. WS also live-captured and released 818 raccoons intentionally between FY 2010 and FY 2015, primarily during activities associated with the ORV program (USDA 2009*a*). In addition, one raccoon was live-captured unintentionally during other damage management activities and released unharmed between FY 2010 and FY 2015.

Based on previous requests for assistance received by WS and in anticipation of additional efforts to manage raccoon damage, WS could lethally remove up to 1,000 raccoons annually under Alternative 1. Using the population estimate ranging from 267,200 to 2.1 million raccoons, the removal of 1,000 raccoons under the proposed action would represent 0.1% to 0.4% of the estimated population. As stated previously, the actual statewide population likely exceeds 267,200 raccoons given the parameters used to estimate the population. Activities conducted to prevent the further spread of raccoon rabies in the State generally do not result in the lethal removal of raccoons. Raccoons are live-captured, sampled, and released on-site as part of the post-baiting protocols (USDA 2009*a*). However, if raccoons were visibly injured or exhibited signs of disease upon live-capture, WS often euthanizes those raccoons and processes the carcass for rabies testing. The number of raccoons lethally removed in the State during the post-baiting trapping varies, but is not likely to exceed 50 individuals annually. However, the statewide cumulative removal of raccoons by WS in Georgia under all damage and disease management activities would not exceed 1,000 raccoons annually, which would represent 0.4% of the lowest population estimate of raccoons in the State. If WS removed 1,000 raccoons, the lethal removal would have presented 6.6% of the estimated statewide harvest of raccoons during the trapping season in 2014 and would represent 8.4% of the average annual number of raccoons harvested during the trapping season from 2010 through 2014. The lethal removal of up to 1,000 raccoons by WS would represent an even smaller percentage of the cumulative removal of raccoons if the number of raccoons that hunter harvest and the number of raccoons that other entities remove to alleviate damage were known.

If the level of annual harvest during the trapping season in 2014 were representative of future annual harvest, and if the annual removal by WS reached 1,000 raccoons, the cumulative removal of raccoons by trappers and WS would be 16,201 raccoons. The cumulative removal of 16,201 raccoons would represent 6.1% of a statewide population estimated at 267,200 raccoons. Since the statewide population is likely higher than 267,200 raccoons for those reasons discussed previously, cumulative removal is likely a much smaller percentage of the actual statewide population.

Raccoon populations can remain relatively abundant if annual harvest levels are below 49% (Sanderson 1987). Therefore, if the statewide population of raccoons were 267,200 raccoons, the cumulative removal by all entities would have to reach 130,928 raccoons to cause the statewide population to begin to decline. If the statewide population of raccoons were 2.1 million raccoons, the cumulative removal of a raccoons would have to reach over 1 million raccoons to cause the statewide population to decline. In addition, the statewide population is likely much higher than estimated in this analysis. As with many of the other mammals species harvested for fur in the State, the unlimited harvest levels allowed by the GDNR provides an indication that overharvest of raccoons is not likely to occur during annual harvest seasons and from damage management activities. Although the actual statewide population of raccoons is unknown, the cumulative removal of raccoons would be of low magnitude when compared to the actual statewide population. In addition, the live-capture and subsequent release of raccoons would not likely result in adverse effects to the statewide population since those animals would be released unharmed (USDA 2009*a*).

The annual removal of raccoons by WS would be of low magnitude compared to the actual statewide population and the number of raccoons people harvest annually in the State. Therefore, the activities of WS to alleviate raccoon damage or threats of damage would not limit the ability of people to harvest raccoons in the State.

RED FOX POPULATION INFORMATION AND EFFECTS ANALYSIS

The red fox is a typically proportioned member of the dog family. The bushy and unusually long tail, pointed ears, slender muzzle, and slanted eyes coupled with its small dog size and typical reddish coloration, make the red fox instantly recognizable to most people. This species is also the most common and well-known species in the genus *Vulpes*, which includes about 10 other species worldwide (Cypher 2003). Typically, black-tipped ears, black cheek patches, white throat parts, a lighter underside, and black "*leg stockings*" occur on most red fox. The white tip of the tail (which is much more prominent in North American fox than elsewhere) can be used to distinguish brownish fox pups from similarly colored coyote pups, which lack a white tail tip (Voigt 1987, Cypher 2003).

In North America, the red fox weighs from 3.5 to 7 kilograms (7.7 to 15.4 lbs), with males averaging about one kilogram (2.2 lbs) heavier than females. Generally, adult fox measure 100 to 110 centimeters (39 to 43 inches) from the tip of the nose to the tip of the tail. Juveniles in their first autumn are similar in size to adults (Voigt 1987). Red fox occur over most of North America, north and east from southern California, Arizona, and central Texas. They occur throughout most of the United States with the exception of a few isolated areas. Prehistoric fossil records suggest that the red fox may not have inhabited much of the United States, but they were plentiful in many parts of Canada. However, climatic factors, interbreeding with the introduced European red fox, extirpation of the wolves, and clearing of land for agriculture has possibly contributed to the present-day expansion and range of this species in North America (Voigt 1987, Cypher 2003).

Red fox are adaptable to most habitats within their range, but usually prefer open country with moderate cover. Some of the highest fox densities reported are in the north-central United States and occur where woodlands are interspersed with farmlands. Red fox have also demonstrated their adaptability by establishing breeding populations in many urban areas of the United States, Canada, and Europe (Phillips and Schmidt 1994). In many areas, competition with other canids and the availability of suitable year-round food resources limit fox survival. Habitat determines the availability of year-round food resources and the presence or absence of other canids. Because those two factors strongly influence red fox survival, habitat limits fox numbers but seldom limits distribution (Voigt 1987).

Red fox mate from December to April and produce litters of one to 12 kits after a gestation period of 51 to 54 days. They rear young in a maternity den, commonly an enlarged woodchuck or badger den, usually in sparse ground cover on a slight rise, with a good view of all approaches (Cypher 2003). Juvenile fox are able to breed before reaching a year old, but in areas of high red fox densities, most yearlings do not produce pups their first year (Harris 1979, Voigt and MacDonald 1984, Voigt 1987). Gier (1968) reported average litter sizes of 4.8 to 5.1 in years with low rodent numbers, but litters of 5.8 to 6.2 during years with high rodent numbers. Offspring disperse from the denning area during the fall and establish breeding areas in vacant territories, sometimes dispersing considerable distances. Red fox are generally solitary animals as adults, except when mating (Phillips and Schmidt 1994). Rabies and distemper are associated with this species (Cypher 2003).

The red fox is a skilled nonspecific predator, foraging on a variety of prey. Red fox are also an efficient scavenger, and in parts of the world, garbage and carrion are extremely important to its diet (Voigt 1987). They are opportunists, feeding mostly on rabbits, mice, bird eggs, insects, and native fruit. They usually kill animals smaller than a rabbit, although fawns, pigs, kids, lambs, and poultry are sometimes killed (Phillips and Schmidt 1994).

Densities of red fox can be difficult to determine because of the animals secretive and elusive nature. Estimates are prone to error even in open areas with good visibility. Methods used to estimate numbers have included aerial surveys, questionnaires to rural residents and mail carriers, scent post surveys, intensive ground searches, and indices derived from hunting and trapping harvest (Voigt 1987, Cypher 2003). In Great Britain, where food is abundant in many urban areas, densities as high as 30 fox per square kilometer (78 per mi^2) have been reported (Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986), while in southern Ontario, densities of about 1 fox per square kilometer (2.6 per mi^2) occur during spring. This includes both pups and adults. In small areas of the best habitat, three times as many fox have been observed (Voigt 1987). However, those densities rarely occur extensively because of the dispersion of unsuitable habitat, high mortality, or from competition with coyotes (Voigt and Earle 1983). Cyclical changes in fox numbers occur routinely and complicate density estimates as well as management. Those cycles can occur because of changes in prey availability, or disease outbreaks, especially rabies, among red fox. For fox populations to remain relatively stable, mortality and reproduction must balance approximately.

Home ranges for red fox in the eastern United States are usually from 500 to 2,000 hectares (1,235 to 4,940 acres) in rural settings, such as farmland (Voigt and Tinline 1980), but such sizes may not apply among fox populations in urban settings.

Red fox occur statewide in Georgia and are common in mixed pine-hardwood forests interspersed with fields, croplands, and/or grasslands (GDNR 2004*a*). Like other furbearing species in the State, the statewide population is currently unknown. In addition, density data for red fox in Georgia is not currently available. However, the majority of trappers report that red fox populations seem to be stable with cyclic population changes occurring in local populations (G. Waters, GDNR, pers. comm. 2015). Given that red fox densities are highest in areas where woodlands are interspersed with farmlands, the cumulative area of these classifications (Southern Coastal Plain, Southern Piedmont, Sand Hills, Atlantic Coast Flatwoods, Tidewater Area) in Georgia is about 53,431 square miles (see Table 4.1). If red fox only occupied 50% of those land classifications in the State and the density of red fox in the State was 2.6 red fox per square mile, the statewide population would be approximately 69,500 red fox.

Similar to gray fox, hunters and trappers can harvest red fox during annual hunting and trapping seasons in the State. During the length of the hunting and trapper seasons, there is no limit on the number of red fox that a person can harvest (GDNR 2016*a*). Trappers harvested 6,172 red fox in the State between 2010 and 2014 (see Table 4.8), which is an average harvest of 1,234 red fox per year. The highest annual harvest of red fox from 2010 through 2014 occurred in 2012 when trappers harvested 1,448 red fox. The number of red fox that hunters harvest annually in the State and the number of red fox removed to alleviate damage is unknown.

Table 4.8 - Cumulative red fox removal from known sources in Georgia, 2010-2014

Year	Harvest[1]	WS' Removal[2,3]	TOTAL	WS % of Total
2010	1,131	6	**1,137**	0.5%
2011	1,081	6	**1,087**	0.6%
2012	1,448	5	**1,453**	0.3%
2013	1,266	4	**1,270**	0.3%
2014	1,246	2	**1,248**	0.2%
TOTAL	**6,172**	**23**	**6,195**	**0.4%**

[1]Based on data from the National Furbearer Harvest Statistics Database (Association of Fish and Wildlife Agencies 2016)

[2]WS' removal is reported by federal fiscal year

[3]WS' removal includes all removal including unintentional removal during other damage management activities

Most requests for assistance received by WS involving red fox have been associated with aircraft strike risks. During direct operational assistance projects, WS lethally removed 25 red fox intentionally from FY 2010 through FY 2015, which is an average lethal removal of four red fox per year. WS' lethal removal of red fox in Georgia has not exceeded 0.6% of the harvest by trappers between 2010 and 2014. On average, the lethal removal of red fox by WS has represented 0.4% of the trapper harvest per year from 2010 through 2014.

Based on previous requests received by WS to reduce damage and in anticipation of additional efforts, WS could remove up to 50 red fox annually under this alternative to alleviate damage or threats of damage. Using a statewide population estimate of 69,500 red fox, the lethal removal of up to 50 red fox annually by WS would represent 0.1% of the estimated population. In addition, the removal of up to 50 red fox annually by WS would represent 4.1% of the average number of fox harvested during the trapping season. If the harvest during the 2012 trapping seasons were representative of harvest that could occur in the future, the cumulative removal by trappers and WS, if WS' removal reached 50 fox, would represent 2.2% of a statewide population estimated at 69,500 red fox. WS could also lethally remove red fox unintentionally during other damage management activities; however, WS does not anticipate the cumulative lethal removal of red fox to exceed 50 fox annually.

Although exact population and density estimates for red fox in Georgia are not available, the unlimited harvest allowed by the GDNR for the species during the hunting and trapping seasons indicates the species is not at risk of overharvesting. Since the statewide population of red fox is likely higher than 69,500 fox, WS' annual removal of red fox and the cumulative harvest would represent a lower percentage of the actual statewide population. The annual removal of red fox by WS would be of low magnitude compared to the actual statewide population and the number of red fox people harvest annually in the State. Therefore, the activities of WS to alleviate red fox damage or threats of damage would not limit the ability of people to harvest red fox in the State.

RIVER OTTER POPULATION INFORMATION AND EFFECTS ANALYSIS

Historically, river otters inhabited aquatic ecosystems throughout much of North America, excluding the frozen Arctic and arid Southwest (Melquist et al. 2003). Information on historic numbers and distribution is limited. As its broad geographic distribution suggests, the river otter is able to adapt to diverse aquatic habitats. Otter occur in both marine and freshwater environments, ranging from coastal to high mountainous habitat. Riparian vegetation adjacent to lakes, streams, and other wetland areas is a key component of otter habitat.

Human encroachment, habitat destruction, and overharvest have eliminated river otters from marginal portions of their range. However, their present distribution spans the North American continent from east to west and extends from southern Florida to northern Alaska (Melquist and Dronkert 1987, Melquist et al. 2003). In southeast Alaska, Woolington (1984) found river otter densities in waterways were one otter per 0.7 miles. Melquist and Dronkert (1987) summarized studies estimating river otter densities, which showed that densities were about 1 per 175 to 262 acres in Texas coastal marshes, and ranged from 1 per 1.8 miles to 1 per 3.6 miles of waterway (stream or river), which is an average of 1 otter per 2.4 miles of waterway. Melquist and Hornocker (1983) found a population density range of 1 otter per 1.8 to 3.6 miles of waterway (primarily streams) in west central Idaho, with an average of 1 otter per 2.4 miles. Erickson et al. (1984) found one otter per 5.0 miles of linear waterways in Missouri and one otter per 1.5 square miles in wetland habitat. More recently, Mowry et al. (2011) found an average otter density of one otter per 2.6 miles along streams in Missouri using latrine surveys.

Although the densities and distribution of river otters declined in many states during the mid-1800s to early 1900s, the river population in Georgia remained relatively widespread and unchanged (GDNR 2007*c*). River otter continue to thrive in Georgia but abundance is directly dependent on the quality and availability of aquatic habitats, such as lakes, ponds, marshes, rivers, and streams (GDNR 2007*c*). The statewide population of river otters and otter densities in the State are unknown.

There are approximately 70,150 miles of perennial and intermittent streams and rivers in Georgia along with 425,382 acres of lakes, reservoirs, and ponds (EPA 2012), with 7.7 million acres of wetlands (Hefner et al. 1994). As was discussed previously, otter are closely associated with aquatic habitats where they forage and den along shorelines. Using 70,150 miles of streams in Georgia and the range of one otter per 2.5 to 5.0 miles of waterway would result in a statewide population estimate ranging from 14,000 otter to 28,100 otter. If only 50% of those streams supported river otter, the minimum statewide river otter population could range from 7,000 to 14,100 otter in Georgia. This would be a worst-case scenario since the otter population is likely to inhabit a much larger portion of the streams and rivers of Georgia. In addition, otter also inhabit other aquatic habitats besides rivers and streams; therefore, the actual population is likely to be higher.

The GDNR (2016*a*) considers river otter to be a furbearer in Georgia with a regulated annual trapping season. During the trapping season, the GDNR places no limits on the number of otter that trappers can harvest during the length of the season (GDNR 2016*a*). Trappers harvested 7,938 river otters in the State during the trapping season from 2010 through 2014 (see Table 4.9), which is an average of 1,588 otter harvested annually in the State. The highest annual harvest occurred in 2014 when trappers harvested 1,869 river otter.

WS responded to seven requests for technical assistance associated with river otter damage from FY 2010 through FY 2015. WS responded to those technical assistance requests by providing information on methods available to address damage. Resources damaged by river otter were primarily associated with predation to commercially grown catfish (aquaculture) and private ponds containing sport fish.

Table 4.9 - Cumulative river otter removal from known sources in Georgia, 2010-2014

Year	Harvest[1]	WS' Removal[2,3]	TOTAL	WS % of Total
2010	1,507	8	**1,515**	0.5%
2011	1,618	3	**1,621**	0.2%
2012	1,621	15	**1,636**	0.9%
2013	1,323	12	**1,335**	0.9%
2014	1,869	12	**1,881**	0.6%
TOTAL	**7,938**	**50**	**7,988**	**0.6%**

[1]Based on data from the National Furbearer Harvest Statistics Database (Association of Fish and Wildlife Agencies 2016)

[2]WS' removal is reported by federal fiscal year

[3]WS' removal includes all removal including unintentional removal during other damage management activities

During all direct operational assistance projects conducted from FY 2010 through FY 2015, WS killed 61 river otters in Georgia, which is average of ten river otters lethally removed each year. Of those otters removed by WS from FY 2010 through FY 2015, 56 otter were removed as unintentional non-target animals during aquatic rodent damage management activities. The highest unintentional removal occurred during FY 2013 and FY 2014 when 12 otter were lethally removed unintentionally each year. Between FY 2010 and FY 2015, WS live-captured and released one river otter during other damage management activities. On average, WS' annual lethal removal of river otter from FY 2010 through FY 2014 represented 0.6% of the harvest of river otter by trappers in the State.

Based on previous requests for assistance and anticipating additional efforts to address damage, WS could lethally remove up to 50 river otters annually in Georgia, including otter that WS could remove unintentional during other activities. WS anticipates receiving requests for assistance primarily from aquaculture producers that were experiencing unacceptable predation of fish stock by river otters. In addition, WS could unintentionally remove river otters during activities targeting other animals, primarily aquatic rodents, despite WS' efforts to minimize non-target removal of otters. Based upon the aforementioned population estimate, WS' lethal removal of up to 50 river otters annually under the proposed action would represent 0.7% of the otter population in Georgia estimated at 7,700 otters and 0.4% of a statewide population estimated at 14,100 otters.

If WS' removal of otter reached 50 otter annually and if the number of otters harvested during the trapping season in 2014 were representative of future harvest, the cumulative lethal removal of otters would represent 24.9% of a statewide population estimated at 7,700 otters and 13.6% of statewide population estimated at 14,100 otter. However, the statewide population is likely to be higher than 14,100 otters; therefore, cumulative removal is likely to represent a smaller percentage of the actual population. The proposed intentional and the cumulative removal of otters in the State by WS and the harvest by trappers would be of low magnitude when compared to the actual statewide population estimates. The unlimited harvest allowed by the GDNR also provides an indication that harvest and damage management activities are not sufficient to cause the overharvest of otters. The annual removal of otters by WS would be of low magnitude compared to the actual statewide population and the number of otter people harvest annually in the State. Therefore, the activities of WS to alleviate otter damage or threats of damage would not limit the ability of people to harvest otters in the State.

ROOF RAT POPULATION INFORMATION AND EFFECTS ANALYSIS

The roof rat is similar in appearance to the Norway rat (*Rattus norvegicus*), but has a longer tail and a shorter nose (Whitaker, Jr. and Hamilton, Jr. 1998). While the roof rat is most abundant in coastal areas, in the eastern United States, it can occur inland to eastern Arkansas, western Kentucky, northern Alabama, northern Georgia, and in North Carolina and Virginia (National Audubon Society 2000).

Within its range, the roof rat is commonly found inhabiting buildings. When found with Norway rats in the same building, roof rats generally occur higher in the building, due to their ability to climb better than Norway rats. Roof rats generally nest and live in the walls of buildings (Whitaker, Jr. and Hamilton, Jr. 1998). Roof rats are capable of breeding when two to three months old. A female roof rat will typically have from four to six litters per year, and wean approximately 20 young (Whitaker, Jr. and Hamilton, Jr. 1998). The roof rat is omnivorous, but prefers to feed on grain and seeds if they are available. Considerable damage to stored grains in the form of consumption and contamination can occur from roof rats (National Audubon Society 2000). Because of their ability to climb, they often can do damage to nuts and fruits while still on the tree (Whitaker, Jr. and Hamilton, Jr. 1998).

WS anticipates receiving requests for assistance associated with roof rats infrequently. WS anticipates responding to most requests for assistance by providing technical assistance. However, WS could occasionally receive request to provide direct operational assistance associated with roof rats. When receiving requests for assistance associated with roof rats, the WS program in Georgia would follow WS Directive 2.345. WS anticipates requests for assistance to be generally associated with rats gnawing on structures and vehicle hoses and belts, as well creating threats to aviation at airports and airbases. Although roof rats rarely cause direct hazards to aviation safety, they can serve as prey attractants to raptors and mammalian predators that may pose serious threats to aircraft safety. Removal of roof rats by WS would occur primarily at airports by methods that may include trapping. Typically, any lethal removal would be associated with small mammal trapping surveys at airports/airbases or with operational activities to manage a localized prey base. WS could receive requests to reduce densities of a localized roof rat population that was attracting avian or mammalian predators to an aircraft operations area. Removal could also occur to alleviate agricultural damage at feedlots or other agricultural facilities.

Between FY 2010 and FY 2015, WS lethally removed one roof rat to alleviate damage or threats of damage. The level of WS' involvement in managing damage or threats of damage associated with roof rats would likely vary considerably from year to year depending on the number of requests for assistance received by WS. If WS implemented Alternative 1, WS anticipates that personnel could lethally remove up to 500 roof rats annually in the State. When using rodenticides, determining the number of rats killed following application of the rodenticide can be difficult because most rats killed by rodenticides die underground or in structures. Although population estimates are not available, roof rats are generally prolific breeders and are generally abundant throughout their range. Additionally, populations fluctuate greatly over time. Due to the species' relatively high reproductive rates and because management activities would be restricted to specific local sites, WS' activities under Alternative 1 would have minimal impacts on overall populations of roof rats in the State. WS would conduct activities associated with roof rats pursuant to Executive Order 13112.

STRIPED SKUNK POPULATION INFORMATION AND EFFECTS ANALYSIS

Although easily recognized by their black and white fur, striped skunks are likely more recognizable by the odiferous smell of their musk. They are common throughout the United States and Canada (Rosatte 1987, Rosatte and Larivière 2003). Striped skunks are primarily nocturnal and do not have a true hibernation period; however, during extremely cold weather skunks may become temporarily dormant. The striped skunk is an omnivore, feeding heavily on insects, such as grasshoppers, crickets, beetles, bees, and wasps (Rosatte and Larivière 2003). The diet of the striped skunk also includes small mammals and the eggs of ground-nesting birds and amphibians. Striped skunks are typically not aggressive and they will attempt to flee when approached by people (Rosatte 1987). However, when provoked, skunks will give a warning and assume a defensive posture prior to discharging their foul-smelling musk. This musk is comprised of sulfur-alcohol compounds known as butylmercaptan (Rosatte and Larivière 2003).

Adult skunks begin breeding in mid-February through mid-April. Yearling females (born in the preceding year) mate in late March. Gestation usually lasts about 59 to 77 days. Litters commonly consist of five to seven young with two litters per year possible (Rosatte and Lariviere 2003). The home range of striped skunks is usually not consistent. Home ranges appear to be reliant upon life history requirements, such as winter denning, feeding activities, dispersal, and parturition (Rosatte 1987). According to Chamberlain and Leopold (2001), very little information regarding striped skunk densities in the southeast exists except densities based on harvest numbers and trapper/hunter observations. During the breeding season, males may travel larger areas in search of females. Skunk densities vary widely according to season, food sources, and geographic area. Densities may range from one skunk per 77 acres to one skunk per 10 acres (Rosatte 1987).

Striped skunks occur statewide in Georgia and are common in a variety of habitats, including forests, agriculture, and urban areas (GDNR 2005*e*). Skunks are most common in areas dominated by brush that are adjacent to grassy and forested areas (GDNR 2005*e*). However, population estimates and density estimates for striped skunks in Georgia are currently not available.

Given that striped skunks prefer the edges of grasslands, agricultural areas, and forestlands, the land classifications most associated with those areas are the Southern Coastal Plain, Southern Piedmont, Sand Hills, Atlantic Coast Flatwoods, and Tidewater Areas, which encompass approximately 53,431 square miles of the State (see Table 4.1). If skunks only inhabit 50% of those land classifications in the State and densities occur at one skunk per 77 acres, the statewide population would be approximately 222,100 skunks. Similar to other furbearing species, skunks occur throughout the State and the analysis uses the estimate to evaluate the magnitude of removal proposed under this alternative. The statewide population of skunks is likely higher than 222,100 skunks.

Skunks are a furbearing animal in Georgia with annual trapping seasons with no limit on the number of skunks that people can possess throughout the trapping season. Trappers harvested 2,367 skunks between 2010 and 2014 (see Table 4.10), which is an average harvest of 473 skunks per year. The highest annual harvest of skunks occurred in 2012 when trappers harvested 744 skunks in the State. People and nuisance animal trappers could also lethally remove skunks to alleviate damage when the GDNR permits such activities. However, the number of skunks other entities lethally removal annually is currently not available.

Table 4.10 - Cumulative skunk removal from known sources in Georgia, 2010-2014

Year	Harvest[1]	WS' Removal[2,3]	TOTAL	WS % of Total
2010	356	0	**356**	0%
2011	396	8	**404**	2.0%
2012	744	5	**749**	0.7%
2013	502	3	**505**	0.6%
2014	369	0	**369**	0%
TOTAL	**2,367**	**16**	**2,383**	**0.7%**

[1]Based on harvest reports in Georgia (Waters 2010, Waters 2011, Waters 2012, Waters 2013, Waters 2014)

[2]WS' removal is reported by federal fiscal year

[3]WS' removal includes all removal including unintentional removal during other damage management activities

WS conducted 22 technical assistance projects associated with skunks in the State between FY 2010 and FY 2015. WS' personnel addressed most requests for technical assistance by providing information on methods the requester could employ to alleviate damage or threats without any direct involvement by WS. WS received requests regarding damage or threats of damage to property, residential buildings, non-residential buildings, pets, turf, flowers, and human safety. Damage and threats occurred primarily from the burrowing/digging behavior of skunks, the odor associated with skunks spraying, and rabies threats. In addition, WS received requests to provide direct operational assistance associated with skunks. Most requests for direct operational assistance received were associated with threats to human safety, primarily risks of disease transmission.

From FY 2010 through FY 2015, WS lethally removed 17 striped skunks during all damage management activities in the State, which is an average annual removal of three skunks. Of the 17 skunks WS lethally removed between FY 2010 and FY 2015, WS lethally removed one skunk unintentionally during activities targeting other animals. WS' highest annual removal of skunks occurred during FY 2011 when WS killed eight skunks during all damage management activities. WS' lethal removal of skunks from FY 2010 through FY 2014 represented 0.7% of total known number of skunks removed in the State. The lethal removal of eight skunks by WS during FY 2011 represented 2.0% of the number of skunks that trappers harvested in the State during 2011. In addition, WS has live-captured but released 10 skunks unharmed from FY 2010 through FY 2015.

Based on previous requests for assistance received by WS and in anticipation of additional efforts to manage striped skunk damage in Georgia, WS could lethally remove up to 100 skunks annually. Using the lowest population estimate of 222,100 skunks, the removal of 100 skunks would represent 0.1% of the estimated statewide population. WS could also lethally remove striped skunks unintentionally during other damage management activities; however, WS does not anticipate the cumulative lethal removal of skunks to exceed 100 skunks annually. If WS' removal of skunks reached 100 skunks annually and if the number of skunks harvested during the trapping season in 2012 was representative of future harvest, the cumulative lethal removal of skunks would represent 0.4% of a statewide population estimated at 222,100 skunks. However, the statewide population is likely to be higher than 222,100 skunks; therefore, cumulative removal is likely to represent a smaller percentage of the actual population.

The GDNR allows people to harvest an unlimited number of skunks during the annual trapping season, which provides an indication that skunk densities in the State are sufficient to maintain a sustained harvest level and adverse effects from harvest and damage management purposes are not likely to cause overharvest of the species leading to population declines. The annual removal of skunks by WS would be of low magnitude compared to the actual statewide population and the number of skunks people harvest annually in the State. Therefore, the activities of WS to alleviate skunk damage or threats of damage would not limit the ability of people to harvest skunks in the State.

VIRGINIA OPOSSUM POPULATION INFORMATION AND EFFECTS ANALYSIS

Opossums are the only marsupials (*i.e.*, possess a pouch in which young are reared) found north of Mexico (Seidensticker et al. 1987, Gardner and Sunquist 2003). They occur over most of the eastern and central United States with scattered occurrences across parts of the western United States, primarily around urbanization areas (Gardner and Sunquist 2003). They also occur in the western portions of California, Oregon, and Washington (Gardner and Sunquist 2003). Adults range in size from less than 1 kilogram (2.2 lbs) to about 6 kilogram (13 lbs), depending on sex and time of year. They have a broad range of pelage colors, but are usually a "*gray*" or "*black*" phase. Their fur is grizzled white above; long white hairs cover black tipped fur below. They climb well and feed on a variety of foods, including carrion, which forms much of its diet. In addition, opossum eat insects, frogs, birds, snakes, small mammals, earthworms, corn, berries, and other fruits, such as persimmons and apples (Gardner and Sunquist 2003). They use a home range of four to 20 hectares (10 to 50 acres), foraging throughout this area frequently (Jackson 1994*b*), but concentrating on a few sites where fruits abound, when they are in season (Seidensticker et al. 1987, Gardner and Sunquist 2003).

The reproductive season of the Virginia opossum typically occurs from December to February, depending on latitude (Gardner 1982, Gardner and Sunquist 2003). Gestation is short (average of 12.8 days) with one to 17 young born in an embryonic state that climb up the mothers belly to the marsupium (pouch), attach to teats, and begin to suckle (Gardner 1982, Gardner and Sunquist 2003). Those young remain in the pouch for about two months. After two months, the young begin to explore and may travel on their mother's back with their tails grasping hers (Whitaker and Hamilton 1998). Opossum live for only one to two years, with as few as 8% of a population of those animals surviving into the second year in a study in Virginia conducted by Seidensticker et al. (1987). In that five-year study, Seidensticker et al. (1987) noted there was a wide variation in opossum numbers, in what they considered excellent habitat for the species. Those variations occurred seasonally and in different years. However, the mean density during the study was 10.1 opossum per square mile with a range of 1.3 opossum per square mile to 20.2 opossum per square mile (Seidensticker et al. 1987). This was comparable to other opossum population densities in similar habitats in Virginia. Verts (1963) found a density estimate of 10.1 opossum per square mile in farmland areas of Illinois, while Wiseman and Hendrickson (1950) found a density of 6.0 opossum per square mile in mixed pasture and woodlands in Iowa. However, VanDruff (1971) found opossum densities in waterfowl nesting habitat as high as 259 opossum per square mile.

Population estimates and density information for opossum in the State are not available. However, based on reports from trappers, population trends show a stable to slightly increasing population, especially in urban areas (G. Waters, GDNR, pers. comm. 2015). Therefore, the analysis will derive a population estimate based on the best available information for opossum to provide an indication of the magnitude of removal proposed by WS to alleviate damage and threats of damage. Opossums are primarily associated with deciduous woodlands near streams, marshlands, forests, grasslands, agricultural habitats, agricultural edges (Seidensticker et al. 1987). Given that striped skunks prefer the edges of grasslands, agricultural areas, and forestlands, the land classifications most associated with those areas are the Southern Coastal Plain, Southern Piedmont, Sand Hills, Atlantic Coast Flatwoods, and Tidewater Areas, which encompass approximately 53,431 square miles of the State (see Table 4.1).

If opossum only occurred on 50% of those land classifications in the State and using a mean density of 10.1 opossum per square mile found by Seidensticker et al. (1987) in Virginia, the population would be approximately 270,000 opossum. Using the range of opossum densities found by Seidensticker et al. (1987) of 1.3 opossum per square mile to 20.2 opossum per square mile and only 50% of those land classification in the State being occupied by opossum, the statewide population would range from a low of 34,700 opossum to a high of nearly 539,700 opossum. Like other population estimates, the analysis based the population estimate for opossum on the species occupying only 50% of the land area to provide a minimum population estimate and to provide an indication of the magnitude of the proposed removal by WS to alleviate or prevent damage.

Opossum are a furbearing animal and a game animal in the State and people can harvest opossum during annual hunting and trapping seasons (GDNR 2016*a*). During the development of the EA, people could harvest opossum during hunting and trapping seasons with no limit on the number that people could lethally remove during those seasons. Between 2010 and 2014, people harvested 44,818 opossum in the State during the trapping season (see Table 4.11), which is an annual average of 8,963 opossum. The highest annual harvest of opossum occurred in 2014 when trappers harvested 13,082 opossum during the trapping season. Hunters can also harvest opossum in the State during the annual hunting season; however, the number of opossum that hunters harvested from 2010 through 2014 is not currently available. In addition, people can lethally remove opossum to alleviate damage; however, the number of opossum lethally removed in the State to alleviate damage is also unknown.

As part of all damage management activities conducted by WS in the State, WS has lethally removed 1,728 opossum from FY 2010 through FY 2015, which is an average annual removal of 288 opossum. Of those 1,728 opossums that WS lethally removed from FY 2010 through FY 2015, WS removed 11 opossum unintentionally during activities targeting other animals. The WS program also live-captured 44 opossum intentionally during FY 2015 and personnel released those animals unharmed. In addition, WS live-captured an additional 478 opossum unintentionally during all damage management activities and released those opossum unharmed. Opossum were primarily live-captured as non-target animals during surveillance activities relating to the ORV program (USDA 2009*a*).

Table 4.11 - Cumulative opossum removal from known sources in Georgia, 2010-2014

Year	Harvest[1]	WS' Removal[2,3]	TOTAL	WS % of Total
2010	7,349	150	**7,499**	2.0%
2011	6,581	402	**6,983**	5.8%
2012	6,390	177	**6,567**	2.7%
2013	11,416	191	**11,607**	1.7%
2014	13,082	396	**13,478**	2.9%
TOTAL	**44,818**	**1,316**	**46,134**	**2.9%**

[1]Based on data from the National Furbearer Harvest Statistics Database (Association of Fish and Wildlife Agencies 2016)

[2]WS' removal is reported by federal fiscal year

[3]WS' removal includes all removal including unintentional removal during other damage management activities

Based on previous requests for assistance received by WS and in anticipation of additional efforts, WS could lethally remove up to 1,000 opossum annually in the State as part of efforts to reduce or eliminate damage under this alternative. Based on a statewide population ranging from 34,700 opossum to 539,700 opossum, the lethal removal of up to 1,000 opossum annually by WS under this alternative would represent 0.2% to 2.9% of the estimated population. WS could also lethally remove opossum unintentionally while targeting other animals; however, WS does not anticipate the cumulative lethal removal of opossum to exceed 1,000 opossum annually.

If the number of opossum harvested during the trapping season in 2014 was representative of harvest that could occur in the future, the cumulative removal by trappers and WS, if WS' removal reached 1,000 opossum, would represent 40.6% of a statewide population estimated at 34,700 opossum. If the annual removal by WS of 1,000 opossum were combined with the average number of opossum harvested in the State by trappers from 2010 through 2014, the cumulative removal would represent 28.7% of a statewide population estimated at 34,700 opossum. However, the actual statewide population likely exceeds 34,700 opossum given the parameters used to derive the estimate.

Although the total number of opossum lethally removed in the State by other entities to alleviate damage and the number of opossum that hunters harvest is unknown, the cumulative removal of opossum, including the proposed removal of up to 1,000 opossum annually by WS, would be of a low magnitude when compared to the actual statewide population. The unlimited harvest allowed by the GDNR during the harvest seasons provides an indication that population densities of opossum in the State are sufficient that overharvest is not likely to occur, including lethal removal to alleviate or prevent damage. In addition, the live-capture and subsequent release of opossum would not likely result in adverse effects to the statewide population since those animals would be released unharmed. The annual removal of opossum by WS would be of low magnitude compared to the actual statewide population and the number of opossum people harvest annually in the State. Therefore, the activities of WS to alleviate opossum damage or threats of damage would not limit the ability of people to harvest opossum in the State.

WHITE-TAILED DEER POPULATION INFORMATION AND EFFECTS ANALYSIS

White-tailed deer have a wide distribution in North America (Miller et al. 2003) and some people have suggested that the white-tailed deer currently occupies the largest geographic range of any other land mammal in North America (Pagel et al. 1991). Rural areas containing a matrix of forest and agricultural crops can contain the highest deer densities (Roseberry and Woolf 1998). One challenge currently facing biologists and resource managers is escalating populations of deer in many urban/suburban areas and in some rural areas. As deer populations increase, there is an increasing occurrence of damage from white-tailed deer to agricultural crops (DeVault et al. 2007), increasing incidences of Lyme disease (Fernandez 2008), a rise in deer-vehicle collisions (Conover et al. 1995), and a disruption in forest health, regeneration, and forest dependent species (Tilghman 1989). Additionally, white-tailed deer are one of the most hazardous species to aviation according to the percentage of strikes that caused damage from 1990 through 2014 (Dolbeer et al. 2015).

Deer occur in areas with adequate woodlands interspersed with early-successional habitats (Miller et al. 2003). White-tailed deer are highly adaptable and live in many habitats, including woodlots in rural areas, the suburbs, and deep within heavily forested areas. Deer are strictly herbivorous (*i.e.*, eat only plants), including mushrooms. Deer eat a variety of forbs, grasses, and fruits. Acorns are a favorite food, and deer consume them in great quantities when putting on fat for winter.

White-tailed deer are present in all Georgia counties, and occupy almost all land types that contain suitable habitat. Although nearly extirpated from the state from unregulated hunting, restoration efforts have since restored deer populations with the deer population exceeding 1.2 million deer in 2004 (GDNR 2004*b*, GDNR 2005*f*). The authority for management of resident wildlife species, including deer, is the responsibility of the GDNR. The GDNR collects and compiles information on white-tailed deer population trends and harvest and uses this information to manage deer populations. The primary tool for the management of deer populations in Georgia is through adjusting the allowed lethal removal during the deer harvest season in the State. White-tailed deer are a big game animal in Georgia with annual hunting seasons. During the 2014 hunting season, the GDNR (2014*a*) reported that hunters harvested 412,068 deer in the State (see Table 4.12). Between 2010 and 2014, 2.1 million deer were harvested in the State by hunters (GDNR 2010, GDNR 2011, GDNR 2012, GDNR 2013, GDNR 2014*a*), which is an average annual harvest of over 420,000 deer. The GDNR uses physiographic regions to set goals for the state's deer herd, which consist of five regions based on geology. One of the goals of the GDNR is to stabilize the deer herd size in four of those five physiographic regions and increase populations in one region (GDNR 2014*b*).

Mortality can also occur from vehicle collisions, dogs, illegal removal, tangling in fences, disease, and other causes (Crum 2003). Annual deer mortality in Georgia from other sources (*e.g.*, illegal removal, disease, and predation) is currently unknown. An estimated 42,996 deer-vehicle collisions occurred in Georgia from July 1, 2011 through June 30, 2012 (State Farm Mutual Automobile Insurance 2012). On average, the GDNR estimates that approximately 50,000 deer collision occur per year in the State (GDNR 2014*b*). The GDNR also issues depredation permits to people experiencing damage to agricultural resources caused by deer. Therefore, the GDNR monitors and considers deer lethally removed under depredation permits in Georgia as part of deer management goals for the State. Between 2010 and 2014, people removed 27,564 deer from depredation permits, which is an average of 5,512 deer per year.

From FY 2010 through FY 2015, WS responded to 237 technical assistance requests associated with white-tailed deer in the State. In addition, WS responded to requests for direct operational assistance associated with deer in the State. As part of those direct operational assistance requests, WS lethally removed 3,291 white-tailed deer between FY 2010 and FY 2015 to alleviate damage or threats of damage in the State, which is an average lethal removal of 549 deer each year. WS also employed non-lethal methods to disperse 13 deer between FY 2010 and FY 2015. WS unintentionally removed two deer during other damage manage activities conducted between FY 2010 and FY 2015. In addition, WS live-captured three deer unintentionally during other damage management activities but released those deer unharmed.

Table 4.12 – Cumulative white-tailed deer removal from known sources in Georgia, 2010-2014

Year[a]	GA Deer Population[b]	Hunter Harvest[c]	Depredation Removal[d]	WS' Removal[e]	WS % removal of population	WS % removal of deer harvest
2010	1,456,031	398,668	4,611	529	0.04%	0.13%
2011	1,457,526	449,850	5,045	560	0.04%	0.13%
2012	1,398,258	411,481	5,694	493	0.04%	0.12%
2013	1,315,136	385,410	5,512	627	0.05%	0.16%
2014	1,263,357	453,952	6,702	575	0.05%	0.13%

[a]Listed by calendar year

[b]Data provided by C. Killmaster, GDNR pers. comm. (2016)

[c]Harvest data from the Georgia deer harvest summary reports (GDNR 2010, GDNR 2011, GDNR 2012, GDNR 2013, GDNR 2014*a*).

[d]Estimates of depredation removal

[e]Figures reported by federal fiscal year

After review of previous activities conducted by WS and in anticipation of additional efforts, WS could lethally remove up to 1,000 deer annually. In addition, WS may receive requests from the GDNR and/or the GDA to assist with sampling and managing the spread of diseases found in free-ranging and/or captive deer populations. If a disease outbreak occurred, WS could receive requests to remove white-tailed deer for sampling and/or to prevent further spread of diseases. However, WS' total annual removal would not exceed 1,000 deer annually under this alternative. WS' personnel could also lethally remove deer unintentionally during other damage management activities; however, WS does not anticipate the cumulative lethal removal of deer by WS to exceed 1,000 deer annually.

If requested, WS could also assist with sampling and removing deer from captive facilities where people confine deer inside a perimeter fence. The detection of a disease at a captive facility often raises concerns for the potential spread of diseases to free-ranging herds. The risk of spreading diseases among deer inside those facilities can increase due to their close contact with one another. Often, once someone detects a disease in a confined deer herd, the entire herd is destroyed to ensure the containment of the disease. Any involvement with the depopulation of deer confined inside a perimeter fence by WS would be at the request of the GDNR and/or the GDA. As proposed in this alternative, in those cases where WS receives a request to assist with the removal of a captive deer herd in Georgia, the removal would not exceed 1,000 deer for purposes of disease monitoring or surveillance. Deer confined inside perimeter fences for the purposes of non-traditional farming, including confined for hunting, are not included in statewide deer population estimates. However, since removal of deer by WS for disease surveillance or monitoring could occur in free-ranging or captive herds, the potential removal of up to 1,000 deer for disease surveillance and monitoring by WS will be part of the impact analysis on the statewide free-ranging deer population.

During the 2014 hunting season, people harvested 453,952 deer in Georgia during the annual hunting season (GDNR 2014*a*). If WS' removal reached 1,000 deer during 2014, WS' removal would have represented 0.2% of the harvest. The total deer mortality in the State in 2014 could be nearly 511,229 deer, based on the number of deer hunters harvested, WS' removal, removal under depredation permits, and vehicle collision data (approximately 50,000 deer). If the deer population estimate provided by the GDNR included recruitment of deer born that year, then the removal of deer from all known sources in

2014 would represent 40.5% of the deer population, if the deer population remained at least stable. If WS had removed 1,000 deer in 2014, the total mortality of deer would continue to represent 40.5% of the population.

With oversight of the GDNR, the magnitude of removal of deer by WS annually would be low. The GDNR has determined that there is no evidence to suggest that human mediated mortality resulting from regulated harvest and damage management, including removal by WS, would be detrimental to the survival of the white-tailed deer population in the State of Georgia (C. Killmaster, GDNR, pers. comm. 2015).

The EPA officially registered GonaCon™ in 2009 for use in reducing fertility in female white-tailed deer. According to the label, only WS or state wildlife management agency personnel or individuals working under their authority can use the reproductive inhibitor. Additionally, before WS can use GonaCon™ in any given state, WS must register the product for use in the state and the state agency responsible for managing wildlife must approve of its use for managing a local deer population. The reproductive inhibitor GonaCon™ is currently not registered for use in Georgia. However, if GonaCon™ becomes available to manage deer in the State, WS could evaluate the use of the inhibitor under this alternative as a method available that WS could use in an integrated approach to managing damage.

When using reproductive inhibitors, including GonaCon™, the intent is to induce a decline in a localized deer population by limiting reproductive output of adults. A reduction in the population occurs when the number of deer recruited into the population cannot replace those individuals that die from other causes each year, which equates to a net loss in the number of individuals in the population and a reduction in the overall population. Although not generally considered a lethal method since no direct removal occurs, reproductive inhibitors can result in the reduction of a target species' population. WS' use of GonaCon™ would target a local deer population identified as causing damage or threatening human safety. Although a reduction in a local deer population would likely occur from constant use of GonaCon™, the actual reduction in the local population annually would be difficult to derive prior to the initiation of the use of the vaccine.

One of the difficulties in calculating and analyzing any actual reduction that could occur in a targeted population prior to application of the vaccine is the variability in the response of deer to the vaccine. Previous studies on GonaCon™ as a reproductive inhibitor have shown variability in the immune response of deer to the vaccine (Miller et al. 2000). Not all deer injected with GonaCon™ develop sufficient antibodies to neutralize the Gonadotropin-releasing Hormone (GnRH) produced in the body. Those deer continue to enter into a reproductive state and produce fawns even after vaccination. The number of deer that do not develop sufficient antibodies after the initial vaccination cannot be predicted beforehand. In one study, 88% of the deer vaccinated with GonaCon™ did not produce fawns the following reproductive season while 12% of the deer injected with GonaCon™ produced fawns (Gionfriddo et al. 2009). The year following the initial vaccination, the number of deer that were vaccinated the first year that did not produce fawns declined to 47% while the number of deer producing fawns increased to 53% (Gionfriddo et al. 2009) demonstrating the diminishing results that are likely over time if deer are not provided a booster shot periodically.

Since the effects of GonaCon™ appear to be reversible if deer are not provided with a booster shot periodically, the reduction in a local population of deer from the use of GonaCon™ can be maintained at appropriate levels where damages or threats were resolved by increasing or decreasing the number of deer receiving booster injections. Although localized deer populations would likely be reduced from the use of GonaCon™, the extent of the reduction would be variable. For example, not all vaccinated deer would likely be prevented from entering into a reproductive state and those deer that were initially prevented from entering into a reproductive state often become reproductively active in subsequent years as the antibody levels neutralizing the GnRH hormone diminish over time. Therefore, the actual decline in the number of deer in a localized population achieved from the use of GonaCon™ would be difficult to predict prior to the use of the reproductive inhibitor. However, since the decline would occur through attrition over time and since the ability of the inhibitor to prevent reproduction diminishes with time, the actual decline in a localized population would be gradual and could be monitored. In addition, the reduction in a local deer population could be fully reversed if deer were no longer vaccinated or provided booster shots and other conditions (*e.g.*, food, disease) were favorable for population growth.

Turner et al. (1993) noted that although contraception in white-tailed deer may be used to limit population growth, it would not reduce the number of deer in excess of the desired level in many circumstances. Turner et al. (1993) further contended that initial population reductions by various other means may be necessary to achieve management goals, and that reproduction control would be one facet of an integrated program. Although immunocontraceptive technology has been effective in laboratories, pens, and in island field applications, it has not been effective in reducing populations of free-ranging white-tailed deer over large geographical areas.

The magnitude of WS' activities to alleviate damage and threats associated with deer in the State would be low with the oversight and permitting of WS' activities occurring by the GDNR. WS would annually report to the GDNR and monitor removal to ensure WS' activities do not adversely affect deer. The permitting of all WS' removal by the GDNR would ensure WS' removal would meet the objectives of the statewide deer population. The annual removal of deer by WS would be of low magnitude compared to the actual statewide population and the number of deer people harvest annually in the State. Therefore, the activities of WS to alleviate deer damage or threats of damage would not limit the ability of people to harvest deer in the State.

WOODCHUCK POPULATION INFORMATION AND EFFECTS ANALYSIS

The woodchuck, also known as the "*groundhog*", is a large rodent, often seen in pastures, meadows, and open fields throughout Georgia. They dig large burrows, generally eight to 12 inches at the opening, sometimes five feet deep and 30 feet long with more than one entrance, which opens to a spacious grass-filled chamber. Green vegetation, such as grass, clover, and alfalfa, forms its diet. At times, woodchucks may cause damage to a variety of crops, such as grains, clover, alfalfa, beans, peas, corn, and apple trees (Armitage 2003). Woodchucks may also jeopardize the integrity of earthen dams, present hazards to livestock and farm equipment because of burrowing, gnawing electrical cables, and damaging hoses and other accessories on automobiles by gnawing (Bollengier 1994, Armitage 2003).

The breeding season for woodchucks is usually from March through April (Bollengier 1994). Female woodchucks usually produce from four to six young per year (Armitage 2003). The offspring breed at one year of age and live four to five years. Mammal species with high mortality rates, such as rodents (*e.g*., woodchucks) and lagomorphs (*e.g*., rabbits), typically possess high reproductive rates, and produce large and frequent litters of young (Smith 1996). For example, if a pair of woodchucks and their offspring all survived to breed as soon as possible, with an average litter size of four with a 1:1 sex ratio; they could produce over 645 woodchucks through their lifetime. The range of woodchucks in the United States extends throughout the East, northern Idaho, northeastern North Dakota, southeastern Nebraska, eastern Kansas, northeastern Oklahoma, and south to Virginia and Alabama (Armitage 2003).

Both sexes are similar in appearance, but the male is slightly larger, weighing an average of five to 10 pounds (2.2 to 4.5 kg). The total length of the head and body averages 16 to 20 inches (40 to 51 cm). The tail is usually four to seven inches (10 to 18 cm) long. Like other rodents, woodchucks have white or yellowish-white, chisel-like incisor teeth. Their eyes, ears, and nose are located toward the top of the head, which allows them to remain concealed in their burrows while they check for danger over the rim or edge. Although they are slow runners, woodchucks are alert and scurry quickly to their dens when they sense danger (Bollengier 1994).

Woodchucks seldom stray far from their home dens. Armitage (2003) estimated that distances of daily travel ranged from 100 m in colonies occupying good habitat to 400 m in somewhat lacking habitat, which makes a home range of seven to 124 acres in size. Study of woodchuck colonies to determine the social structure of a typical colony is limited. However, at a minimum, a colony would generally consist of two adults and the young of that year, totaling at least six to eight individuals.

In Georgia, woodchucks occur from the Piedmont region northward into the mountains of north Georgia where they prefer open areas, such as fields, clearings, open forests, and rocky slopes (GDNR 2007*d*). Woodchucks are a nongame animal in Georgia, with a continuously open statewide harvest season and no limits on the number of woodchucks that a person can harvest. Since woodchucks occur from the Piedmont region northward into the mountains, the land categories most likely to encompass those habitats include the Southern Piedmont, Southern Blue Ridge, Sand Mountain, and Southern Appalachian Ridge, which cumulatively total approximately 22,893 square miles in Georgia (see Table 4.1). If only 50% of those land classes supported woodchucks, under a worst-case scenario, with an estimate of a single woodchuck home range at 124 acres and assuming that only one woodchuck occupied a home range and no home ranges overlapped, the statewide woodchuck population would be approximately 59,100 woodchucks. This would be a worst-case scenario since the woodchuck population likely inhabits a much larger portion of those land classifications, woodchuck colonies likely consist of six to eight individuals, and some portion of most other land cover categories can support woodchuck populations.

WS continues to receive requests for assistance to manage damage associated with woodchucks in the State. WS conducted 13 technical assistance projects associated with woodchucks from FY 2010 through FY 2015. Requests for assistance received by WS from FY 2010 through FY 2015 were primarily associated with woodchuck damage occurring to gardens, vegetables, turf and flowers, building foundations, and drainage and irrigation structures. As part of those requests for assistance, WS also provided direct operational assistance by conducting activities to alleviate woodchuck damage. As part of those activities, WS employed lethal methods to remove 19 woodchucks between FY 2010 and FY 2015, which is an average of three woodchucks lethally removed by WS annually. The highest annual number removed occurred during FY 2012 when WS removed 18 woodchucks to alleviate damage. In addition, WS live-captured one woodchuck intentionally in a cage trap during FY 2015 and released the woodchuck unharmed. WS also live-captured seven woodchucks unintentionally during FY 2013 but released those woodchucks unharmed.

WS anticipates continuing to receive requests for assistance to address woodchuck damage in the State. Based on previous requests for assistance and in anticipation of additional efforts to manage damage, WS could lethally remove up to 100 woodchucks annually to alleviate damage. When receiving requests for assistance associated with woodchucks, the WS program in Georgia would follow WS Directive 2.345.

WS' personnel could use gas cartridges to fumigate woodchuck burrows in areas where damage was occurring. Gas cartridges act as a fumigant by producing carbon monoxide gas when ignited. The cartridges contain sodium nitrate that when burnt, produces carbon monoxide gas. WS' personnel would place the cartridges inside active burrows at the entrance and ignite the fuse on the cartridge. Then, personnel would seal the entrance to the burrow with dirt, which would allow the burrow to fill with carbon monoxide gas.

The number of entrances to burrow systems used by woodchucks varies. Twichell (1939) found the number of entrances to burrow systems used by woodchucks ranged from two to six entrances in Missouri with the average number being 2.8 entrances. Other studies note the number of entrances per burrow system ranged from one to five entrances (Grizzell 1955) to a high of 11 entrances per system (Merriam 1971). Merriam (1971) found the mean number of entrances per burrow system was 2.98 entrances. The use of burrow systems is usually restricted to a male and a reproductive female (Swihart 1992, Armitage 2003). When using gas cartridges to fumigate burrows, WS' personnel would base the number of woodchucks lethally removed on the mean number of entrances per burrow system of approximately three entrances (Twichell 1939, Merriam 1971) and each burrow system occupied by a male and a female (Swihart 1992, Armitage 2003). The removal of woodchucks could also occur using other methods, such as shooting, live traps, and body gripping traps. However, WS does not expect the number of woodchucks lethally removed using gas cartridges and the number removed by other methods to exceed 100 woodchucks annually.

Damage management activities associated with woodchucks would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property. Removing woodchucks to alleviate damage at a local site under this alternative would likely temporarily reduce some local populations. If WS' annual removal reached 100 woodchucks, the removal would represent 0.2% of a statewide population estimated at 59,100 woodchucks, if the population remained at least stable. However, WS' annual removal of woodchucks would likely represent a smaller percentage of the actual population given the population estimate derived represents a worst-case scenario. The unlimited removal and continuous open season for woodchucks provides an indication that densities are sufficient that overharvest is unlikely to occur. The annual removal of woodchucks by WS would be of low magnitude compared to the actual statewide population and the number of woodchucks people harvest annually in the State. Therefore, the activities of WS to alleviate woodchuck damage or threats of damage would not limit the ability of people to harvest woodchucks in the State.

ADDITIONAL TARGET SPECIES

WS could also receive requests for assistance associated with feral or free-ranging mammals, such as domestic animals or pen-raised animals. For example, WS could receive a request to remove non-native cervids for disease testing that have escaped from a hunting enclosure. Additional species that entities could request WS provide assistance with include feral or free-ranging burros, cattle, goats, horses, and other non-native mammals that have escaped an enclosure or were released due to a natural disaster. While WS does not currently expect to lethally remove any of those species, the GDNR and/or the GDA could request WS' assistance with unique situations where a small number of those mammals have escaped or were released. Those occasions could include the accidental release of feral animals onto airport properties or animals that have escaped from fenced enclosures. In addition, the GDNR and/or the GDA could request WS' assistance as part of an incident response, such as the accidental release of domestic or exotic mammals from vehicle wrecks. There may also be additional need for removing other mammal species in the event of an animal disease outbreak to limit the spread of the disease. As part of the proposed program, WS could provide assistance, upon request, involving exotic and domestic mammals not specifically listed in this EA in emergencies to alleviate threats to human health and safety. Any lethal removal requested would target specific individual mammals and removal would not reach a magnitude where adverse effects would occur to a species' population based on the limited scope of the removal. In most cases, the removal would be limited to a few individuals and removal would likely occur by other entities in the absence of WS' involvement.

ANIMAL 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.

WS' implementation of disease sampling strategies to detect or monitor diseases in the United States would not adversely affect mammal populations in the State. Sampling strategies that WS could employ would involve sampling live-captured mammals that WS' personnel could release on site after sampling occurs. The sampling (*e.g.*, drawing blood, tissue sample, collecting fecal samples) and the subsequent release of live-captured mammals would not result in adverse effects since those mammals would be released unharmed on site. In addition, the sampling of mammals that were sick, dying, or harvested by hunters would not result in the additive lethal removal of mammals that would not have already occurred in the absence of disease sampling. Therefore, the sampling of mammals for diseases would not adversely affect the populations of any of the mammals addressed in this EA nor would sampling mammals result in any lethal removal of mammals that would not have already occurred in the absence of disease sampling (*e.g.*, hunter harvest).

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

WS would not directly affect mammal populations in the State from a program implementing technical assistance only. However, persons experiencing damage or threats from mammals may implement methods based on WS' recommendations. Under this alternative, WS would recommend and demonstrate for use both non-lethal and lethal methods legally available for use to resolve mammal damage. WS' personnel would recommend methods and techniques based on the WS Decision Model using information provided from the requester or from a site visit. Requesters may implement WS' recommendations, implement other actions, seek assistance from other entities, or take no further action. However, those people requesting assistance would likely be those people that would implement damage abatement methods in the absence of WS' recommendations.

Under this alternative, those persons experiencing threats or damage associated with mammals in the State could lethally remove mammals or request assistance from other entities despite WS' lack of direct involvement in the management action. Therefore, under this alternative, the number of mammals lethally removed annually would likely be similar to the other alternatives. Removal of mammals by other entities would likely be similar since removal could occur through authorization by the GDNR, removal of non-regulated mammal species could occur without the need for authorization from the GDNR, and removal would continue to occur during the harvest season for those species. People can lethally remove beaver, coyotes, woodchucks, armadillos, and roof rats at any time on private property in the State. WS' participation in a management action would not be additive to an action that would occur in the absence of WS' participation. WS' recommendation of the use of lethal methods under this alternative would not limit the ability of those persons interested in harvesting mammals during the regulated season since the GDNR determines the number of animals that people may lethally remove during the hunting/trapping season and under authorizations the GDNR issues to people to alleviate damage.

With the oversight of the GDNR, it is unlikely that implementation of this alternative would adversely affect target mammal populations. Under this alternative, WS would not provide any assistance with managing damage. However, other entities could provide direct operational assistance, such as the GDNR, private entities, municipal authorities, and/or private businesses. 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 removal, which could lead to real but unknown effects on other wildlife populations. People have resorted to the illegal use of chemicals and methods to resolve wildlife damage issues (*e*.*g*., see Allen et al. 1996, United States Department of Justice 2014, United States Department of Justice 2015).

Alternative 3 – No Mammal Damage Management Conducted by WS

Under this alternative, WS would not conduct damage management activities in the State. WS would have no direct involvement with any aspect of addressing damage caused by mammals and would provide no technical assistance. No removal of mammals by WS would occur under this alternative. People could continue to lethally remove mammals to resolve damage and/or threats occurring when authorized by the GDNR, during the regulated hunting or trapping seasons, or in the case of non-regulated species, removal could occur anytime using legally available methods. Management actions taken by non-federal entities would constitute the *environmental status quo*.

Local mammal populations could decline, stay the same, or increase depending on actions taken by those persons experiencing mammal damage. Some resource/property owners may take illegal, unsafe, or environmentally harmful action against local populations of mammals out of frustration or ignorance. While WS would provide no assistance under this alternative, other individuals or entities could conduct lethal damage management resulting in lethal removal levels similar to Alternative 1. WS would have no impact on the ability to harvest mammal species under this alternative.

Since other entities could still remove mammals under this alternative, the potential effects on the populations of those mammal species in the State would be similar to the other alternatives for this issue. WS' involvement would not be additive to removal that could occur since the cooperator requesting WS' assistance could conduct mammal damage management activities without WS' direct involvement. Therefore, any actions to resolve damage or reduce threats associated with mammals could occur by other entities despite WS' lack of involvement under this alternative. In addition, WS would have no impact on the ability to harvest mammals under this alternative. WS would not provide any assistance with managing damage caused by target mammal species under this alternative. The GDNR would continue to regulate populations through adjustments of the allowed removal during the regulated harvest season and the continued authorization of removal when those species cause damage or pose a threat of damage.

Issue 2 - Effects of Activities on the Populations of Non-target Animals, Including T&E Species

As discussed previously, a concern would be the potential impacts to non-target species, including T&E species, from the use of methods to resolve damage caused by mammals. Discussion on the potential effects of the alternatives on the populations of non-target animal species, including T&E species occurs below.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

The potential for adverse effects to non-target animals occurs from the employment of methods to address mammal damage. Under Alternative 1, WS could provide both technical assistance and direct operational assistance to those people requesting assistance. The risks to non-target animals from the use of non-lethal methods, as part of an integrated direct operational assistance program, would be similar to those risks to non-target animals discussed in the other alternatives.

Personnel from WS would be experienced with managing animal damage and would receive training in the employment of methods, which would allow WS' employees to use the WS Decision Model to select the most appropriate methods to address damage caused by targeted animals and excluding non-target species. To reduce the likelihood of capturing non-target animals, 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-target animals. Chapter 3 of this EA discusses the SOPs to prevent and reduce any potential adverse effects on non-target animals. Despite the best efforts to minimize non-target exposure to methods during program activities, the potential for WS to disperse or lethally remove non-target animals 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-target animals primarily through exclusion, harassment, and dispersal. Any exclusionary device erected to prevent access of target species also potentially excludes species that were not the primary reason for erecting the exclusion; therefore, exclusion methods potentially could adversely affect non-target species if the area excluded was large enough. The use of auditory and visual dispersal methods to reduce damage or threats caused by mammals would also likely disperse non-target animals in the immediate area the methods were employed. Therefore, non-target animals may disperse permanently from an area while employing non-lethal 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 methods that use auditory and visual stimuli to reduce or prevent damage elicit fright responses in animals. When employing those methods to disperse or harass target species, any non-target animals nearby when employing those methods would also likely disperse from the area. Similarly, any exclusionary device constructed to prevent access by target species could also exclude access to some non-target species. The persistent use of non-lethal methods would likely result in the dispersal or abandonment of those areas where non-lethal methods were employed of both target and non-target species. Therefore, any use of non-lethal methods would likely elicit a similar response from both non-target and target species. Although non-lethal methods do not result in the lethal removal of non-target animals, the use of non-lethal methods could restrict or prevent access of non-target animals to beneficial resources. However, long-term adverse effects would not occur to a species' population since WS would not employ non-lethal methods over large geographical areas or at such intensity levels that resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope. Non-lethal methods would generally have minimal impacts on overall populations of animal since individuals of those species were unharmed. Overall, the use of non-lethal methods would not adversely affect populations of animals since those methods would often be temporary.

Other non-lethal methods available for use under this alternative would include live traps, nets, water control devices, repellents, immobilizing drugs, and reproductive inhibitors. Live traps and nets restrain animals once captured; therefore, those methods would be live-capture methods. Live traps would have the potential to capture non-target species. 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-target animals. Attending to traps and nets appropriately would allow the release of any non-target animals captured unharmed. Water control devices are systems that allow the passage of water through a beaver dam to manage the level of impounded water. Taylor and Singleton (2014) provide a comprehensive summary of the evolution of water control devices to reduce flooding by beaver. The use or recommendation of water control devices would not adversely affect non-target animals.

Chemical repellents could also be available to reduce mammal damage. Since FY 2010, WS has not used repellents to reduce mammal damage in the State. However, WS may recommend or employ commercially available repellents when providing technical assistance and direct operational assistance. WS would only use or recommend those products registered with the EPA pursuant to the FIFRA and registered with the GDA under this alternative. The active ingredients in many commercially available repellents are naturally occurring substances (*e.g.*, capsaicin, whole egg solids), which are substances often used in food preparation (EPA 2001). When used according to label instructions, most repellents would be safe since 1) they are not toxic to animals, if ingested; 2) there is normally little to no contact between animals and the active ingredient, and 3) the active ingredients are found in the environment and degrade quickly (EPA 2001). Therefore, the use and recommendation of repellents would not have negative impacts on non-target species when used according to label requirements. Most repellents for mammals pose a very low risk to non-target animals when exposed to or when ingested.

WS could employ immobilizing drugs to handle and transport target mammal species. WS' personnel would apply immobilizing drugs directly to target animals through hand injection or by projectile (*e.g.*, dart gun). WS would make reasonable efforts to retrieve projectiles containing immobilizing drugs if misses occurred or if the projectile detached from target animals. Therefore, no direct effects to non-target animals would be likely since identification would occur prior to application. Animals anesthetized using immobilizing drugs recover once the animal's body has fully metabolized the drug. Therefore, non-target animals that may consume animals that recover are unlikely to receive a dosage that would cause any impairment. When using immobilizing drugs to handle or transport target animals, WS would monitor anesthetized animals until that animal recovers sufficiently to leave the site.

Exposure of non-target animals to GonaCon™ could occur primarily from secondary hazards associated with animals consuming deer that have been injected with GonaCon™. Since GonaCon™ would be applied directly to deer through hand injection after the animal was live-captured and restrained, the risk of directly exposing non-target animals to GonaCon™ while being administered to deer would be nearly non-existent. Several factors inherent with GonaCon™ reduce risks to non-target animals from direct consumption of deer injected with the vaccine (EPA 2009). The vaccine itself and the antibodies produced by the deer in response to the vaccine are both proteins, which if consumed, would be broken down by stomach acids and enzymes (EPA 2009, USDA 2010). The EPA determined that the potential risks to non-target animals from the vaccine and the antibodies produced by deer in response to the vaccine "*...are not expected to exceed the Agency's concern levels*" (EPA 2009).

Potential impacts to non-target animals from the use of non-lethal methods would be similar to the use of non-lethal methods under any of the alternatives. Non-target animals would generally be unharmed from the use of non-lethal methods under any of the alternatives since no lethal removal would occur. Non-lethal methods would be available under all the alternatives analyzed; however, the use of GonaCon™ would be restricted to use by the GDNR or persons under their supervision under Alternative 2 and Alternative 3, if registered. WS' involvement in the use of or recommendation of non-lethal methods would ensure WS' employees would consider the potential impacts to non-target animals when using the WS Decision Model. Potential impacts to non-target animals under this alternative from the use of and/or the recommendation of non-lethal methods are likely to be low.

WS could also employ and/or recommend lethal methods under Alternative 1 to alleviate damage, when WS' personnel deemed those methods appropriate for use using the WS Decision Model. Lethal methods available for use to manage damage caused by mammals under this alternative would include the recommendation of harvest during hunting and/or trapping seasons, shooting, body-gripping traps, cable devices, fumigants, rodenticides, euthanasia chemicals, and euthanasia after live-capture. WS could also use foothold traps and submersion cables or rods as a drowning set when targeting beaver. Available methods and the application of those methods to resolve mammal damage is further discussed in Appendix B.

The use of firearms would essentially be selective for target species since animals would be identified prior to application; therefore, no adverse effects would be anticipated from use of this method. Similarly, the use of euthanasia methods would not result in non-target removal since identification would occur prior to euthanizing an animal.

When using fumigants, WS' personnel would survey burrows and dens for the presence of non-target animals before their use. If WS' personnel observed non-target activity (*e.g*., tracks, scat), the fumigation of those burrows or dens would not occur. Since non-target animals may occur in burrows or dens, some risks of unintentional removal of non-target animals does exist from the use of fumigants. For example, burrows of woodchucks can be used by a variety of non-target species such as the eastern cottontail, striped skunk, raccoon, red fox, coyote, white-footed mouse (*Peromyscus leucopus*), house mouse (*Mus musculus*), and short-tailed shrew (*Blarina brevicauda*) (Hamilton 1934, Grizzell 1955, Dolbeer et al. 1991).

WS' personnel would use fumigants in active burrows or dens only, which would minimize risk to non-target animals. Of 97 woodchuck burrows treated with gas cartridges during the late summer, Dolbeer et al. (1991) found a total of one cottontail rabbit and three mice (*Permyscus* spp.) in three of the burrows. During 2,064 trap nights at 86 woodchuck burrow entrances targeting small mammals, Swihart and Picone (1995) captured 99 individuals of four small mammal species, which included short-tailed shrews, meadow voles (*Microtus pennsylvanicus*), meadow jumping mouse (*Zapus hudsonius*), and white-footed mice. WS' personnel would use fumigants in active burrows or dens only, which would minimize risk to non-target animals (Dolbeer et al. 1991). There are no secondary poisoning risks involved with the use of gas cartridges as the gas produced dissipates into the atmosphere shortly after activation. Therefore, WS' personnel can minimize the primary risks to non-target animals by treating only active burrows or dens, by covering entrances of burrows or dens, and by following the pesticide label. Although non-target animals could be present in burrows or dens, even after WS' conducts site investigations, the risks would be relatively low and unintentional removal from the use of fumigants would be limited.

Zinc phosphide is a toxicant that WS could use or recommend for use when targeting wood rats, muskrats, and woodchucks. However, zinc phosphide is currently not registered in the State for use to remove woodchucks or muskrats. According to the EPA, zinc phosphide, when ingested, reacts with the acids in the gut releasing phosphine gas, which interferes with cell respiration leading to the death of the animal (EPA 1998). Zinc phosphide is two to 15 times more toxic to rodents than to carnivores (Hill and Carpenter 1982). Secondary risks appear to be minimal to predators and scavengers that scavenge carcasses of animals killed with zinc phosphide (Tietjen 1976, Hegdal and Gatz 1977, Hegdal et al. 1980, Hill and Carpenter 1982, Johnson and Fagerstone 1994). Risks would be minimal since the digestive tract detoxifies 90% of the zinc phosphide ingested by rodents (Hegdal et al. 1980) and 99% of the zinc phosphide residues occur in the digestive tracts, with none occurring in the muscle. In addition, the amount of zinc phosphide required to kill target rodents is not enough to kill most other predatory animals that consume tissue (Johnson and Fagerstone 1994).

In addition, zinc phosphide has a strong emetic action (*i.e*., causes vomiting) and most non-target animals in research tests regurgitated bait or tissues contaminated with zinc phosphide without succumbing to the toxicant (Hegdal and Gatz 1977, Hegdal et al. 1980, Johnson and Fagerstone 1994). Furthermore, predators tend to eviscerate zinc phosphide-poisoned rodents before eating them or otherwise avoid the digestive tract and generally do not eat the stomach and intestines (Hegdal et al. 1980, Johnson and Fagerstone 1994). Although zinc phosphide baits have a strong, pungent, phosphorous-like odor (garlic like), this characteristic seems to attract rodents, particularly rats, and apparently makes the bait unattractive to some other animals. Many birds appear capable of distinguishing treated from untreated baits and they prefer untreated grain when given a choice (Siegfried 1968, Johnson and Fagerstone 1994). Birds appear particularly susceptible to the emetic effects of zinc phosphide, which would tend to offer an extra degree of protection against bird species dying from the consumption of bait treated with zinc phosphide or, for scavenging bird species, from eating poisoned rodents. Use of rolled oats instead of whole grain also appears to reduce bird acceptance of bait. Uresk et al. (1988) reported on the effects of zinc phosphide on six non-target rodent populations. Uresk et al. (1988) observed no differences in populations of eastern cottontail rabbits and white-tailed jackrabbits (*Lepus townsendii*) between areas treated with zinc phosphide (ground application) and untreated areas eight months after applying treated bait for black-tailed prairie dogs (*Cynomys ludovicianus*). However, primary consumption of bait by non-target animals could occur and potentially cause mortality. Uresk et al. (1988) reported a 79% reduction in deer mouse populations in areas treated with zinc phosphide; however, the effect was not statistically significant because of high variability in densities and the reduction was not long-term (Deisch et al. 1990).

Five weeks after treatment, Ramey et al. (2000) reported that zinc phosphide baiting did not kill any ring-necked pheasants (*Phasianus colchicus*). In addition, Hegdal and Gatz (1977) determined that zinc phosphide did not affect non-target populations and that predators killed more radio-tracked animals than died from zinc phosphide intoxication (Hegdal and Gatz 1977, Ramey et al. 2000). Tietjen (1976) observed horned larks (*Eremophila alpestris*) and mourning doves (*Zenaida macroura*) on zinc phosphide-treated prairie dog colonies, but observations after treatment did not locate any sick or dead birds, a finding similar to Apa et al. (1991). Uresk et al. (1988) reported that ground-feeding birds showed no difference in numbers between control and treated sites. Apa et al. (1991) further stated that horned larks did not consume zinc phosphide because: 1) poisoned grain remaining for their consumption was low (*i.e*., prairie dogs consumed the bait before larks could consume it), 2) birds have an aversion to black-colored foods, and 3) birds have a negative sensory response to zinc phosphide.

Tietjen and Matschke (1982) have also reported minimal impacts on birds associated with the use of zinc phosphide. Deisch et al. (1989) reported on the effect zinc phosphide has on invertebrates. Deisch et al. (1989) determined that zinc phosphide bait reduced ant densities; however, bait did not affect spider mites, crickets, wolf spiders, ground beetles, darkling beetles, and dung beetles. Wolf spiders and ground beetles showed increases after one year on zinc phosphide treated areas (Deisch 1986). Generally, direct long-term impacts from rodenticide treatments were minimal for the population of insects that were sampled (Deisch et al. 1989). Long-term effects were not directly related to rodenticides, but more to habitat changes (Deisch 1986) as vegetative cover and prey diversity increased without prairie dogs grazing and clipping the vegetation (Deisch et al. 1989).

WS' personnel would use zinc phosphide in accordance with the requirements of the product label that the EPA and the GDA have approved. WS' personnel that use chemical methods would be certified as pesticide applicators by the GDA and would adhere to all certification requirements set forth in the FIFRA and the Georgia pesticide control laws and regulations. WS' personnel would not use zinc phosphide without authorization from the property owner or manager.

An additional concern that has arisen is the potential for low-level flights to disturb animals, including T&E species. Aerial operations could be an important method of damage management in Georgia when used to address damage or threats associated with feral swine, coyotes, and/or fallow deer in remote areas where access was limited due to terrain and habitat. Aerial operations involving shooting would only occur in those areas where a work initiation document allowing the use of aircraft had been signed between WS and the cooperating landowner or manager. Aircraft could also be used for aerial surveys of animals or radio telemetry. Aerial operations would typically be conducted with aircraft between the months of December and April when the foliage has fallen; however, aircraft could be used at any time of year. The amount of time spent conducting aerial operations would vary depending on the survey area, severity of damage, the size of the area where damage or threats were occurring, and the weather, as low-level aerial activities would be restricted to visual flight rules and would be impractical in high winds or at times when animals were not easily visible.

Aircraft play an important role in the management of various wildlife species for many agencies. Resource management agencies rely on low flying aircraft to monitor the status of many animal populations, including large mammals (Lancia et al. 2000), birds of prey (Fuller and Mosher 1987), waterfowl (Bellrose 1976), and colonial waterbirds (Speich 1986). Low-level flights also occur when aircraft are used to track animal movements by radio telemetry (Gilmer et al. 1981, Samuel and Fuller 1996).

A number of studies have looked at responses of various animal species to aircraft overflights. The National Park Service (1995) reviewed the effects of aircraft overflights on wildlife and suggested that adverse effects could occur to certain species. Some species will frequently or at least occasionally show an adverse response to even minor overflights. In general though, it appears that the more serious potential adverse effects occur when overflights are chronic (*i.e.*, they occur daily or more often over long periods). Chronic exposures generally involve areas near commercial airports and military flight training facilities. Aerial operations conducted by WS rarely occur in the same areas on a daily basis, and little time is actually spent flying over those particular areas.

The effects on wildlife from military-type aircraft have been studied extensively (Air National Guard 1997), and were found to have no expected adverse effects on wildlife. Examples of species or species groups that have been studied with regard to the issue of aircraft-generated disturbance are as follows:

Waterbirds and Waterfowl**:** Low-level overflights of two to three minutes in duration by a fixed-wing airplane and a helicopter produced no "*drastic*" disturbance of tree-nesting colonial waterbirds, and, in 90% of the observations, the individual birds either showed no reaction or merely looked up (Kushlan 1979). Belanger and Bedard (1989, 1990) observed responses of greater snow geese (*Chen caerulescens atlantica*) to man-induced disturbance on a sanctuary area and estimated the energetic cost of such disturbance. Belanger and Bedard (1989, 1990) observed that disturbance rates exceeding two per hour reduced goose use of the sanctuary by 50% the following day. They also observed that about 40% of the disturbances caused interruptions in feeding that would require an estimated 32% increase in nighttime feeding to compensate for the energy lost. They concluded that overflights of sanctuary areas should be strictly regulated to avoid adverse effects. Conomy et al. (1998) quantified behavioral responses of wintering American black ducks (*Anas rubripes*), American wigeon (*A. americana*), gadwall (*A. strepera*), and American green-winged teal (*A. crecca carolinensis*) exposed to low-level military aircraft and found that only a small percentage (2%) of the birds reacted to the disturbance. They concluded that such disturbance was not adversely affecting the "*time-activity budgets*" of the species. Low-level aerial operations conducted by WS would not be conducted over federal, state, or other governmental agency property without the concurrence of the managing entity. Those flights, if requested, would be conducted to reduce threats and damages occurring to natural resources and should not result in impacts to bird species. Thus, there is little to no potential for any adverse effects on waterbirds and waterfowl.

Raptors**:** The Air National Guard analyzed and summarized the effects of overflight studies conducted by numerous federal and state government agencies and private organizations (Air National Guard 1997). Those studies determined that military aircraft noise initially startled raptors, but negative responses were brief and did not have an observed effect on productivity (see Ellis 1981, Fraser et al. 1985, Lamp 1989, United States Forest Service 1992 as cited in Air National Guard 1997). A study conducted on the impacts of overflights to bald eagles (*Haliaeetus leucocephalus*) suggested that the eagles were not sensitive to this type of disturbance (Fraser et al. 1985). During the study, observations were made of more than 850 overflights of active eagle nests. Only two eagles rose out of either their incubation or brooding postures. This study also showed that perched adults were flushed only 10% of the time during aircraft overflights. Evidence also suggested that golden eagles (*Aquila chrysaetos*) were not highly sensitive to noise or other aircraft disturbances (Ellis 1981, Holthuijzen et al. 1990). Finally, one other study found that eagles were particularly resistant to being flushed from their nests (see Awbrey and Bowles 1990 as cited in Air National Guard 1997). Therefore, there is considerable evidence that eagles would not be adversely affected by overflights during aerial operations.

Mexican spotted owls (*Strix occidentalis lucida*) (Delaney et al. 1999) did not flush when chain saws and helicopters were greater than 110 yards away; however, owls flushed to these disturbances at closer distances and were more prone to flush from chain saws than helicopters. Owls returned to their pre-disturbance behavior 10 to 15 minutes following the event and researchers observed no differences in nest or nestling success (Delaney et al. 1999), which indicates that aircraft flights did not result in adverse effects on owl reproduction or survival.

Andersen et al. (1989) conducted low-level helicopter overflights directly at 35 red-tailed hawk (*Buteo jamaicensis*) nests and concluded their observations supported the hypothesis that red-tailed hawks habituate to low level flights during the nesting period since results showed similar nesting success between hawks subjected to overflights and those that were not. White and Thurow (1985) did not evaluate the effects of aircraft overflights, but found that ferruginous hawks (*B. regalis*) were sensitive to certain types of ground-based human disturbance to the point that reproductive success may be adversely affected. However, military jets that flew low over the study area during training exercises did not appear to bother the hawks, nor did the hawks become alarmed when the researchers flew within 100 feet in a small fixed-wing aircraft (White and Thurow 1985). White and Sherrod (1973) suggested that disturbance of raptors by aerial surveys with helicopters may be less than that caused by approaching nests on foot. Ellis (1981) reported that five species of hawks, two falcons (*Falco* spp.), and golden eagles (*Aquila chrysaetos*) were "*incredibly tolerant*" of overflights by military fighter jets, and observed that, although birds frequently exhibited alarm, negative responses were brief and the overflights never limited productivity.

Grubb et al. (2010) evaluated golden eagle response to civilian and military (Apache AH-64) helicopter flights in northern Utah. Study results indicated that golden eagles were not adversely affected when exposed to flights ranging from 100 to 800 meters along, towards, and from behind occupied cliff nests. Eagle courtship, nesting, and fledging were not adversely affected, indicating that no special management restrictions were required in the study location.

The above studies indicate raptors were relatively unaffected by aircraft overflights, including those by military aircraft that produce much higher noise levels. Therefore, aerial operations would have little or no potential to affect raptors adversely.

Passerines**:** Reproductive losses have been reported in one study of small territorial passerines ("*perching*" birds that included sparrows, blackbirds) after exposure to low altitude overflights (see Manci et al. 1988 as cited in Air National Guard 1997), but natural mortality rates of both adults and young are high and variable for most species. The research review indicated passerine birds cannot be driven any great distance from a favored food source by a non-specific disturbance, such as military aircraft noise, which indicated quieter noise would have even less effect. Passerines avoid intermittent or unpredictable sources of disturbance more than predictable ones, but return rapidly to feed or roost once the disturbance ceases (Gladwin et al. 1988, United States Forest Service 1992). Those studies and reviews indicated there is little or no potential for aerial operations to cause adverse effects on passerine bird species.

Pronghorn (antelope) and Mule Deer**:** Krausman et al. (2004) found that Sonoran pronghorn (*Antilocapra americana sonoriensis*) were not adversely affected by military fighter jet training flights and other military activity on an area of frequent and intensive military flight training operations. Krausman et al. (1986) reported that only three of 70 observed responses of mule deer (*Odocoileus hemionus*) to small fixed-wing aircraft overflights at 150 to 500 feet above ground level resulted in the deer changing habitats. The authors believed that the deer might have been accustomed to overflights because the study area was near an interstate highway that was followed frequently by aircraft. Krausman et al. (2004) also reported that pronghorn and mule deer do not hear noise from military aircraft as well as people, which potentially indicates why they appeared not to be disturbed as much as previously thought.

Mountain Sheep**:** Krausman and Hervert (1983) reported that, of 32 observations of the response of mountain sheep to low-level flights by small fixed-wing aircraft, 60% resulted in no disturbance, 81% in no or "*slight*" disturbance, and 19% in "*great*" disturbance. Krausman and Hervert (1983) concluded that flights less than 150 feet above ground level could cause mountain sheep to leave an area. When Weisenberger et al. (1996) evaluated the effects of simulated low altitude jet aircraft noise on desert mule deer (*Odocoileus hemionus crooki*) and mountain sheep (*Ovis canadensis mexicana*), they found that heart rates of the ungulates increased according to the dB levels, with lower noise levels prompting lesser increases. When they were elevated, heart rates rapidly returned to pre-disturbance levels suggesting that the animals did not perceive the noise as a threat. Responses to the simulated noise levels were found to decrease with increased exposure.

Bison**:** Fancy (1982) reported that only two of 59 bison (*Bison bison*) groups showed any visible reaction to small fixed-winged aircraft flying at 200 to 500 feet above ground level. The study suggests that bison were relatively tolerant of aircraft overflights.

Domestic Animals and Small Mammals**:** A number of studies with laboratory animals (*e.g.*, rodents [Borg 1979]) and domestic animals (*e.g.*, sheep [Ames and Arehart 1972]) have shown that these animals can become habituated to noise. Long-term lab studies of small mammals exposed intermittently to high levels of noise demonstrate no changes in longevity. The physiological "*fight or flight*" response, while marked, does not appear to have any long-term health consequences on small mammals (Air National Guard 1997). Small mammals habituate, although with difficulty, to sound levels greater than 100 dbA (United States Forest Service 1992).

Although many of those animal species discussed above are not present in Georgia, the information was provided to demonstrate the relative tolerance most animal species have of overflights, even those that involve noise at high decibels, such as from military aircraft. In general, the greatest potential for impacts to occur would be expected to exist when overflights were frequent, such as hourly and over many days that could represent "*chronic*" exposure. Chronic exposure situations generally involve areas near commercial airports and military flight training facilities. Even then, many animal species often become habituated to overflights, which would naturally minimize any potential adverse effects where such flights occur on a regular basis. Therefore, aircraft used by WS should have far less potential to cause any disturbance to animal than military aircraft because the military aircraft produce much louder noise and would be flown over certain training areas many more times per year, and yet were found to have no expected adverse effects on wildlife (Air National Guard 1997).

The fact that WS would only conduct aerial hunting on a very small percentage of the land area of the State indicates that most animals would not even be exposed to aerial overflights in the State. Further lessening the potential for any adverse effects is that such flights occur infrequently throughout the year.

EFFECTS ON NON-TARGET ANIMAL POPULATIONS FROM WS' PREVIOUS ACTIVITIES

While WS' personnel take precautions to safeguard against capturing non-target animals during operational use of methods and techniques, the use of such methods can result in the unintentional live-capture or lethal removal of unintended species. In accordance with WS' policy (see WS Directive 2.101, WS Directive 2.450, WS Directive 2.455), WS' personnel take precautions to minimize the risk of capturing or lethally removing non-target animals. Some precautions that WS' personnel could take to minimize the risk of capturing non-target animals include selective trap placement, proper site selection, breakaway locks on cable devices (Phillips et al. 1990, Phillips et al. 1991), trap pan-tension devices on foothold traps (Phillips and Gruver 1996), and adjusting the trigger position on body-grip traps (Association of Fish and Wildlife Agencies 2014). Nevertheless, WS has captured or lethally removed some non-target animals unintentionally during activities conducted to alleviate damage.

Table 4.13 shows the number of non-target animals lethal removed unintentionally during activities conducted by WS from FY 2010 through FY 2015. To ensure a cumulative evaluation occurs, Table 4.13 includes non-target animals lethally removed unintentionally during activities associated with the ORV program (USDA 2009*a*) that overlap with non-target animals lethally removed during activities targeting those mammal species addressed in this EA. WS' personnel unintentionally lethally removed most of those non-target animals shown in Table 4.13 during activities targeting aquatic rodents, primarily beaver. For example, most of the river otter lethally removed unintentionally by WS between FY 2010 and FY 2015 were associated with activities that WS' personnel were conducting to alleviate damage caused by beaver.

Between FY 2010 and FY 2105, WS' unintentional removal included 65 common snapping turtles (*Chelydra serpentina*), 56 river otters, and 25 raccoons in the State during activities targeting those mammal species identified in Section 1.1 of this EA, primarily activities targeting beaver. In limited situations, WS has also lethally removed other non-target species during damage management activities, including American alligators (*Alligator mississippiensis*), American bullfrogs (*Lithobates catesbeiana*), American crow (*Corvus brachyrhynchos*), bobcats, Canada geese (*Branta canadensis*), coyotes, cottontails, gray squirrels, feral cats, feral swine, gray fox, largemouth bass (*Micropterus salmoides*), muskrats, pied-billed grebe (*Podilymbus podiceps*), venomous snakes, striped skunks, red-eared sliders (*Trachemys scripta*), turkey vultures (*Cathartes aura*), Virginia opossum, white-footed mouse (*Peromyscus leucopus*), white-tailed deer, and wild turkeys (*Meleagris gallopavo*).

Similar to the analyses of lethal removal on the populations of target mammal species under Issue 1, of primary concern with the unintended removal of non-target animals is the magnitude of removal on those species' populations. As shown in Table 4.13, WS' lethal removal of any single species of non-target animals since FY 2010 has not exceeded one or two individuals annually, except for snapping turtles, river otters, raccoons, and muskrats. For those species in which WS' unintentional removal did not exceed one or two individuals annually from FY 2010 through FY 2015, WS' removal did not adversely affect those species' populations based on the limited removal that occurred. The lethal removal of two American crows, two Canada geese, one pied-billed grebe, and 12 turkey vultures between FY 2010 and FY 2015 occurred within allowed take levels permitted by the USFWS through the issuance of depredation permits[22] to WS.

In addition, people can harvest some of those species that WS lethally removed unintentionally between FY 2010 and FY 2015. People can harvest American crows, wild turkeys, and Canada geese during annual hunting seasons in the State. The magnitude of WS' unintentional removal of crows, turkeys, and geese would be low when compared to the number of crows, turkeys, and geese that people harvest in the State annually. People can also harvest alligators, bullfrogs, turtles, bobcats, coyotes, cottontails, squirrels, feral swine, gray fox, largemouth bass, muskrats, raccoons, river otters, skunks, opossum, and deer in Georgia. WS' unintentional removal of those species when compared to the harvest level of those species would be of low magnitude. WS' activities did not limit the ability to harvest those species given the limited removal that occurred by WS.

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[22]The Migratory Bird Treaty Act allow for the lethal take of those bird species protected by the Act through the issuance of depredation permits or the establishment of depredation orders. Under authorities in the Migratory Bird Treaty Act, the United States Fish and Wildlife Service is the federal agency responsible for the issuance of depredation permits for the take of protected bird species. For more information regarding migratory bird depredation permits, see 50 CFR 13 and 50 CFR 21.

Table 4.13 – WS' lethal removal of non-target animals by method in Georgia, FY 2010 – FY 2015†

Species	Method of Lethal Removal				Total
	Body Grip	Cage Trap‡	Foothold	Neck Snare	
American Alligator	1	0	1	0	**2**
American Bullfrog	0	1	0	0	**1**
American Crow	0	0	2	0	**2**
Bobcat	0	0	1	0	**1**
Canada Goose	0	0	2	0	**2**
Coyote	0	0	0	2	**2**
Eastern Cottontail	0	2	5	0	**7**
Eastern Gray Squirrel	0	1	0	0	**1**
Feral Cat	0	0	2	0	**2**
Feral Swine	0	1	0	0	**1**
Gray Fox	0	0	2	0	**2**
Largemouth Bass	1	0	0	0	**1**
Muskrat	15	0	0	0	**15**
Pied-billed Grebe	1	0	0	0	**1**
Raccoon	11	1	13	0	**25**
River Otter	53	0	1	2	**56**
Snakes (Venomous)	0	5	0	0	**5**
Striped Skunk	0	0	1	0	**1**
Turtle (Slider)	4	0	0	0	**4**
Turtle (Common Snapping)	61	0	1	3	**65**
Turkey Vulture	0	6	6	0	**12**
Virginia Opossum	0	2	9	0	**11**
White-footed Mouse	0	0	4	0	**4**
White-tailed Deer	0	1	1	0	**2**
Wild Turkey	0	0	3	0	**3**

†Includes non-target animals lethally removed unintentionally during activities associated with the ORV program (USDA 2009*a*) that overlap with non-target animals lethally removed during activities targeting those mammal species addressed in this EA

‡Animals were dispatched with firearms to minimize safety concerns of personnel with the release of animals

In addition, bobcats, coyotes, cottontails, gray squirrels, feral cats, feral swine, gray fox, muskrats, raccoons, river otters, striped skunks, Virginia opossum, and white-tailed deer are species that WS could target to alleviate damage when receiving a request for such assistance. The level of annual lethal removal analyzed for each of those species under Issue 1 in Section 4.1 of this EA included the unintentional removal that could occur by WS (*i.e.*, the unintentional removal by WS was evaluated as part of the cumulative analysis). Therefore, the analyses evaluated lethal removal of those species cumulatively under Issue 1, including removal that could occur when an animal was a target or non-target.

Table 4.14 shows those non-target animals live-captured unintentionally but released unharmed by WS from FY 2010 through FY 2015. Similar to Table 4.13, Table 4.14 includes non-target animals live-captured unintentionally but released during activities associated with the ORV program (USDA 2009*a*). For example, many of the feral cats and opossum live-captured in cage traps from FY 2010 through FY 2015 were associated with activities that WS conducts under the ORV program (USDA 2009*a*). However, those species could also be live-captured and released during activities conducted under Alternative 1.

Table 4.14 – Non-target animals live-captured and released by WS in Georgia, FY 2010 – FY 2015†

Species	Method of Live-Capture				Total
	Body Grip‡	Cage Trap	Foothold‡	Snare‡	
American Alligator	2	1	0	2	**5**
American Crow	0	0	1	0	**1**
Black Vulture	0	0	1	0	**1**
Bobwhite Quail	0	4	0	0	**4**
Channel Catfish	1	0	0	0	**1**
Cotton Rat	0	1	0	0	**1**
Coyote	0	0	0	1	**1**
Domestic Animal	0	0	1	0	**1**
Eastern Cottontail	0	36	0	0	**36**
Eastern Gray Squirrel	0	18	0	0	**18**
Feral Cat	0	134	1	0	**135**
Feral Chicken	0	3	0	0	**3**
Feral Dog	0	7	0	1	**8**
Fox Squirrel	0	0	1	0	**1**
Gopher Tortoise	0	0	1	0	**1**
Great Horned Owl	0	0	1	0	**1**
Gray Fox	0	0	6	0	**6**
Mink	0	1	0	0	**1**
Mourning Dove	0	1	0	0	**1**
Northern Mockingbird	0	1	0	0	**1**
Raccoon	0	1	0	0	**1**
River Otter	0	1	0	0	**1**
Snake (Banded Water)	0	1	0	0	**1**
Striped Skunk	0	10	0	0	**10**
Swamp Rabbit	0	1	0	0	**1**
Turtles (Sliders and Eastern Box)	4	41	0	0	**45**
Turtle (Common Snapping)	132	5	0	2	**139**
Turkey Vulture	0	8	2	0	**10**
Virginia Opossum	0	476	2	0	**478**
White-tailed Deer	0	3	0	0	**3**
Woodchuck	0	7	0	0	**7**

†Includes non-target animals lethally removed unintentionally during activities associated with the ORV program (USDA 2009*a*) that overlap with non-target animals lethally removed during activities targeting those mammal species addressed in this EA

‡Animals captured in body grip traps, foothold traps, or neck snares by the tail or other extremity would be released if they are unharmed and can be released safely.

As shown in Table 4.14, most non-target animals captured by WS during damage management activities are live-captured and subsequently released unharmed. Non-target animals released have been primarily live-captured during activities targeting raccoons as part of the ORV program (USDA 2009*a*) addressed in Chapter 1 in which WS employs cage traps to live-capture raccoons for sampling. The EA addressing the ORV program and the post-baiting trapping program further discuss those activities (USDA 2009*a*). In addition, the EA for the ORV program further addresses the capture and limited lethal removal of non-target animals that could occur as part of the ORV program and trapping activities (USDA 2009*a*).

EFFECTS ON NON-TARGET ANIMAL POPULATIONS UNDER ALTERNATIVE 1

Under Alternative 1, WS' personnel would continue to take precautions to minimize the risk of capturing or lethally removing non-target animals, including those SOPs discussion in Section 3.3 and Section 3.4 of this EA. Despite those precautions and SOPs, the use of some methods could continue to result in the unintentional live-capture or lethal removal of unintended species. The unintentional removal and capture of animal species during damage management activities conducted under the proposed action alternative would primarily be associated with the use of body-gripping traps and cable devices and in some situations, with live-capture methods, such as foothold traps and cage traps (see Table 4.13 and Table 4.14).

WS would monitor the removal of non-target species to ensure program activities or methodologies used in mammal damage management would not adversely affect the populations of non-target species. Methods available to resolve and prevent mammal damage or threats when employed by trained, knowledgeable personnel would be selective for target species. WS would report to the GDNR any non-target animals lethally removed to ensure the GDNR had the opportunity to consider that removal as part of management objectives established for those species by the GDNR. The potential for adverse effects to occur to a population of a non-target species would be similar to the other alternatives and would be considered minimal to non-existent based on the limited removal that has occurred previously by WS.

As discussed previously, the use of non-lethal methods to address damage or threats generally have no effect on a species' population since those individuals addressed using non-lethal methods would be unharmed and no actual reduction in the number of individuals in a species' population occurs. Similarly, the live-capture and release of non-target animals generally has no adverse effects on a species' population since those individuals would be released unharmed and no actual reduction in the number of individuals in a population occurs. Therefore, the live-capture and subsequent releasing of non-target animals during damage management activities conducted under Alternative 1 would not result in declines in the number of individuals in a species' population.

The lethal removal of non-target animals could result in declines in the number of individuals in a population; however, as was discussed previously, the lethal removal of non-target animals by WS during damage management activities would be of low magnitude when compared to the actual statewide population of those species. The previous non-target animals lethally removed unintentionally by WS are representative of non-target animals that WS' personnel could lethally remove under Alternative 1. Although personnel could lethally remove additional species of non-target animals, the removal of individuals from any species would not be likely to increase substantively above the number of non-target animals removed annually by WS during previous damage management activities.

Therefore, WS expects the potential effects of implementing Alternative 1 would be similar to those effects that have occurred previously. In addition, many of the species that WS could capture or lethally remove unintentionally during the implementation of Alternative 1 are species that people have requested assistance with from WS. The analyses of potential effects on a species population that occurred under Issue 1 in Section 4.1 of this EA include the cumulative removal that could occur under Alternative 1, including those individuals of a species that WS could remove intentionally to alleviate damage or that WS could remove unintentionally during activities targeting other animals. Since Alternative 1 would be a continuation of the current program of using an adaptive integrated methods approach to managing damage, WS expects the magnitude of cumulative removal of target animals and non-target animals to be similar to WS' previous activities conducted between FY 2010 and FY 2015. WS would continue to monitor activities, including non-target animal removal, to ensure the annual removal of non-target animals does not result in adverse effects to a species' population.

ANALYSIS OF RISKS TO THREATENED OR ENDANGERED SPECIES

Special efforts would be made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or minimization measures. SOPs to avoid effects on T&E species are described in Chapter 3 of this EA.

Federally Listed Species – WS and the TVA reviewed the current list of species designated as threatened or endangered in Georgia as determined by the USFWS and the National Marine Fisheries Service during the development of this EA. Appendix C contains the list of species currently listed in the State along with common and scientific names.

As part of the development of this EA, WS consulted with the USFWS pursuant to Section 7 of the ESA. As part of that consultation process, WS conducted a review of potential impacts of Alternative 1 on each of the species listed at the time WS developed the EA. The evaluation took into consideration the direct and indirect effects of available methods, including physical exclusion, beaver dam removal/breeching, traps, and shooting. As part of the review process, WS prepared and submitted a biological evaluation to the USFWS as part of the consultation process pursuant to Section 7 of the ESA. For several species listed within the State, WS determined that the proposed activities "*may affect*" those species but those effects would be solely beneficial, insignificant, or discountable, which would warrant a "*not likely to adversely affect*" determination (see Appendix C). WS also determined the proposed action alternative would have no effect on several species listed as threatened, endangered, proposed for listing, or considered a candidate species by the USFWS and the National Marine Fisheries Service (see Appendix C). The USFWS concurred with WS' effects determination (R. Goodloe, USFWS pers. comm. 2016).

State Listed Species – Appendix D contains the current list of species the GDNR lists as rare, endangered, threatened, or unusual in State. Based on a review of those species listed in the State by the GDNR during the development of the EA, WS and the TVA determined that activities conducted pursuant to Alternative 1 would not cause adverse effects on those species listed in the State or their critical habitats. WS consulted the Comprehensive Wildlife Conservation Strategy (GDNR 2005*a*) and the wildlife action plan (GDNR 2015) as part of this analysis and the alternatives would be consistent with both plans.

Alternative 2 – Mammal 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. People seeking technical assistance from WS could employ those methods that WS' employees recommend or provide through loaning of equipment. WS' personnel would base recommendations on the 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 that WS' employees recommend or loan. Methods recommended could include non-lethal and lethal methods as deemed appropriate by the WS Decision Model and as permitted by laws and regulations.

The potential impacts to non-target animals under this alternative would be variable and based on several factors. If people requesting assistance employed methods as recommended by WS, the potential impacts to non-target animals would likely be similar to Alternative 1. If recommended methods and techniques were not followed or if other methods were employed that were not recommended, the potential impacts on non-target species, including T&E species would likely be higher compared to Alternative 1.

The potential impacts of harassment and exclusion methods on non-target species would be similar to those described under Alternative 1. Harassment and exclusion methods would be easily obtainable and simple to employ. Since identification of target animals would occur when employing shooting as a method, the potential impacts to non-target species would likely be low under this alternative; however, the impacts would likely be low only if people had the knowledge and experience to recognize and correctly identify a target animal.

Those persons experiencing damage from mammals may implement methods and techniques based on the recommendations of WS. Therefore, the knowledge and skill of those persons implementing recommended methods would influence the potential for impacts to occur. If those persons experiencing damage do not implement methods or techniques correctly, the potential impacts from providing only technical assistance could be greater than Alternative 1. The incorrect implementation of methods or techniques recommended by WS could lead to an increase in non-target removal when compared to the non-target removal that could occur by WS under Alternative 1.

If requesters were provided technical assistance but do not implement any of the recommended actions and conducted no further action, the potential to remove non-target animals would be lower when compared to Alternative 1. If those persons requesting assistance implement recommended methods appropriately and as instructed or demonstrated, the potential impacts to non-target animals would be similar to the Alternative 1. If WS made recommendations on the use of methods to alleviate damage but those methods were not implemented as recommended by WS or if those methods recommended by WS were used inappropriately, the potential for lethal removal of non-target animals would likely increase under this alternative. Therefore, the potential impacts to non-target animals, including T&E species, would be variable under this alternative.

If those people requesting assistance deemed non-lethal methods recommended by WS ineffective under this alternative, those people could employ lethal methods. Those people requesting assistance would likely be those persons that would use lethal methods since the damage had reached a threshold for that individual requester that triggered the requester to seek assistance to reduce damage. The potential impacts on non-target animals by those people experiencing damage would be highly variable. People whose mammal damage problems were not effectively resolved by non-lethal control methods would likely 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 removal of non-target animals than Alternative 1. When those persons experiencing damage caused by animals 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. The illegal use of methods often results in loss of both target and non-target animals (*e.g.*, see Allen et al. 1996, United States Department of Justice 2014, United States Department of Justice 2015). 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 removal of animal species.

The ability to reduce negative effects caused by mammals to wildlife species and their habitats, including T&E species, would be variable under this alternative. The skills and abilities of the people implementing damage management actions would determine their ability to reduce risks. Therefore, this alternative would have a greater chance of reducing damage than Alternative 3 since WS would be available to provide information and advice on appropriately employing methods and reducing the risk of non-target removal.

Alternative 3 – No Mammal Damage Management Conducted by WS

Under this alternative, the WS program in the State would not conduct damage management activities associated with mammals. Therefore, no direct impacts to non-target animals or T&E species would occur by WS under this alternative. Other people and entities could continue to conduct damage management activities, including the lethal removal of mammals, when authorized by the GDNR. People could continue to harvest mammals during the regulated harvest seasons and people could continue to remove non-regulated mammal species without the need for authorization from the GDNR. Risks to non-target animals and T&E species would continue to occur from those people who implement damage management activities on their own or through recommendations by other federal, state, and private entities. Although some risks could occur from those people that implement mammal damage management in the absence of any involvement by WS, those risks would likely be low, and would be similar to those risks under the other alternatives.

The ability to reduce negative effects caused by mammals to other 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 under this alternative.

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

A common concern is the potential adverse effects that methods available could have on human health and safety. Each of the alternatives evaluates the threats to human safety of methods available under the alternatives below.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed 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 possible use of those methods on property they own or manage to identify any risks to human safety associated with the use of those methods. Signing a MOU, work initiation document, or another similar document would assist WS and the cooperating entity with identifying any risks to human safety associated with methods at a particular location.

Under Alternative 1, WS could use or recommend those methods discussed in Appendix B singularly or in combination to resolve and prevent damage associated with mammals in the State. WS would use the Decision Model to determine the appropriate method or methods that would effectively resolve the request for assistance. Those methods would be continually evaluated for effectiveness and if necessary, additional methods could be employed. Non-lethal and lethal methods could be used under this alternative. WS would continue to provide technical assistance and/or direct operational assistance to those persons seeking assistance with managing damage or threats from mammals. Risks to human safety from technical assistance conducted by WS would be similar to those risks addressed under Alternative 2. Those non-lethal methods that could be used as part of an integrated approach to managing damage that would be available for use by WS as part of direct operational assistance, would be similar to those risks associated with the use of those methods under the other alternatives.

Lethal methods available under this alternative would include the use of euthanasia chemicals, body-gripping traps, cable devices, the recommendation of harvest during hunting and/or trapping seasons, fumigants, rodenticides, and shooting. In addition, target mammal species live-captured using non-lethal methods (*e.g.*, live-traps, immobilizing drugs) could be euthanized. WS could also use foothold traps and submersion rods or cables for drowning sets when targeting beaver. Those lethal methods available under this alternative (or similar products) would also be available under the other alternatives. None of the lethal methods available would be restricted to use by WS only. Euthanasia chemicals would not be available to the public but those mammals live-captured could be killed using other methods. Other entities (*e.g.*, the GDNR, veterinarians) could be available to euthanize animals using euthanasia chemicals. Zinc phosphide and aluminum phosphide would only be available to persons with a pesticide applicators license issued by the GDA.

WS' employees who conduct activities to manage damage caused by mammals would be knowledgeable in the use of those methods available, the animal 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 mammals. When employing lethal methods, WS' employees would consider risks to human safety when employing those methods based on location and method. For example, risks to human safety from the use of methods would likely be lower in rural areas that are 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 occur on private property in rural areas where access to the property could be controlled and monitored, the risks to human safety from the use of methods would likely be less. If damage management activities occurred at public parks or near other 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 were minimal (*e.g.*, in areas closed to the public).

The use of live-capture traps, restraining devices (*e.g.*, foothold traps, some cable devices), and body gripping traps have been identified as a potential issue. Live-capture traps available for mammals would typically be walk-in style traps where mammals enter but are unable to exit. Live-traps, restraining devices, and body-gripping traps would typically be set in situations where human activity was minimal to ensure public safety. Those methods rarely cause serious injury and would only be triggered through direct activation of the device. Therefore, human safety concerns associated with live traps, restraining devices, and body-gripping traps used to capture animals, including mammals, would require direct contact to cause bodily harm. Therefore, if left undisturbed, risks to human safety would be minimal. Signs warning of the use of those tools in the area could be posted for public view at access points to increase awareness that those devices were being used and to avoid the area, especially pet owners.

Other live-capture devices, such as nets, pose minor safety hazards to the public since use of the device would occur by trained personnel. Lasers also pose minimal risks to the public since application would occur directly to target species by trained personnel, which would limit the exposure of the public to misuse of the method.

Safety issues related to the misuse of firearms and the potential human hazards associated with the use of firearms were issues identified. To help ensure the safe use of firearms and to increase awareness of those risks, WS' employees who use firearms during official duties would be required to attend an approved firearm safety training course and to remain certified for firearm use must attend a safety training course in accordance with WS Directive 2.615. As a condition of employment, WS' employees who carry and use firearms are subject to the Lautenberg Domestic Confiscation Law, which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence (18 USC § 922(g)(9)). A safety assessment based on site evaluations, coordination with cooperating and local agencies (if applicable), and consultation with cooperators 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 firearms would be deemed appropriate for use. The use of all methods, including firearms, would be agreed upon with the cooperator to ensure the safe use of those methods. The security of firearms would also occur pursuant to WS Directive 2.615.

The recommendation by WS that people harvest certain mammal species during the regulated hunting and/or trapping season, that the GDNR establishes, would not increase risks to human safety above those risks already inherent with hunting or trapping those species. Recommendations of allowing hunting and/or trapping on property owned or managed by a cooperator to reduce certain mammal populations, which could then reduce damage or threats, would not increase risks to human safety. Safety requirements established by the GDNR for the regulated hunting and trapping season would further minimize risks associated with hunting and trapping. Although hunting and trapping accidents do occur, the recommendation of allowing hunting or trapping to reduce localized populations of certain mammal species would not increase those risks.

The issue of using chemical methods as part of managing damage associated with animals relates to the potential for human exposure either through direct contact with the chemical or through exposure to the chemical from animals that have been exposed. Under the alternatives identified, the use of chemical methods could include immobilizing drugs, euthanasia chemicals, reproductive inhibitors, fumigants, rodenticides, and repellents.

WS' employees would only administer immobilizing drugs to mammals that have been live-captured using other methods or would administer those drugs through injection using a projectile (*e.g.*, dart gun). WS' employees could use immobilizing drugs to sedate animals that require handling (*e.g.*, during disease sampling) and/or to transport target animals (*e.g.*, placed in an animal crate and transported to a release site). Sedating the animal could lessen the distress of the animal during the handling and/or transportation process. Drug delivery would likely occur on site with close monitoring of the animal to ensure proper care of the animal. Immobilizing drugs would be reversible with a full recovery of sedated animals occurring. Drugs used in capturing and handling animals that would be available include ketamine, a mixture of ketamine/Xylazine, and Telazol. Appendix B contains a list and description of immobilizing drugs available for use under the identified alternatives.

If mammals were immobilized for sampling or translocation and released, risks could occur to human safety if harvest and consumption occurred. SOPs employed by WS to reduce risks are discussed in Chapter 3 and in Appendix B. SOPs that would be part of the activities conducted include:

- All immobilizing drugs used in capturing and handling animals would be under the direction and authority of state veterinary authorities, either directly or through procedures agreed upon between those authorities and WS.
- As determined on a state-level basis by those veterinary authorities (as allowed by AMDUCA), animal damage management programs may choose to avoid capture and handling activities that utilize immobilizing drugs within a specified number of days prior to the hunting or trapping season for the target species. This practice would avoid release of animals that may be consumed by hunters and/or trappers prior to the end of established withdrawal periods for the particular drugs used. Ear tagging or other marking of animals drugged and released to alert hunters and trappers that they should contact state officials before consuming the animal.
- Most animals administered immobilizing drugs would be released well before hunting/trapping seasons, which would give the drug time to metabolize completely out of the animals' systems before they might be harvested and consumed by people. In some instances, animals collected for control purposes would be euthanized when they were captured within a certain specified time period prior to the legal hunting or trapping season to avoid the chance that they would be consumed as food while still potentially having immobilizing drugs in their systems.

Meeting the requirements of the AMDUCA should prevent any adverse effects to human health with regard to this issue.

Euthanizing chemicals would be administered under similar circumstances to immobilizing drugs and would be administered to animals live-captured using other methods. Euthanasia chemicals would include sodium pentobarbital and potassium chloride. Euthanized animals would be disposed of in accordance with WS Directive 2.515; therefore, would not be available for harvest and consumption. Euthanasia of target animals would occur in the absence of the public to minimize risks, whenever possible.

The recommendation of repellents or the use of those repellents registered for use to disperse mammals in the State could occur under Alternative 1 as part of an integrated approach to managing mammal damage. Those chemical repellents that would be available to recommend for use or that could be directly used by WS under this alternative would also likely 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 of repellents by WS or the recommendation of repellents by WS is addressed under the technical assistance only alternative (Alternative 2). Risks to human safety 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 were 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.

WS' personnel would place a gas cartridge inside the burrow or den and ignite the cartridge. Once personnel ignited the cartridge inside the burrow or den, they would cover the entrance with dirt, which traps the carbon monoxide inside the burrow. Ultimately, the carbon monoxide would dissipate into the atmosphere and be diluted by the air (EPA 1991). WS would follow label instructions when employing gas cartridges. Therefore, minimal risks to human safety would occur from the use of gas cartridges. Similarly, WS' personnel would place aluminum phosphide tablets inside the burrows of woodchucks and then seal the burrow entrances with dirt, which would trap the phosphine gas inside the burrow. The gas would eventually dissipate into the atmosphere and be diluted by the air. WS' personnel would use aluminum phosphide in accordance with the label requirements. Therefore, minimal risks to human safety would occur from the use of aluminum phosphide to target woodchucks.

The recommendation of zinc phosphide or the use of zinc phosphide products registered for use to manage damage associated with woodchucks, muskrats, and roof rats in the State could occur if WS implemented Alternative 1. When using zinc phosphide products, WS' personnel would follow the label requirements of the products, which would reduce risks to human safety. As discussed previously, WS' personnel would use the WS Decision Model to identify the appropriate methods for each assistance request. Using the WS Decision Model, WS' personnel would assess the problem and then evaluate the appropriateness and availability of strategies and methods, including risks to human safety associated with that specific request for assistance. Based on the use of the Decision Model and the incorporation of risk factors into the decision process, minimal risks to human safety would occur from WS' use of zinc phosphide to target woodchucks, muskrats, and roof rats.

Due to the classification of GonaCon™ as a restricted-use pesticide by the EPA, this product would be restricted to use by federal or state agencies that have successfully completed the requirements of the GDA for the purchase and application of restricted-use pesticides. Risks to human safety would be limited primarily to the actual applicator due to the necessity to capture and inject GonaCon™ into each animal to be vaccinated. During the development of this EA, GonaCon™ was not registered for use in Georgia; therefore, GonaCon™ would not be available for use within the State. Current Georgia statute prohibits the use of any fertility control in any wildlife species. However, this product could be registered for use in Georgia and could be administered by GDNR or their agents under any of the alternatives.

Risks to human safety from the use of GonaCon™ would be minimal and would occur primarily to those persons injecting the deer through accidental self-injection or those persons handling syringes. To reduce the risks of accidental exposure through self-injection, the label of GonaCon™ requires the use of long sleeved shirts, long pants, gloves, socks, and shoes. In addition, injection would only occur after deer had been properly restrained to minimize accidental injection during application to the deer. The label also requires that children be absent from the area during application of the vaccine as well as a warning to women that accidental self-injection could cause infertility.

In addition, human exposure could occur through consumption of deer that were treated with GonaCon™. As was discussed previously, the vaccine and the antibodies produced in response to the vaccine are amino acid proteins that if consumed would be broken down by stomach acids and enzymes, posing no risks to human safety. The vaccine would only be used in localized areas where deer populations have exceeded the biological or social carrying capacity. Those areas would likely be places where hunting was prohibited or restricted (*e.g.*, in public parks); therefore, the consumption of deer would be unlikely in those areas where the vaccine would be used since hunting would be prohibited or restricted. Deer injected with the vaccine must also be marked for identification, which would allow for placement of warnings to people that could harvest and consume a treated deer. Based on the use pattern of GonaCon™ and the chemical make-up of the vaccine and the antibodies, the risks to human safety from the use of the vaccine would be extremely low and would occur primarily to the handler (EPA 2009).

The recommendation by WS that mammals be harvested during the regulated hunting and/or trapping season that are established by the GDNR would not increase risks to human safety above those risks already inherent with hunting or trapping those species. Recommendations of allowing hunting and/or trapping on property owned or managed by a cooperator to reduce mammal populations, which could then reduce damage or threats, would not increase risks to human safety. Safety requirements established by the GDNR for the regulated hunting and trapping season would further minimize risks associated with hunting and trapping. Although hunting and trapping accidents do occur, the recommendation of allowing hunting or trapping to reduce localized populations of mammals would not increase those risks.

When WS received a request to remove a beaver dam, WS' employees would assess the potential for downstream flooding to determine the appropriate removal method. WS would generally breach or remove beaver dams by hand with a rake or power tools (*e.g.*, a winch). WS would normally breach or remove dams through incremental stages of debris removal from the dam that allows water levels to be gradually lowered. Breaching of dams would normally occur to limit the potential for flooding downstream by gradually allowing water levels to lower as more of the dam was breached over time. Depending on the size of the impoundment, water levels could be slowly lowered over several hours or days when breaching dams. When breaching dams, only that portion of the dam blocking the stream or ditch channel would be altered or breached, with the intent of returning water levels and flow rates to historical levels or to a level that eliminates damage threats that would be acceptable to the property owner or resource manager. Similar to breaching dams, the removal of the dam removes the debris impounding water and restores the normal flow of water. WS could also use explosives to breach or remove beaver dams. WS' employee would generally use explosives to remove beaver dams that were too large to remove by hand.

WS' personnel responsible for the use of explosives would be required to complete in-depth training and must demonstrate competence and safety with use of explosives pursuant to the WS Explosives Safety Manual (see WS Directive 2.435). Employees would adhere to WS' policies as well as regulations promulgated by the Bureau of Alcohol, Tobacco, and Firearms, the Occupational Safety and Health Administration, the United States Department of Transportation, and the Georgia State Police concerning explosives use, storage, safety, and transportation. WS would use binary explosives that require the mixing of two components for activation. Binary explosives reduce the hazard of accidental detonation during storage and transportation since the two components are stored separately. Storage and transportation of mixed binary explosives is prohibited. When explosives were being used by WS, warning signs would be posted to restrict public entry. WS would also contact the appropriate utility resources to identify and mark underground utilities before removing dams with explosives. When beaver dams were near roads or highways, police or other road officials would be used to help stop traffic and restrict public entry.

Aerial wildlife operations, like any other flying, may result in an accident. WS' pilots and crewmembers would be trained and experienced to recognize the circumstances that lead to accidents. The national WS Aviation Program has increased its emphasis on safety, including funding for additional training, the establishment of a WS Flight Training Center and annual recurring training for all pilots. Still, accidents may occur and the environmental consequences should be evaluated.

Although fires could result from aircraft-related accidents, no such fires have occurred from aircraft incidents previously involving government aircraft and low-level flights.

Aviation fuel is generally extremely volatile and will evaporate within a few hours or less. The fuel capacity for aircraft used by WS varies. For fixed-winged aircraft, a 52-gallon capacity would generally be the maximum, while 91 gallons would generally be the maximum fuel capacity for helicopters. In some cases, little or none of the fuel would be spilled if an accident occurs. Thus, there should be little environmental hazard from unignited fuel spills.

With the size of aircraft used by WS, the quantities of oil (*e.g.*, 6 to 8 quarts maximum for reciprocating (piston) engines and 3 to 5 quarts for turbine engines) capable of being spilled in any accident would be small with minimal chance of causing environmental damage. Aircraft used by WS would be single engine models, so the greatest amount of oil that could be spilled in one accident would be about eight quarts.

When exposed to oxygen, petroleum products biodegrade through volatilization and bacterial action (EPA 2000). Thus, small quantity oil spills on surface soils can be expected to biodegrade readily. Even in subsurface contamination situations involving underground storage facilities that would generally be expected to involve larger quantities than would ever be involved in a small aircraft accident, the EPA guidelines provide for *"natural attenuation"* or volatilization and biodegradation in some situations to mitigate environmental hazards (EPA 2000). Thus, even where oil spills in small aircraft accidents were not cleaned up, the oil does not persist in the environment or persists in such small quantities that no adverse effects would be expected. In addition, WS' accidents generally would occur in remote areas away from human habitation and drinking water supplies. Thus, the risk to drinking water appears to be exceedingly low to nonexistent.

For these reasons, the risk of ground fires or fuel/oil pollution from aviation accidents would be low. In addition, based on the history and experience of the program in aircraft accidents, it appears the risk of significant environmental damage from such accidents is exceedingly low.

No adverse effects to human safety have occurred from WS' use of methods to alleviate mammal damage in the State from FY 2010 through FY 2015. 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. WS would use only legal, effective, and environmentally safe damage management methods, tools, and approaches. WS and the TVA would properly dispose of any excess solid or hazardous waste. The EPA through the FIFRA, the GDA, the United States Drug Enforcement Administration, MOUs with land managing agencies, and WS' Directives would regulate chemical methods that could be available for use by WS pursuant to the alternatives and the TVA would allow to be used on properties they own or manage. WS and the TVA do not anticipate this alternative would result in any adverse or disproportionate environmental impacts to minority and low-income persons or populations. In contrast, this alternative might benefit minority or low-income populations by reducing threats to public health and safety and property damage.

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 Alternative 1 might have on children. The proposed activities would occur by using only legally available and approved methods where it is highly unlikely that activities conducted pursuant to the alternatives would adversely affect children. For these reasons, WS and the TVA conclude that it would not create an environmental health or safety risk to children from implementing this alternative. Additionally, the need for action identified a need to reduce threats to human safety, including risks to children; therefore, cooperators could request WS' assistance with reducing threats to the health and safety of children posed by mammals. Therefore, based on the use patterns of methods available to address damage caused by mammals, this alternative would comply with Executive Order 12898 and Executive Order 13045.

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

Under this alternative, WS would be restricted to making recommendations on the use of methods and the demonstration of methods to resolve damage. WS would only provide technical assistance to those people requesting assistance with mammal damage and threats. 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. Risks to human safety associated with non-chemical methods, such as resource management methods (*e.g*., crop selection, limited habitat modification, modification of human behavior), exclusion devices, frightening devices, and cage traps, could be considered low based on their use profile for alleviating damage associated with animals. 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, those methods could be used with a high degree of safety.

Under this alternative, GonaCon™, immobilizing drugs, euthanasia chemicals, and the use of aircraft would have limited availability to people experiencing damage or to other entities. However, personnel with the GDNR or their designated agents could use GonaCon™ under this alternative, if registered. Immobilizing drugs used in capturing and handling animals could be administered under the direction and authority of state veterinary authorities, either directly or through procedures agreed upon between those authorities and other entities, such as the GDNR. Without access to immobilizing drugs or euthanizing chemicals, those persons capturing mammals using live-traps or other live-capture methods would be responsible for euthanizing or handling live-captured captive animals. Since the availability of immobilizing drugs and euthanizing chemicals would be limited under this alternative, a gunshot would likely be the primary method of euthanasia. The use of aircraft, primarily the use of firearms from an aircraft, would require authorization from the GDNR.

If cannon nets were recommended, persons employing nets would be present at the site during application to ensure the safety of the public and operators. Although some fire and explosion hazards exist with rocket nets during ignition and storage of the explosive charges, safety precautions associated with the use of the method, when adhered to, would pose minimal risks to human safety and would primarily occur to the handler. Nets would not be recommended in areas where public activity was high, which would further reduce the risks to the public. Nets would be recommended for use in areas where public access was restricted whenever possible to reduce risks to human safety. Overall, nets would pose minimal risks to the public.

The use of chemical methods that are considered non-lethal could be available under this alternative. Chemical methods available would include repellents. There are few chemical repellents registered for use to manage damage caused by mammals 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 mammals from areas where the repellents were applied. 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 would occur to the applicator, as well as others, as the product was applied due to the potential for drift. Some repellents also have restrictions on whether application can occur on edible plants with some restricting harvest for a designated period after application. All restrictions on harvest and required personal protective equipment would be included on the label and if followed, would minimize risks to human safety associated with the use of those products.

The recommended use of chemical methods that were considered lethal would also be available under this alternative. Lethal chemicals available would consist primarily of those Ready-To-Use toxicants targeting rodents that were available at local hardware stores for use in managing old world rodents. Those toxicants would require no special certification to use and they would generally be considered safe when their use occurred in accordance with label directions. Additional lethal chemicals would be available through WS' recommendation to contact private sector animal control operators that have received GDA certification for use of restricted-use pesticides. While those chemicals may not be available to individual landowners, using a private sector animal control operator, similar chemical use, and mammal damage control could be achieved.

The recommendation by WS that mammals be harvested during the regulated hunting and/or trapping season, which would be established by the GDNR would not increase risks to human safety above those risks already inherent with hunting and trapping mammals. Recommendations of allowing hunting or trapping on property owned or managed by a cooperator to reduce local mammal populations that could then reduce mammal damage or threats would not increase risks to human safety. Safety requirements established by the GDNR for the regulated hunting and trapping season would further minimize risks associated with those activities. Although hunting and trapping accidents do occur, the recommendation of allowing hunting or trapping to reduce localized mammal populations would not increase those risks.

The recommendation of shooting with firearms as a method of direct lethal removal could occur under this alternative. Safety issues do 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 would be minimal. If firearms were employed inappropriately or without regard to human safety, serious injuries 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 mammal damage would be available under any of the alternatives and the use of firearms by those persons experiencing mammal 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 Alternative 1. 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 mammal damage could threaten human safety. However, when used appropriately, methods available to alleviate damage would not threaten human safety. The recommendation of methods by WS to people requesting assistance and the pattern of use recommended by WS would comply with Executive Order 12898 and Executive Order 13045.

Alternative 3 – No Mammal Damage Management Conducted by WS

Under this alternative, WS would not be involved with any aspect of managing damage associated with mammals in the State, including technical assistance. Due to the lack of involvement in managing damage caused by mammals, no impacts to human safety would occur directly from WS. This alternative would not prevent those entities experiencing threats or damages associated with mammals from conducting damage management activities in the absence of WS' assistance. The direct burden of implementing permitted methods would be placed on those people experiencing damage or would require those people to seek assistance from other entities.

Similar to Alternative 2, GonaCon™, immobilizing drugs, euthanasia chemicals, and the use of aircraft would have limited availability under this alternative to the public. However, fumigants, rodenticides, and repellents would continue to be available to those persons with the appropriate pesticide applicators license. Since most methods available to resolve or prevent mammal damage or threats would be available to anyone, the threats to human safety from the use of those methods would be similar between the alternatives. However, methods employed by those persons not experienced in the use of methods or were not trained in their proper use, could increase threats to human safety. Overall, the methods available to the public, when applied correctly and appropriately, would pose minimal risks to human safety.

Issue 4 - Effects of Mammal Damage Management Activities on the Aesthetic Value of Mammals

Another concern often raised is the potential impact the alternatives could have on the aesthetic value that people often regard for mammals. The effects of the alternatives on this issue are analyzed below by alternative.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

Under this alternative, methods would be employed that would result in the dispersal, exclusion, or removal of individuals or small groups of mammals to resolve damage and threats. In some instances where mammals were dispersed or removed, the ability of interested persons to observe and enjoy those mammals would likely temporarily decline.

Even the use of exclusionary devices can lead to the dispersal of animals if the resource being damaged was acting as an attractant. Thus, once the attractant was removed or made unavailable, the animals would likely disperse to other areas where resources would be more vulnerable.

The use of lethal methods would result in temporary declines in local populations resulting from the removal of mammals to address or prevent damage and threats. The goal under Alternative 1 would be to respond to requests for assistance and to manage those mammals responsible for the resulting damage. Therefore, the ability to view and enjoy mammals would remain if a reasonable effort were made to locate mammals outside the area in which damage management activities were occurring. In most cases, the mammals removed by WS could be removed by the person experiencing damage or removed by other entities if no assistance was provided by WS.

All activities would be conducted where a request for assistance was received and only after the cooperator and WS had signed a MOU, work initiation document, or similar document. Some aesthetic value would be gained by the removal of some mammal species 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 mammal densities.

Since other entities could remove those mammals that WS could remove, WS' involvement in removing those mammals would not likely be additive to the number of mammals that could be removed in the absence of WS' involvement. Other entities could remove mammals when the GDNR authorizes the removal, without the need for specific authorization if the species was unregulated (*e.g*., coyote, armadillos, beaver, woodchucks), or during the regulated hunting or trapping seasons. In addition, entities could request the assistance of other state and federal agencies or seek assistance from private entities to manage damage.

WS' removal of mammals from FY 2010 through FY 2015 has been of low magnitude compared to the total mortality and populations of those species. WS' activities would not likely be additive to the mammals that could be lethally removed in the absence of WS' involvement. Although mammals removed by WS would no longer be present for viewing or enjoying, the property owner or manager would likely remove those mammals if WS were not involved in the action. Removal by the property owner or manager could occur when authorized, during the regulated hunting and trapping seasons, or if the mammals were unregulated, removal could occur without the need for specific authorization. Given the limited removal proposed by WS under this alternative when compared to the known sources of mortality of mammals and the population estimates of those species, WS' mammal damage management activities conducted pursuant to Alternative 1 would not adversely affect the aesthetic value of mammals. The impact on the aesthetic value of mammals and the ability of the public to view and enjoy mammals under Alternative 1 would be similar to the other alternatives and would likely be low.

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

If those persons seeking assistance from WS were those persons likely to conduct damage management activities in the absence of WS' involvement, then technical assistance provided by WS would not adversely affect the aesthetic value of mammals in the State similar to Alternative 1. Mammals could be lethally removed under this alternative by those entities experiencing mammal damage or threats, which could result in localized reductions in the presence of mammals at the location where damage was occurring. The presence of mammals 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 mammals from the area if those non-lethal methods recommended by WS were employed by those persons receiving technical assistance. Therefore, technical assistance provided by WS would not prevent the aesthetic enjoyment of mammals since any activities conducted to alleviate mammal 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 mammals would be similar to those addressed in Alternative 1. When people seek assistance with managing damage from either WS or another entity, the damage level has often reached an unacceptable threshold for that particular person. Therefore, in the case of mammal damage, the social acceptance level of those mammals causing damage 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 could be employed by the requester that could result in the dispersal and/or removal of mammals responsible for damage or threatening safety. If those mammals causing damage were dispersed or removed by those persons experiencing damage based on recommendations by WS or other entities, the potential effects on the aesthetic value of those mammals would be similar to Alternative 1. In addition, those persons could contact other entities to provide direct assistance with dispersing or removing those mammals causing damage.

The potential impacts on aesthetics from a technical assistance program would only be lower than Alternative 1 if those individuals experiencing damage were not as diligent in employing those methods as WS would be if conducting an operational program or if the requester took no further action. If those persons experiencing damage abandoned the use of those methods or conducted no further actions, then mammals would likely remain in the area and available for viewing and enjoying for those persons interested in doing so. Similar to the other alternatives, the geographical area in which damage management activities could occur would not be such that mammals would be dispersed or removed from such large areas that opportunities to view and enjoy mammals would be severely limited.

Alternative 3 – No Mammal Damage Management Conducted by WS

Under the no mammal damage management by WS alternative, the actions of WS would have no impact on the aesthetic value of mammals in the State. Those people experiencing damage or threats from mammals would be responsible for researching, obtaining, and using all methods as permitted by federal, state, and local laws and regulations. People could continue to disperse and lethally remove mammals under this alternative in the State. Lethal removal could continue to occur when authorized by the GDNR, removal could occur during the regulated harvest season, and in the case of non-regulated species, removal could occur any time without the need for specific authorization.

Since those persons experiencing damage or other entities could continue to remove mammals under this alternative, despite WS' lack of involvement, the ability to view and enjoy mammals would likely be similar to the other alternatives. The lack of WS' involvement would not lead to a reduction in the number of mammals dispersed or removed since WS' has no authority to regulate removal or the harassment of mammals in the State. The GDNR, with management authority over mammals could continue to adjust all removal levels based on population objectives for those mammal species in the State. Therefore, the GDNR would regulate and adjust the number of mammals lethally removed annually through harvest and under authorizations issued by the GDNR.

Those people experiencing damage or threats could continue to use those methods they feel appropriate to resolve mammal damage or threats, including lethal removal or could seek the direct assistance of other entities. Therefore, WS' involvement in managing damage would not be additive to the mammals that could be dispersed or removed. The impacts to the aesthetic value of mammals would be similar to the other alternatives.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

As discussed previously, a common issue often raised is concerns about the humaneness of methods available under the alternatives for resolving mammal damage and threats. The issues of method humaneness relating to the alternatives are discussed below.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

Under this alternative, WS would integrate methods using the WS Decision Model as part of technical assistance and direct operational assistance. Methods available under this alternative could include non-lethal and lethal methods integrated into direct operational assistance conducted by WS. Under this alternative, non-lethal methods would be used by WS that were generally regarded as humane. Non-lethal methods that would be available include resource management methods (*e.g.*, crop selection, limited habitat modification, modification of human behavior), translocation, exclusion devices, frightening devices, reproductive inhibitors, cage traps, foothold traps, nets, immobilizing drugs, 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 individuals believe any use of lethal methods to resolve damage associated with animals is inhumane because the resulting fate is the death of the animal. Others believe that certain lethal methods can lead to a humane death. Others believe most non-lethal methods of capturing animals to be humane because the animal is generally unharmed and alive. Still others believe that any disruption in the behavior of animals 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 animals. The goal of WS would be to use methods as humanely as possible to resolve 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 resolve 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, a cage trap would generally be considered by most members of the public as "*humane*", since the animal would be alive and generally unharmed. Yet, without proper care, live-captured animals in a cage trap could be treated inhumanely if not attended to appropriately.

Therefore, the goal would be to address requests for assistance effectively 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 would be regarded as humane when used appropriately. Although some concern arises from the use of live-capture methods, the stress of animals is likely temporary.

Although some issues of humaneness could occur from the use of cage traps, foothold traps, reproductive inhibitors, translocation, immobilizing drugs, nets, and repellents, those methods, when used appropriately and by trained personnel, would not result in the inhumane treatment of animals. Concerns from the use of those non-lethal methods would be from injuries to animals while those animals were restrained in traps and 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 people do not take action to alleviate conditions that cause pain or distress in animals.

WS' personnel would check methods in accordance with WS Directive 2.210 and WS Directive 2.450. Personnel would directly monitor some live-capture methods (*e.g*., drops nets, cannon nets, immobilizing drugs administered through a dart gun), which ensures that personnel could release non-target species quickly, if captured. In most cases, WS' personnel would check other live-traps (*e.g*., cage traps, foothold traps, restraining cables), which do not require direct monitoring, at least once every 24 hours or in accordance with Georgia laws and regulations. Checking traps frequently would help ensure that personnel could release live-captured non-target species in a timely manner. Although stress could occur to animals restrained in a trap, timely attention to live-captured animals would alleviate suffering. Stress would likely be temporary.

Under this alternative, WS' personnel could use lethal methods to alleviate or prevent mammal damage and threats, when requested. Lethal methods would include shooting, body-gripping traps, cable devices, fumigants, rodenticides, euthanasia chemicals, and the recommendation of harvest during hunting and/or trapping seasons. WS could also use foothold traps and submersion cables or rods with drowning sets when targeting beaver. In addition, WS' personnel could euthanize target animals that an employee live-captures using non-lethal methods. WS' use of lethal methods under this alternative would follow those required by WS' directives (see WS Directive 2.430, WS Directive 2.505).

The euthanasia methods that WS is considering for use under this alternative for animals live-captured are carbon dioxide, carbon monoxide, gunshot, and barbiturates or potassium chloride in conjunction with general anesthesia. The AVMA considers those methods as acceptable for euthanasia and the use of those methods would meet the definition of euthanasia (AVMA 2013). The use of carbon dioxide, carbon monoxide, barbiturates, and potassium chloride for euthanasia would occur after the animal had been live-captured and would occur away from public view. Although the AVMA guideline also lists gunshot as a conditionally acceptable method of euthanasia for free-ranging wildlife, there is greater potential the method may not consistently produce a humane death (AVMA 2013). WS' personnel that employ firearms to address mammal damage or threats to human safety would be aware of the proper placement of shots to ensure a timely and quick death.

An issue when dealing with aquatic rodent species is the use of foothold traps to create drowning sets and the humaneness of drowning. There is considerable debate and disagreement among animal interest groups, veterinarians, wildlife professionals, fur trappers, and nuisance animal agents on this issue. The debate centers on an uncertainty as to whether the drowning animals are rapidly rendered unconscious by high levels of carbon dioxide and therefore, insensitive to distress and pain (Ludders et al. 1999). The inhalation of carbon dioxide at concentrations of 7.5% can increase the pain threshold and higher concentrations can have a rapid anesthetic effect on animals (AVMA 2013). For comparison, room air contains approximately 0.04% carbon dioxide (AVMA 2007).

The American Veterinary Medical Association considers drowning to be an unacceptable method of euthanasia because the death of the animal does not meet their definition of euthanasia (Beaver et al. 2001, AVMA 2007, AVMA 2013). Ludders et al. (1999) concluded animals that drowned were distressed because of the presence of high levels of the stress related hormones epinephrine and norepinephrine that were present in their bloodstreams. Ludders et al. (1999) showed death during drowning occurred from hypoxia and anoxia; thus, animals experienced hypoxemia. Ludders et al. (1999) reported carbon dioxide narcosis did not occur in drowning animals until the mercury levels in the arterial blood of animals exceeded 95 millimeters. Therefore, Ludders et al. (1999) also concluded drowning did not meet the definition of euthanasia. This conclusion was based on animals not dying rapidly from carbon dioxide narcosis (Ludders et al. 1999).

Death by drowning in the classical sense is caused by the inhalation of fluid into the lungs and is referred to as "*wet*" drowning (Gilbert and Gofton 1982, Noonan 1998). Gilbert and Gofton (1982) reported that all submerged beaver do not die from wet drowning, but die of narcosis induced by carbon dioxide, and the American Veterinary Medical Association has stated the use of carbon dioxide is acceptable (Gilbert and Gofton 1982, Noonan 1998, AVMA 2013). Gilbert and Gofton (1982) reported that after beaver were trapped and they entered the water, the beaver struggled for two to five minutes, followed by a period of reflexive responses. Andrews et al. (1993) stated that with some techniques that induce hypoxia, some animals have reflex motor activity followed by unconsciousness that is not perceived by the animal. Gilbert and Gofton (1982) stated it is unknown how much conscious control actually existed at this stage and they stated anoxia might have removed much of the sensory perception by five to seven minutes post submersion.

However, Gilbert and Gofton (1982) have been criticized because levels of carbon dioxide in the blood were not reported and there was insufficient evidence that the beaver in their study were under a state of carbon dioxide narcosis when they died (Ludders et al. 1999). Adding to the controversy, Clausen and Ersland (1970) did measure carbon dioxide in the blood for submersed restrained beaver; yet, none of the beaver in their study died, so Clausen and Ersland (1970) could not determine if beaver died of carbon dioxide narcosis. Clausen and Ersland (1970) demonstrated that carbon dioxide increased in arterial blood while beaver were submersed and carbon dioxide was retained in the tissues. While Clausen and Ersland (1970) did measure the amounts of carbon dioxide in the blood of submersed beaver, they did not attempt to measure the analgesic effect of carbon dioxide buildup to the beaver. When beaver were trapped using foothold traps with intent to "*drown*", the beaver exhibit a flight response. Gracely and Sternberg (1999) reported that there is stress-induced analgesia resulting in reduced pain sensitivity during fight or flight responses. Environmental stressors that animals experience during flight or fight activate the same stress-induced analgesia (Gracely and Sternberg 1999).

The use of drowning trap sets has been a traditional wildlife management technique in trapping aquatic rodents, such as beaver and muskrat. Trapper education manuals and other manuals written by wildlife biologists recommend drowning sets for foothold traps set for beaver (Howard et al. 1980, Randolph 1988, Bromley et al. 1994, Dolbeer et al. 1994, Miller and Yarrow 1994). In some situations, drowning trap sets are the most appropriate and efficient method available to capture beaver and muskrat. For example, a drowning set attachment should be used with foothold traps when capturing beaver to prevent the animals from injuring themselves while restrained, or from escaping (Miller and Yarrow 1994). Animals that drown die relatively quickly (*e.g.*, within minutes) versus the possible stress of being restrained and harassed by people, dogs, and other wildlife before being euthanized. Drowning sets make the captured animal, along with the trap, less visible and prevents injury from the trapped animal (*i.e.*, bites and scratches) to people who may otherwise approach a restrained animal. Furthermore, the sight of dead animals may offend some people. Drowning places the dead animal out of public view. Some sites may be unsuitable for body-gripping traps or cable devices because of unstable banks, deep water, or a pond with a soft bottom, but those sites would be suitable for foothold traps.

Although rarely used by WS, WS concludes that using drowning trap sets are acceptable and WS recognizes some people disagree. WS based those conclusions on the short time period of a drowning event, the possible analgesic effect of carbon dioxide buildup, the minimal, if any, pain or distress on drowning animals, the American Veterinary Medical Association acceptance of hypoxemia as euthanasia, and the American Veterinary Medical Association acceptance of a minimum of pain and distress during euthanasia. In addition, the best management practice trapping standards for beaver and muskrat allow for the use of submersion sets (Association of Fish and Wildlife Agencies 2014) and the current acceptance of catching and drowning muskrats and beaver approved by International Humane Trapping Standards (Fur Institute of Canada 2009).

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 were found practical, a certain amount of animal suffering could occur when some methods were used in situations where non-lethal damage management methods were not practical or effective. As stated previously, research suggests that some methods, such as restraint in foothold traps or changes in the blood chemistry of trapped animals, indicate "*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, Sharp and Saunders 2008, Sharp and Saunders 2011).

Personnel from WS would be experienced and professional in their use of management methods. Consequently, management methods would be implemented in the most humane manner possible. Many of the methods discussed in Appendix B to alleviate mammal damage and/or threats in the State could be used under any of the alternatives by those persons experiencing damage regardless of WS' direct involvement. The only methods that would have limited availability to those people experiencing damage associated with mammals would be GonaCon™ (deer only), immobilizing drugs, euthanasia chemicals, and the use of aircraft. Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives since those methods could be employed by other entities in the absence of WS' involvement. 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 were used by WS as humanely as possible are listed in Chapter 3.

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

The issue of humaneness of methods under this alternative would be similar to the humaneness issues discussed under Alternative 1. This similarity would be derived from WS' recommendation of methods that some people may 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 Alternative 1. Under Alternative 2, WS would recommend the use of euthanasia methods pursuant to WS Directive 2.505. However, the person requesting assistance would determine what methods to use to euthanize or kill a live-captured animal under Alternative 2.

WS would instruct and demonstrate the proper use and placement of methodologies to increase effectiveness in capturing target mammal species and to ensure methods were 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 requester in resolving the threat to safety or damage situation despite WS' demonstration. Therefore, a lack of understanding of the behavior of mammals or improperly identifying the damage caused by mammals along with inadequate knowledge and skill in using methodologies to resolve the damage or threat could lead to incidents with a greater probability of being perceived as inhumane. In those situations, the potential for pain and suffering would likely be regarded as greater than discussed under Alternative 1.

Alternative 3 – No Mammal Damage Management Conducted by WS

Under this alternative, WS would not be involved with any aspect of mammal damage management in Georgia. Those people experiencing damage or threats associated with mammals could continue to use those methods legally available. 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.

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 animals 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 to use to resolve damage and threats caused by mammals. Under Alternative 3, euthanasia or killing of live-captured animals would also be determined by those persons employing methods to live-captured animals.

Issue 6 – Effects of Beaver Removal and Dam Manipulation on the Status of Wetlands in the State

Generally, people consider beaver to be beneficial where their activities do not compete with human land use or human health and safety (Wade and Ramsey 1986). The opinions and attitudes of individuals, organizations, and communities vary greatly and are primarily influenced and formed by the benefits and/or damage directly experienced by each individual (Hill 1982, Baker and Hill 2003). Woodward et al. (1976) found that 24% of landowners who reported beaver activity on their property indicated benefits to having beaver ponds on their land and desired assistance with beaver pond management (Hill 1976, Woodward et al. 1985). In some situations, the damage and threats caused by beaver outweigh the benefits (Grasse and Putnam 1955, Woodward et al. 1985, Novak 1987).

Concern has been expressed regarding the potential effects of Alternative 1 and the alternatives on wetland ecosystems associated with activities that could be conducted to address beaver damage or threats. Concerns have been raised that removing and/or modifying beaver dams in an area would result in the loss of wetland habitat and the plant and animal species associated with those wetlands. In addition, concerns are often raised regarding the use of lethal methods to remove beaver to alleviate damage or threats. If beaver were lethally removed from an area and any associated beaver dam was removed or breached, the manipulation of water levels by removing/breaching the dam could prevent the establishment of wetlands in areas where water has been impounded by beaver dams for an extended period.

Over time, the impounding of water associated with beaver dams can establish new wetlands. Because beaver dams may involve waters of the United States, the removal of a beaver dam is regulated under Section 404 of the CWA. The United States Army Corps Of Engineers and the EPA regulatory definition of a wetland (40 CFR 232.2) is: "[t]*hose areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas*."

Although beaver can cause damage to resources, there can be many benefits associated with beaver and beaver activities. Beaver can provide ecological benefits associated with the creation of wetland habitats (*e.g*., see Munther 1982, Wright et al. 2002, Rosell et al. 2005, Pollock et al. 2007, Fouty 2003, Fouty 2008, Hood and Bayley 2008, Taylor et al. 2009, Pollock et al. 2012, Pollock et al. 2014). Beaver can also provide aesthetic and recreational opportunities for wildlife observation (Wade and Ramsey 1986, Ringleman 1991), improve water quality (Muller-Schwarze and Sun 2003), and provide cultural and economic gains from fur harvest (Hill 1976, Arner and Dubose 1978*a*, Arner and Dubose 1978*b*, McNeely 1995, Lisle 1996, Lisle 2003).

Beaver impoundments can increase surface and groundwater storage, which can help reduce problems with flooding by slowing the downstream movement of water during high-flow events and help to mitigate the adverse effects of drought (Wade and Ramsey 1986, Naiman et al. 1988, Hey and Philippi 1995, Westbrook et al. 2006, Fouty 2003, Fouty 2008). Hood and Bayley (2008) determined that the presence of beaver could help reduce the loss of open water wetlands during warm, dry years. The presence of beaver impoundments in riverine systems of the Rocky Mountains could affect groundwater recharge and the ability of the water table to withstand drought effects (Westbrook et al. 2006). The presence of active beaver lodges accounted for over 80% of the variability in the amount of open water present in the mixed-wood boreal region of east-central Alberta (Hood and Bayley 2008). Hood and Bayley (2008) also found temperature and rainfall influenced the amount of open-water wetlands, but to a much lesser extent than the presence of beaver. During wet and dry years, the presence of beaver was associated with a 9-fold increase in open water area over the same areas when beaver were absent. Hood and Bayley (2008) noted that beaver could mitigate some of the adverse effects of global warming through their ability to create and maintain areas of open water. Beaver ponds and associated wetlands can provide a potential water source for livestock, serve as basins for the entrapment of streambed silt and eroding soil (Hill 1982), and help to filter nutrients from the water; thereby, maintaining the quality of nearby water systems (Arner and Hepp 1989).

Beaver may increase habitat diversity by opening forest habitats via dam building and tree cutting, which can result in a greater mix of plant species, and different-aged plant communities (Hill 1982, Arner and Hepp 1989). The creation of standing water, edge habitat, and plant diversity, all in close proximity, can result in excellent habitat for many wildlife species (Jenkins and Busher 1979, Arner and DuBose 1982, Hill 1982, Arner and Hepp 1989, Medin and Clary 1990, Medin and Clary 1991, Edwards and Otis 1999). The wetland habitat that beaver ponds might create can be beneficial to some fish (primarily warm water species), reptiles, amphibians, waterfowl, shorebirds, and furbearers, such as muskrats, otter, and mink (Arner and DuBose 1982, Naiman et al. 1986, Miller and Yarrow 1994, Metts et al. 2001, Cunningham et al. 2007). For example, in Mississippi, beaver ponds over three years in age were found to have developed plant communities valuable as nesting and brood rearing habitat for wood ducks (Arner and DuBose 1982). Reese and Hair (1976) found that beaver pond habitats were highly attractive to a large number of birds throughout the year and that the value of beaver pond habitat to waterfowl was minor when compared to other species of birds (Novak 1987). During the winter, Lochmiller (1979) found that woodpeckers spent more time at beaver ponds than areas upstream of beaver ponds. In the Piedmont region of South Carolina, Edwards and Otis (1999) found that six established beaver ponds (10 to 35 years old) were attractive to several bird species seasonally, with the average species richness during all seasons ranging from 23.3 to 30.3 bird species. Metts et al. (2001) found that the abundance, species richness, and species diversity of reptiles was higher at beaver impoundments when compared to unimpounded streams in the Upper Piedmont region of South Carolina. However, the species richness, species diversity, and evenness of amphibians were higher at unimpounded streams compared to beaver impoundments (Metts et al. 2001). Beaver ponds could be beneficial to some T&E species. The USFWS estimates that up to 43% of T&E species rely directly or indirectly on wetlands for their survival (EPA 1995).

Under Alternative 1, WS could recommend and/or implement methods to manipulate water levels associated with water impounded by beaver dams to alleviate flooding damage. If Alternative 2 (technical assistance alternative) was selected, WS could recommend methods to people requesting assistance that could result in the manipulation of water levels associated with water impounded by beaver dams. WS would not be involved with any aspect of activities associated with beaver dams under Alternative 3. Methods that would generally be available under all the alternatives would include explosives, high-pressure water pumps, exclusion devices, and water flow devices (see Appendix B for additional information). However, the availability to breach or remove beaver dams using explosives would be limited under Alternative 2 and Alternative 3, since the property owner or manager seeking to remove or breach a dam would be required to locate a person certified to use explosives to conduct the work. In addition, the property owner or manager could use backhoes or other mechanical methods to remove or breach beaver dams under any of the alternatives; however, WS would not operationally employ backhoes or other large machinery to remove or breach dams.

Exclusion devices and water control systems have been used for many years to manipulate the level of water impounded by beaver dams with varying degrees of success (United States General Accounting Office 2001, Taylor and Singleton 2014). Taylor and Singleton (2014) provide a comprehensive summary of the evolution of flow devices to reduce flooding by beaver. Landowner management objectives play a role in how the efficacy of a level system is perceived (Nolte et al. 2001). Nolte et al. (2001) found that survey respondents classified pond levelers installed to manage wetlands for waterfowl habitat more successful than levelers installed to provide relief from flooding. Langlois and Decker (2004) reported that "*...very few beaver problems...can actually be solved with a water level control device*" with a 4.5% success rate in Massachusetts and a 3% success rate in New York. Nolte et al. (2001) reported only 50% of installed pond levelers in Mississippi met landowner objectives and found that pond levelers placed in sites with high beaver activity more frequently failed if installed without implementing population control measures. Taylor and Singleton (2014) recommended, "*…that natural resource managers avoid using fence systems or pipe systems alone, unless they can be used in areas where maintenance requirements and expected damage are extremely low. Flow devices are not intended to replace lethal control.*" Taylor and Singleton (2014) also recommended that flow devices be used "*…as part of integrated management plans where beaver flooding conflicts are expected and where local conditions allow flow-device installation and maintenance*".

Higher success rates have been reported for newer exclusion and water control systems ranging from 87% to 93% (Callahan 2005, Boyles 2006, Simon 2006, Boyles and Owens 2007). Lisle (2003) reported the use of water control devices or a combination of a Beaver Deceiver™ and flow management device virtually eliminated the need for maintenance and beaver removal at 20 sites where clogged culverts and flooded roads had previously been a routine issue.

When using exclusion and water control systems, those methods must be specifically designed to meet the needs of each site (Langlois and Decker 2004). Consequently, devices installed by inexperienced individuals may have a higher failure rate than those installed by a professional (Lisle 1996, Callahan 2003, Boyles 2006, Simon 2006, Spock 2006). Higher success rates reported for newer exclusion and water control devices may be indicative of increased understanding of the kinds of situations where those devices work best. For example, Callahan (2005) noted that exclusion and water control systems installed at culvert sites were more successful than similar systems installed at freestanding dams. Callahan (2003) and Callahan (2005) also provided a list of sites that were not well suited to the use of exclusion or water control devices. Boyles (2006) and Boyles and Owens (2007) reported some of the highest success rates for newer exclusion and water control systems; however, those devices were only tested at culvert sites.

Beaver build dams to raise water levels to meet their needs for security and access to forage. While pond levelers allow for the retention of some water, if the water level does not meet the needs of the beaver, they may move a short distance upstream or downstream and build a new dam, or abandon the area (Callahan 2003, Langlois and Decker 2004). This may merely result in moving the problem to a new landowner or, depending upon site characteristics, the resulting pond may result in new or increased damage problems for the original landowner. McNeely (1995) reported the most common reasons cited for lack of success of water flow devices were clogging caused by debris or silt and beaver construction of additional dams upstream or downstream of the management device. In a study by Callahan (2005), construction of a new dam upstream or downstream of a pond leveler device was the most common cause of failure for free-standing dams (*e.g.*, dams not associated with a culvert or other similar constriction in water flow, 11 of 156 sites). Callahan (2005) also found that insufficient pipe capacity (6 sites), dammed fencing (2 sites), and lack of maintenance (2 sites) were causes for pond leveler failures. Nolte et al. (2001) also reported the need to address problems with dams upstream or downstream of a device. At culvert sites, Callahan (2005) found a lack of maintenance was the primary cause of failure with culvert exclusion devices (4 of 227 sites). Callahan (2005) also found vandalism resulted in the failure of a culvert device at one of the sites. At two culvert sites, Callahan (2005) found dammed fencing reduced or completely impeded the operation of exclusion devices.

Most pond levelers and exclusion devices require maintenance. The amount of maintenance required can vary considerably among sites, depending on site conditions and the type of device (Nolte et al. 2001, Callahan 2005, Boyles 2006, Spock 2006). Stream flow, leaf fall, floods, and beaver activity can continuously bring debris to the intake of a water control device. Ice damage and damage from debris washed downstream during high water events may also trigger the need for maintenance (*e.g*., cleaning out the intake pipe). Although most exclusion and water control devices generally require some level of maintenance, there are reports of devices that have remained effective for a period of years with no maintenance (Nolte et al. 2001). Nolte et al. (2001) reported that post-installation maintenance had been performed by property owners or managers on 70% of the 20 successfully operating Clemson pond levels installed by WS in Mississippi. The most common action was to adjust the riser on the pipe to manipulate water levels. Other maintenance included removal of vegetation and secondary dams built after the installation of the devices. In a survey of individuals who had received assistance with exclusion and water control devices, Simon (2006) found 18 of 36 survey respondents reported maintaining their devices, while installation program staff monitored an additional 10 devices. Of those survey respondents, Simon (2006) found that 61% reported that routine maintenance took 15 minutes or less while 93% reported that maintenance took a half hour or less. Boyles (2006) reported that time spent on device maintenance ranged from one to 4.75 hours per year.

Installation and upkeep of water control devices vary from site to site. For example, transporting materials over long distances in difficult terrain to install devices in remote locations where road access is not available could increase costs compared to the ability to transport materials for installation at a culvert site along a roadway. Callahan (2005) reported that the average cost for an exclusion fence at a culvert was $750 with an average annual maintenance cost of approximately $200. Flexible leveler pipe systems cost an average of $1,000 to install and $100 per year in maintenance, while the average cost to install a combination fence and leveler was $1,400 with approximately $150 per year in maintenance (Callahan 2005). Over a ten-year period, Callahan (2005) estimated the cost of installation and annual maintenance would range from $200 to $290 per year depending on the device installed. Spock (2006) reported that exclusion and/or water control device installation cost ranged from < $600 to over $3,000 dollars, with slightly more than half the systems (58.2%) ranging between $600 and $1,000 to install. In many cases, Spock (2006) found the cost included the first year of maintenance. The more expensive installations tended to be extensive fence and leveler systems or systems with numerous leveler pipes (Spock 2006). Boyles (2006) reported that device installation cost an average of $1,349 per device and $3,180 per site with subsequent annual maintenance cost averaging $19.75 per site per year (Boyles 2006). However, unlike the study by Callahan (2005) the devices evaluated by Boyles (2006) had only been in place for a relatively short time (average time in place 15 months, range 6 to 22 months versus average time in place 36.6 months, range 3 to 75 months). The cost of maintenance may vary over time as site conditions change.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

Under this alternative, WS could manipulate water levels associated with water impoundments caused by beaver dams using either dam breaching, dam removal, or the installation of water flow devices, including exclusion devices. Breaching or removing beaver dams would maintain the normal flow of water. WS' personnel would not use heavy equipment, such as backhoes or bulldozers, to breach, remove, or install water flow devices. However, cooperators or their agents could utilize heavy machinery to breach a dam, remove a dam, or to install water flow devices in a dam. WS may utilize small all-terrain or amphibious vehicles and/or watercraft for transporting personnel, equipment, and supplies to worksites. WS would only remove or breach that portion of the beaver dam blocking the stream or ditch channel.

The breaching or removal of dams could occur by hand. Breaching would normally occur through incremental stages of debris removal from the dam, which would allow water levels to lower gradually. Breaching of dams would normally occur to limit the potential for flooding downstream by gradually allowing water levels to lower as WS' personnel breached more of the dam over time. Breaching also minimizes the release of debris and sediment downstream by allowing water to move slowly over or through the dam. Depending on the size of the impoundment, WS' personnel could lower water levels slowly over several hours or days when breaching dams. When breaching dams, WS' personnel would only alter or breach that portion of the dam blocking the stream or ditch channel, with the intent of returning water levels and flow rates to historical levels or to a level that eliminates damage threats that would be acceptable to the property owner or resource manager. Similar to breaching dams, the removal of the dam removes the debris impounding water and restores the normal flow of water.

WS' personnel would generally breach or remove beaver dams by hand with a rake or the use of power tools (*e.g.*, a winch). However, explosives would also be available to remove beaver dams. WS' personnel specially trained and certified to conduct such activities could potentially utilize explosives. Explosives are defined as any chemical mixture or device that serves as a blasting agent or detonator. Explosives would generally be used to remove beaver dams that were too large to remove by hand. After a blast, the majority of materials are lifted up and out of the drainage area, away from the water flow. Any remaining fill material still obstructing the channel would normally be washed downstream by water current. The only noticeable side effects from this activity are diluted mud, water, and small amounts of debris from the dam scattered around the blasting site. Considerably less than 10 cubic yards of material would be moved in each of those project activities. Explosives would only be used after beaver were removed from the site.

WS' personnel would only utilize binary explosives (*i.e.*, explosives comprised of two parts that must be mixed at the site before they can be detonated as an explosive material) for beaver dam removal, when requested. Binary explosives consist of either ammonium nitrate and nitro-methane or nitro-methane and aluminum powder; however, the two components separated are not classified as explosives until mixed. Therefore, binary explosives would be subject to fewer regulations and controls. However, once mixed, binary explosives would be considered high explosives and subject to all applicable federal and state regulations. Detonating cord and detonators would also be considered explosives and WS would adhere to all applicable state and federal regulations for storage, transportation, and handling. WS' use of explosives and safety procedures would occur in accordance with WS Directive 2.435.

In addition to dam breaching and removal, water flow devices and exclusion methods would also be available for WS to employ during direct operational assistance or to recommend during technical assistance. Several different designs of water flow devices and exclusion methods would be available; however, the intent of all those methods would be to lower water levels by allowing water to flow through the beaver dam using pipes and wire mesh. After installation, beaver dams would be left intact with water levels maintained at desired levels by adjusting the water flow device. Water flow devices and exclusion methods allow beaver to remain at the site and maintain the beaver dam.

Although dams could be breached/removed manually or with binary explosives, those methods can be ineffective because beaver can quickly repair or replace the dam if the beaver were not removed prior to breaching or removing the dam (McNeely 1995). Damage may be effectively reduced in some situations by installing exclusion and water control devices. Exclusion and water control devices can be designed so that the level of the beaver-created water impoundment can be managed to eliminate or minimize damage from flooding while retaining the ecological and recreational benefits derived from beaver impounding water over time. For example, WS may recommend modifications to site and culvert design (Jensen et al. 1999) as a non-lethal way of reducing problems with beaver dams at culverts.

Manipulating water levels impounded by beaver dams under this alternative would generally be conducted to maintain existing stream channels and drainage patterns, and to reduce water levels to alleviate flooding. WS could be requested to assist with manipulation of a beaver dam to alleviate flooding to agricultural crops, timber resources, public property, such as roads and bridges, private property, areas flooded because of beaver dams constructed on adjacent TVA property, and water management structures, such as culverts. The intent of breaching or removing beaver dams would not be to drain established wetlands. With few exceptions, requests for assistance received by WS from public and private entities would involve breaching or removing dams to return an area to the condition that existed before the dam had been built, or before the impounded water had been affecting the area long enough for wetland characteristics to become established.

Most activities conducted by WS in Georgia do not have the potential to affect wetlands, since those activities would not be conducted near or in wetlands. Under this alternative, water levels would be manipulated to return streams, channels, dikes, culverts, and canals to their original function. Most requests to alleviate flooding from impounded water would be associated roads, crops, merchantable timber, pastures, and other types of property or resources that were not previously flooded. Most dams removed would have been created because of recent beaver activity. WS' personnel receive most requests for assistance associated with beaver dams soon after affected resource owners discover damage.

As stated previously, WS could install water control devices, breach, or remove up to 500 beaver dams annually under this alternative. Upon receiving a request to manipulate the water levels in impoundments caused by beaver dams, WS would visually inspect the dam and the associated water impoundment to determine if characteristics exist at the site that would meet the definition of a wetland under section 404 of the CWA (see 40 CFR 232.2). If wetland conditions were present at the site, the entities requesting assistance from WS would be notified that a permit might be required to manipulate the water levels impounded by the dam and to seek guidance from the Environmental Protection Department with the GDNR, the EPA, and/or the United States Army Corps of Engineers pursuant to State laws and the CWA. If the area does not already have hydric soils, it usually takes several years for them to develop and a wetland to become established. This process often takes more than 5 years as indicated by the Swampbuster provision of the Food Security Act. Most beaver dam removal by WS would occur under exemptions stated in 33 CFR parts 323 and 330 of Section 404 of the CWA or parts 3821 and 3822 of the Food Security Act. However, manipulating water levels associated with some beaver dams could trigger certain portions of Section 404 that require landowners to obtain permits from the United States Army Corps of Engineers prior to removing a blockage. WS' personnel would determine the proper course of action upon inspecting a beaver dam impoundment. Appendix E describes the procedures used by WS to assure compliance with the pertinent laws and regulations.

The manipulation of water impoundment levels by WS through dam breaching, dam removal, or installation of water flow devices would typically be associated with dams constructed from recent beaver activity and would not have occurred long enough to take on the qualities of a true wetland (*i.e.* hydric soils, hydrophytic vegetation, and hydrological function). WS' activities associated with beaver dam breaching, beaver dam removal, or the installation of flow control device would only be conducted to restore the normal flow of water through drainages, streams, creeks, canals, and other watercourses where flooding damage was occurring or would occur. Activities most often take place on small watershed streams, tributary drainages, and ditches and those activities can best be described as small, one-time projects conducted to restore water flow through previously existing channels. Beaver dam breaching or removal would not affect substrate or the natural course of streams since only the dam would be breached or removed.

In the majority of instances, beaver dam removal would be accomplished by manual methods (*i.e*., hand tools). WS' personnel would not utilize heavy equipment, such as trackhoes or backhoes, for beaver dam removal. In some cases, small explosive charges may be used by certified, trained personnel. These explosives would be placed in a manner to remove only that portion of the dam necessary to alleviate flooding. In addition, explosives are placed to lift and remove debris out from the drainage, stream, or creek flow to prevent unnecessary sediment or debris downstream. In all cases, only the portion of the dam blocking the stream or ditch channel would be breached or removed. In some instances, WS would install water flow devices to manage water levels at the site of a breached beaver dam. From FY 2010 through FY 2015, WS breached or removed 924 dams (902 by hand and 22 by using explosives) during damage management activities associated with beaver. WS would use hand tools to breach or remove dams. Dams could be breached or removed in accordance with exemptions from Section 404 permit requirements established by regulation or as allowed under nationwide permits (NWPs) granted under Section 404 of the CWA (see Appendix E). The majority of impoundments that WS would remove would only be in existence for a few months. Therefore, those impoundments would generally not be considered wetlands as defined by 40 CFR 232.2 and those impoundments would not possess the same wildlife habitat values as established wetlands.

In those situations where a non-federal cooperator had already made the decision to breach or remove a beaver dam to manipulate water levels with or without WS' assistance, WS' participation in carrying out the action would not affect the environmental status quo.

Additional concern has been raised relating to the lethal removal of beaver by WS or the recommendation of lethal methods to alleviate damage or threats of damage under this alternative. Beaver lethally removed could be replaced by other beaver requiring additional assistance later. Houston et al. (1995) indicated that beaver tend to reoccupy vacant habitats. The likelihood that a site would be recolonized by beaver varies depending on many factors. For example, removal of beaver and a beaver dam from a relatively uniform section of irrigation canal may resolve the problem for an extended period because the relatively uniform nature of the canal does not predispose a site to repeat problems. Recolonization would also depend on the proximity and density of the beaver population in the surrounding area. Isolated areas or areas with a lower density of beaver would normally take longer for beaver to recolonize than areas with higher beaver densities. Activities conducted under Alternative 1 would be directed at specific beaver and/or beaver colonies and would not be conducted to suppress the overall beaver population in the State.

In accordance with WS Directive 2.101, preference would be given to non-lethal methods where practical and effective. Although use of exclusion and water control devices could greatly reduce the need for lethal beaver removal, beaver removal may still be needed in some situations even though a flow device or water control system had been installed (Wood et al. 1994, Nolte et al. 2001, Simon 2006, Spock 2006). Callahan (2005) states the trapping of beaver to alleviate damage should occur "...*where a flow device is either not feasible or fails, the water level needs to be drastically lowered, or the landowner wants no beavers or ponds on their property*". Spock (2006) reported that beaver had to be trapped out of one site when an exclusion system was augmented by the installation of a water control device. Lisle (1996) noted that it might be necessary to remove beaver that have learned to dam around exclusion and water control devices. In some instances, trapping during the annual trapping season for beaver continued to occur at or near the area where water control devices were installed but was not prompted by the failure of the devices (Lisle 1996, Simon 2006, Spock 2006).

Exclusion and water control devices may not be the most effective method in specific types of terrain and are not suitable for every site (Wood et al. 1994, Nolte et al. 2001, Langlois and Decker 2004, Callahan 2005). Exclusion devices and water control devices may not be suitable for man-made, uniform channels, such as agricultural drainage ditches and irrigation canals. In addition, exclusion devices and water control devices may not be suitable for reservoirs, areas where human health, property or safety would be threatened with even minor elevation in water level, and areas where the landowner has expressed zero tolerance for beaver activity on their property (Callahan 2003, Callahan 2005, Simon 2006). Water control devices may be ineffective in beaver ponds in broad, low-lying areas because even a slight increase in water depth can result in a substantial increase in the area flooded (Organ et al. 1996). Exclusion and water control systems would not resolve problems related to beaver construction of bank dens. Depending upon site characteristics, beaver may build bank dens instead of lodges by burrowing into banks, levees, and other earthen impoundments. When bank dens are built in earthen levees or in banks supporting roadways or railroad tracks, they can greatly weaken the earthen structure. Burrowing into embankments can weaken the integrity of impoundments. Burrows allow water to infiltrate embankments, which can allow water to seep through the embankments causing erosion and weakening water impoundments. In those situations, removal of the beaver (either by translocation or by lethal methods) could be the only practical solution to resolve the potential for damage.

Water control devices may also be inappropriate in areas that are managed for aquatic species that need free-flowing water conditions and gravel substrate to survive. The still water and silt that accumulates behind beaver dams can be detrimental to some species. In addition, beaver dams could impede the movement of fish upstream. Avery (2004) found the removal of beaver dams resulted in substantial increases in the stream area where trout could be found. For example, a 9.8-mile treatment zone on the North Branch of the Pemebonwon River in Wisconsin and an additional 17.9 miles of seven tributaries to the treatment section of the river were maintained free of beaver dams since 1986. In 1982, prior to dam removal, wild brook trout were found in only four of the seven tributaries within the treatment zone and at only four of the 12 survey stations. In the spring of 2000, wild brook trout were present in all seven tributaries and at all 12 survey stations (Avery 2004). In some cases, water control devices could be modified to improve fish passage (Close 2003). Although the presence of beaver dams could be detrimental to some species of fish, some fish species may benefit from the presence of a beaver dam (Rosell et al. 2005, Pollock et al. 2007, Taylor et al. 2009, Pollock et al. 2012, Pollock et al. 2014).

Although beaver can serve a valuable role in wetland ecology, the presence of beaver dams in existing wetlands that property owners or managers manage intensively could be a concern to those entities. In those wetlands, property owners or managers often use man-made water control structures to manage the water level in the wetland area in order to maximize habitat value for waterfowl and specific types of wetland-dependent wildlife. Therefore, the presence of beaver dams can impede the use of those structures or cause elevated water levels that are contrary to the objectives of the wetland. While general elevations or reductions in water levels might conceivably be achieved by installing pipe systems through beaver dams in managed wetlands, the devices tend to be more difficult to adjust than man-made water control structures. More importantly, the primary difficulty associated with pipe systems in those situations comes when property owners or managers use drawdowns to achieve wetland management objectives. Drawdowns generally involve reducing the water level until large sections of mudflat are exposed. Many plant species valuable to waterfowl and other wetland bird species need exposed mudflats to sprout. Shorebirds can also use the mudflats to forage for invertebrates. The extent of the water level reduction conflicts with the beaver's desire for water deep enough to provide protection, and water area of sufficient extent to provide relatively easy access to foraging sites. The extent of the water level reduction during a drawdown would likely increase the risk of new dam creation in other locations that may cause new problems (Callahan 2003).

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

The issues regarding the effects on wetlands under this alternative would likely be similar to those issues discussed under Alternative 1. This similarity would be based on WS' recommendation of methods to manage damage caused by beaver and the recommendation of methods to manage the water impounded by beaver dams. Based on information provided by the person requesting assistance or based on site visits, WS could recommend that a landowner or manager manipulate beaver dams to reduce flooding damage or threats of damage. WS would not be directly involved with conducting activities associated with the manipulation of beaver dams under this alternative. However, the recommendation of the use of methods would likely result in the requester employing those methods or employing an agent to employ them. Therefore, by recommending methods and thus a requester employing those methods, the potential for those methods to reduce the presence of impounded water would be similar to Alternative 1.

WS could instruct and demonstrate the proper use and placement of flow control and exclusionary devices, as well as recommend the breaching or removal of beaver dams, when appropriate. WS would also assist requesters by providing information on permit requirements and which state and/or federal agencies need to be contacted by the requester to obtain appropriate permits to manipulate the levels of water impounded by beaver dams.

The efficacy of methods employed by a cooperator would be based on the skill and knowledge of the requester or their agent despite WS' recommendations or demonstration. Therefore, a lack of understanding of the behavior of beaver along with inadequate knowledge and skill in using methodologies to resolve flooding could lead to incidents with a greater probability of unforeseen impacts to wetlands. In those situations, the potential for dam manipulation to affect the status of wetlands adversely would likely be regarded as greater than those affects discussed under Alternative 1.

WS would recommend the landowner or manager seek and obtain the proper permits to manipulate water levels impounded by beaver dams under this alternative; however, WS would not be responsible for ensuring that appropriate permits were obtained, proper methods were implemented for manipulating water levels, or for reviewing sites for the presence of T&E species. Those responsibilities would be incurred by the property owner/manager and/or their designated agent who may or may not properly follow WS' recommendations.

Alternative 3 – No Mammal Damage Management Conducted by WS

Under this alternative, WS would not be involved with any aspect of managing water levels associated with beaver dam impoundments. Under this alternative, WS would not be involved with any aspect of managing damage associated with beaver in the State, including technical assistance. Due to the lack of involvement in managing damage caused by beaver, no impacts to wetlands would occur directly from WS. This alternative would not prevent those entities experiencing threats or damage due to flooding from manipulating water levels associated with beaver dams in the absence of WS' assistance. Those methods described previously would be available to other entities to breach or remove dams, including explosives and water flow devices. However, the use of explosives to remove dams under this alternative would be limited to those persons trained and licensed to use explosives. A property owner or manager could seek the services of an entity trained and licensed to use explosives to remove beaver dams under this alternative. The direct burden of implementing permitted methods would be placed on those persons experiencing damage.

Since the same methods would be available to resolve or prevent beaver damage or threats related to beaver dams, effects on the status of wetlands in the State from the use of those methods would be similar between the alternatives. However, manipulating water levels by those persons not experienced in identifying wetland characteristics or unaware of the requirement to seek appropriate permits to alter areas considered as a wetland, could increase threats to wetlands and the associated flora and fauna.

4.2 CUMULATIVE IMPACTS OF ALTERNATIVE 1 BY ISSUE

Cumulative impacts, as defined by the 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 mammals either by providing technical assistance only (Alternative 2) or by providing technical assistance and direct operational assistance (Alternative 1) in the State. WS would be the primary federal agency conducting direct operational assistance in the State under Alternative 1. However, other federal, state, and private entities could also be conducting mammal damage management in the State.

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 companies may conduct damage management activities in the same area. The potential cumulative impacts could occur from either WS' damage management program activities over time or from the aggregate effects of those activities combined with the activities of other agencies and private entities. Through ongoing coordination and collaboration between WS, the TVA, and the GDNR, activities of each agency and the removal of mammals would be available. Damage management activities in the State would be monitored to evaluate and analyze activities to ensure they were within the scope of analysis of this EA.

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 proposed alternatives. Those alternatives would meet the requirements of applicable laws, regulations, and Executive Orders, including the Clean Air Act and Executive Order 13514.

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

The issue of the effects on target mammal species arises from the use of non-lethal and lethal methods to address the need for reducing damage and threats. As part of an integrated methods approach to managing damage and threats, WS could apply both lethal and non-lethal methods when requested by those persons experiencing damage.

Non-lethal methods could exclude, disperse, or otherwise make an area unattractive to mammals causing damage; thereby, reducing the presence of mammals at the site and potentially the immediate area around the site where non-lethal methods were employed. WS' employees would give non-lethal methods priority when addressing requests for assistance (see WS Directive 2.101). However, WS would not necessarily employ non-lethal methods to resolve every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model. For example, if a cooperator requesting assistance, had already attempted to disperse mammals using non-lethal harassment methods, WS would not necessarily employ those methods again during direct operational assistance since those methods had already been proven to be ineffective in that particular situation. WS and other entities could use non-lethal methods to exclude, harass, and disperse target animals from areas where damage or threats were occurring. When effective, non-lethal methods would disperse mammals from an area resulting in a reduction in the presence of those mammals at the site where WS or another entity employed those methods. However, mammals responsible for causing damage or threats would likely disperse to other areas with minimal impacts occurring to those species' populations. WS would not employ non-lethal methods over large geographical areas or apply those methods 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. WS and most people generally regard non-lethal methods as having minimal impacts on overall populations of animals since individuals of those species would be unharmed. Therefore, the use of non-lethal methods would not have cumulative effects on mammal populations in the State.

WS' employees could employ lethal methods to resolve damage associated with those target mammal species identified by WS as responsible for causing damage or threats to human safety. However, lethal removal by WS would only occur after receiving a request for such assistance and only after the GDNR authorized WS to remove the target species, when required. Therefore, the use of lethal methods could result in local reductions in the number of target animals in the area where damage or threats were occurring since WS would remove those target individuals from the population. WS would often employ lethal methods to reinforce non-lethal methods and to remove mammals that have been identified as causing damage or posing a threat to human safety. The use of lethal methods could therefore result in local reductions of mammals in the area where damage or threats were occurring. The number of mammals removed from a species' population using lethal methods under Alternative 1 would be dependent on the number of requests for assistance received, the number of mammals involved with the associated damage or threat, and the efficacy of methods employed.

WS would maintain ongoing contact with the GDNR to ensure activities were within management objectives for those species. WS would submit annual activity reports to the GDNR. The GDNR would have the opportunity to monitor the total removal of mammals from all sources and could factor in survival rates from predation, disease, and other mortality data.

WS would monitor removal by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of removal was below the level that would cause undesired adverse effects to the viability of native species populations. This EA analyzed the potential cumulative impacts on the populations of target mammal species from the implementation of Alternative 1 in Section 4.1.

Evaluation of activities relative to target species indicated that program activities would likely have no cumulative adverse effects on mammal populations when targeting those species responsible for damage at the levels addressed in this EA. 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 would not be limited to

- Natural mortality of mammals
- Mortality through vehicle strikes, aircraft strikes, and illegal harvest
- Human induced mortality of mammals through private damage management activities
- Human induced mortality through regulated harvest
- Human and naturally induced alterations of wildlife habitat
- Annual and perennial cycles in animal population densities

All those factors play a role in the dynamics of mammal 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 would be constrained as to scope, duration, and intensity for the purpose of minimizing or avoiding impacts to the environment. WS would use the Decision Model to evaluate the damage occurring, including other affected elements and the dynamics of the damaging species, to determine appropriate strategies to minimize effects on environmental elements. The Model would allow

WS to implement damage management actions and to monitor those actions to adjust/cease damage management actions, which would allow WS to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative effects on target species (Slate et al. 1992).

With management authority over wildlife populations in the State, the GDNR could adjust removal levels, including the removal by WS, to ensure population objectives for mammals were achieved. Consultation and reporting of removal by WS would ensure the GDNR had the opportunity to consider any activities WS conducts.

The populations of several wildlife species are sufficient to allow for annual harvest seasons that typically occur during the fall and winter. The GDNR establishes hunting and trapping seasons in the State for wildlife. With oversight of activities to alleviate damage associated with wildlife, the GDNR maintains the ability to regulate removal by WS to meet management objectives for wildlife in the State. Therefore, the GDNR would have the opportunity to consider the cumulative removal of wildlife as part of their objectives for wildlife populations in the State. WS' removal of mammals in Georgia from FY 2010 through FY 2015 was of a low magnitude when compared to the total known removal of those species and the populations of those species. The anticipated annual removal of target animal species would also be of low magnitude when compared to estimated populations and the annual harvest of those species. Therefore, the proposed activities would not limit the ability of people to harvest target wildlife species in the State.

The GDNR could consider all known removal when determining population objectives for wildlife and could adjust the species and the number of individuals of a species that people can harvest during the regulated hunting/trapping season and the number of wildlife that people can remove for damage management purposes to achieve the population objectives. Any removal of regulated wildlife species by WS would occur at the discretion of the GDNR. Therefore, any wildlife population declines or increases would be the collective objective for those wildlife populations established by the GDNR through the regulation of lethal removal. The cumulative removal of individuals from a wildlife species annually or over time by WS would occur at the discretion of the GDNR as part of management objectives for wildlife in the State. WS does not expect cumulative adverse effects to occur to the populations of target and non-target animals from WS' damage management activities based on the following considerations:

Historical outcomes of WS' damage management activities on mammal populations

WS would conduct damage management activities associated with mammals 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 were identified and addressed. WS would work closely with resource agencies to ensure damage management activities would not adversely affect mammal populations and that WS' activities were considered as part of management goals established by those agencies. Historically, WS' activities to manage damage caused by mammals in Georgia have not reached a magnitude that would cause adverse effects to mammal populations in the State.

SOPs built into the WS program

SOPs are designed to reduce the potential negative effects of WS' actions on mammals, and have been tailored to respond to changes in animal populations that could result from unforeseen environmental changes. This would include those changes occurring from sources other than WS. Alteration of activities would be defined through SOPs, and implementation would be insured through monitoring, in accordance with the WS Decision Model (see WS Directive 2.201; Slate et al. 1992).

Issue 2 - Effects of Activities on the Populations of Non-target Animals, Including T&E Species

Potential effects on non-target species from conducting mammal 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 mammals has the potential to exclude, disperse, or capture non-target animals. However, the effects of non-lethal methods are often temporary and often do not involve the removal (killing) of non-target animal species. When using exclusion devices and/or repellents, both target and non-target animals can be prevented from accessing the resource being damaged. Since exclusion and repellents do not involve lethal removal, cumulative impacts on non-target species from the use of exclusionary methods or repellents would not occur but would likely disperse those individuals to other areas. Exclusionary methods and repellents can require constant maintenance to ensure effectiveness. Therefore, the use of exclusionary devices and repellents would be somewhat limited to small, high-value areas and not used to the extent that non-target animals would be excluded from large areas that would cumulatively impact populations from the inability to access a resource, such as potential food sources, denning, or fawning sites. The use of visual and auditory harassment and dispersion methods would generally be temporary with non-target species returning after the cessation of those activities. Dispersal and harassment do not involve the removal (killing) of non-target species and similar to exclusionary methods would not be used to the extent or at a constant level that would prevent non-target animals 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 animals through the removal (killing) or capture of non-target species. Capture methods used are often methods that would be set to confine or restrain target animals after being triggered by a target individual. Capture methods would be employed in such a manner as to minimize the threat to non-target species by placement in those areas frequently used by target animals, using baits or lures that are as species specific as possible, and modification of individual methods to exclude non-target animals from capture. Most methods described in Appendix B are methods that would be employed to confine or restrain animals that would be subsequently euthanized using humane methods. With all live-capture devices, non-target animals captured could be released on site if determined to be able to survive following release. SOPs are intended to ensure removal of non-target animals was minimal during the use of methods to capture target animals.

The use of firearms and euthanasia methods would essentially be selective for target species since identification of an individual would be made prior to the application of the method. Euthanasia methods would be applied through direct application to target animals. Therefore, the use of those methods would not affect non-target species.

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. Chemical methods available for use under the proposed action would include repellents, reproductive inhibitors, rodenticides, fumigants, immobilizing drugs, and euthanasia chemicals, which are described in Appendix B. Except for repellents that would be applied directly to the affected resource and reproductive inhibitors that would be applied directly to target animals, those chemical methods available for use would be employed using baits that were highly attractive to target species, used in known burrow/den sites, and/or used in areas where exposure to non-target animals would be minimal. The use of those methods often requires an acclimation period and monitoring of potential bait sites for non-target activity. All chemicals would be used according to product labels, which would ensure that proper use would minimize non-target threats. WS' adherence to Directives and SOPs governing the use of chemicals would also ensure non-target hazards would be minimal.

Repellents may be used or recommended by the WS program in Georgia to manage mammal damage. The active ingredients in numerous commercial repellents are capsaicin, pepper oil, and carnivore urine. Characteristics of these chemicals and potential use patterns indicate that no cumulative impacts related to environmental fate would be expected from their use in WS' programs in Georgia when used according to label requirements.

When using rodenticides, as required by WS' SOPs and applicable pesticide labels, 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-target animals were observed feeding on the pre-bait, the areas would be abandoned and no baiting would occur at those locations. Once sites were baited, sites would be monitored to further observe for non-target feeding activity. If non-target animals were observed feeding on bait, those sites would be abandoned. WS would retrieve all dead target species to the extent possible following treatment to minimize any secondary hazards associated with or perceived to be associated with scavengers feeding on target species carcasses. When using rodenticides, appropriate bait stations would be utilized and inspected as required by the applicable label.

The amount of chemicals used or stored by WS would be minimal to ensure human safety. All label requirements of repellents and toxicants would be followed to minimize non-target hazards. Based on this information, WS' use of chemical methods, as part of the proposed action, would not have cumulative impacts on non-target animals.

The methods described in Appendix B have a high level of selectivity and could be employed using SOPs to ensure minimal impacts to non-target species. Those species lethally removed as unintentional non-target animals were included in analysis as target species in this EA. The cumulative removal of those species, including target and non-target removal were evaluated in Chapter 4 of this EA. The unintentional removal of animals would likely be limited and would not reach a magnitude where adverse effects would occur.

Based on the methods available to resolve mammal damage and/or threats, WS does not anticipate the number of non-target animals lethally removed to reach a magnitude where declines in those species' populations would occur. Therefore, removal under Alternative 1 of non-target animals would not cumulatively affect non-target species. WS' has reviewed the T&E species listed by the GDNR, the USFWS, and the National Marine Fisheries Service, and has determined that damage management activities proposed by WS would not likely adversely affect T&E species. Cumulative impacts would be minimal on non-target animals from any of the alternatives discussed.

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

Non-chemical methods described in Appendix B would be used within a limited period, would not be residual, and do not possess properties capable of inducing cumulative effects on human health and safety. Non-chemical methods would be used after careful consideration of the safety of those persons employing methods and to the public. When possible, capture methods would be employed where human activity was minimal to ensure the safety of the public. 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 remove animals. Firearms used to alleviate or prevent damage, though hazards do exist, would be 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 to the public. Based on the use patterns of non-chemical methods, those methods would not cumulatively affect human safety.

Repellents to disperse mammals from areas of application would be available. Repellents must be registered with the EPA according to the FIFRA and registered with the GDA. 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 applicator. When repellents were applied according to label requirements, no effects to human safety would be expected. Similarly, fumigants and rodenticides must also be registered for use with the EPA and the GDA. Given the use patterns of repellents, rodenticides, and fumigants, no cumulative effects would occur to human safety.

When using explosives to remove beaver dams, WS would only use binary explosives (see Appendix B). WS' employees who conduct activities using binary explosives would receive training in accordance with WS Directive 2.435. WS personnel who use explosives undergo extensive training and are certified to safely use explosives. WS' employees must adhere to the safe storage, transportation and use policies and regulations of WS, the Bureau of Alcohol, Tobacco and Firearms, the Occupational Safety and Health Administration, and the Department of Transportation.

WS has received no reports or documented any effects to human safety from WS' mammal damage management activities conducted from FY 2010 through FY 2015. 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 mammal damage in the State.

Issue 4 - Effects of Mammal Damage Management Activities on the Aesthetic Value of Mammals

The activities of WS would result in the removal of mammals from those areas where damage or threats were occurring. Therefore, the aesthetic value of mammals 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 mammal densities, including the return of native species that may be suppressed or dispersed by non-native species.

Some people experience a decrease in aesthetic enjoyment of animals because they feel that overabundant species are objectionable and interfere with their enjoyment of animals in general. Continued increases in numbers of individuals or the continued presence of mammals may lead to further degradation of some people's enjoyment of any animals or the natural environment. The actions of WS could positively affect the aesthetic enjoyment of animals for those people that were being adversely affected by the target species identified in this EA.

Mammal population objectives would be established and enforced by the GDNR by regulating harvest during the statewide hunting and trapping seasons after consideration of other known mortality factors. Therefore, WS would have no direct impact on the status of mammal populations since removal by WS would occur at the discretion of the GDNR. Since those persons seeking assistance could remove mammals from areas where damage was occurring when authorized by the GDNR, WS' involvement would have no effect on the aesthetic value of mammals in the area where damage was occurring. When damage caused by mammals has occurred, any removal of mammals by the property or resource owner would likely occur whether WS was involved with taking the mammals or not.

In the wild, few animals in the United States have life spans approaching that of people. Mortality is high among animal populations and specific individuals among a species may experience death early in life.

Mortality in animal populations is a natural occurrence and people who form affectionate bonds with animals experience loss of those animals over time in most instances. A number of professionals in the field of psychology have studied human behavior in response to attachment to pet animals (Gerwolls and Labott 1994, Marks et al. 1994, Zasloff 1996, Archer 1999, Ross and Baron-Sorensen 1998, Meyers 2000). Similar observations were probably applicable to close bonds that could exist between people and wild animals. As observed by researchers in human behavior, normal human responses to loss of loved ones proceed through phases of shock or emotional numbness, sense of loss, grief, acceptance of the loss or what cannot be changed, healing, and acceptance and rebuilding which leads to resumption of normal lives (Lefrancois 1999). Those who lose companion animals, or animals for which they may have developed a bond and affection, are observed to proceed through the same phases as with the loss of human companions (Gerwolls and Labott 1994, Boyce 1998, Meyers 2000). However, they usually establish a bond with other individual animals after such losses. Although they may lose the sense of enjoyment and meaning from the association with those animals that die or are no longer accessible, they usually find a similar meaningfulness by establishing an association with new individual animals or through other relational activities (Weisman 1991). Through this process of coping with the loss and establishing new affectionate bonds, people may avoid compounding emotional effects resulting from such losses (Lefrancois 1999).

Some mammals with which people have established affectionate bonds may be removed from some project sites by WS. However, other individuals of the same species would likely continue to be present in the affected area and people would tend to establish new bonds with those remaining animals. In addition, human behavior processes usually result in individuals ultimately returning to normalcy after experiencing the loss of association with a wild animal that might be removed from a specific location. WS' activities would not be expected to have any cumulative effects on this element of the human environment.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

WS would continue to seek new methods and ways to improve current technology to improve the humaneness of methods used to manage damage caused by animals. 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.

WS' personnel would check all methods not requiring direct supervision during employment (*e.g.*, live traps) at least once every 24 hours or in accordance with Georgia laws and regulations. Checking methods frequently would ensure WS' personnel addressed any animals confined or restrained in a timely manner to minimize distress of the animal. Personnel would apply all euthanasia methods used for live-captured mammals according to WS' directives. Shooting would occur in some situations and personnel would receive training in the proper use of firearms to minimize pain and suffering of mammals removed by this method.

WS would employ methods as humanely as possible by applying SOPs to minimize pain and that allow animals 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 mammals in the State, the cumulative impacts on the issue of method humaneness would be minimal. All methods would be evaluated to ensure SOPs were adequate and that animals captured were addressed in a timely manner to minimize distress.

Issue 6 – Effects of Beaver Removal and Dam Manipulation on the Status of Wetlands in the State

Beaver build dams primarily in smaller riverine streams (intermittent and perennial brooks, streams, and small rivers) and in drainage areas with dams consisting of mud, sticks, and other vegetative materials. Their dams obstruct the normal flow of water and typically change the pre-existing hydrology from flowing or circulating waters to slower, deeper, more expansive waters that accumulate bottom sediment behind the dam. The depth of bottom sediment depends on the length of time an area is covered by water and the amount of suspended sediment in the water.

The pre-existing habitat and the altered habitat have different ecological values to the fish and wildlife native to an area. Some species would abound by the addition of a beaver dam, while others would diminish. For example, some fish species require fast moving waters over gravel or cobble beds, which beaver dams can eliminate, thus reducing the habitat's value for these species. In general, it has been found that wildlife habitat values decline around bottomland beaver impoundments because trees are killed from flooding and mast production declines. On the other hand, beaver dams can potentially be beneficial to some species of fish and wildlife such as river otter, Neotropical birds, and waterfowl. If a beaver dam is not breached and water is allowed to stand, hydric soils and hydrophytic vegetation may eventually form. This process can take anywhere from several months to years depending on pre-existing conditions. Hydric soils are those soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. In general, hydric soils form much easier where wetlands have preexisted. Hydrophytic vegetation includes those plants that grow in water or on a substrate that is at least periodically deficient in oxygen because of excessive water content. If these conditions are met, then a wetland has developed that would have different wildlife habitat values than an area that has been more recently impounded by beaver dam activity. For example, Russell et al. (1999) found that the species richness and the total abundance of reptiles were statistically higher at beaver ponds greater than 10 years old when compared to beaver ponds that were less than 5 years old.

The intent of most dam breaching is not to drain established wetlands. With few exceptions, requests from public and private individuals and entities that WS receives involve dam breaching to return an area back to its pre-existing condition within a few years after beaver create the dam. If the area does not have hydric soils, it usually takes many years for them to develop and a wetland to become established. This often takes greater than five years as recognized by the Swampbuster provisions. Most beaver dam removal by WS is either exempt from regulation under Section 404 of the CWA as stated in 33 CFR Part 323 or may be authorized under the United States Army Corps of Engineers Nationwide Permit System in 33 CFR Part 330.

However, the breaching of some beaver dams can trigger certain portions of Section 404 that require landowners to obtain permits from the United States Army Corps of Engineers. WS' personnel determine the proper course of action upon inspecting a beaver dam impoundment.

It should also be noted that beaver created wetlands are dynamic and do not remain in one state for indefinite periods. Large beaver ponds may eventually fill with sediment and create a beaver meadow. Beaver may be removed from an area due to natural predation or they may abandon an area due to lack of food. Once a dam is abandoned, it is subject to natural decay and damage due to weather. The dam would eventually fail and the wetland would return to a flowing stream or brook. WS' beaver management activities may accelerate or modify these natural processes by removing beaver and restoring or increasing water flow; however, they are generally processes that would occur naturally over time.

Muskrat management would usually be intended to maintain or protect existing wetlands by reducing threats to natural and man-made wetlands and associated floral, faunal and T&E communities. Wetlands are often created by natural or man-made dams, dikes, levees, and berms that contain standing water or control drainage, particularly after precipitation events that could result in flooding. Muskrat burrowing activity can degrade the integrity of these structures by allowing water infiltration or by causing erosion by feeding on vegetation intended to stabilize dirt structures. Muskrats are omnivores and feed on a variety of aquatic and terrestrial plants and aquatic animals. At high population densities, they may disrupt or damage natural wetland floral and faunal communities or they may feed on T&E species. WS activities would be intended to protect existing wetlands from damage caused by muskrats.

Therefore, the activities of WS to manage flooding damage by manipulating beaver dams would not be expected to have any cumulative adverse effects on wetlands in Georgia when conducted in accordance with the CWA and the Swampbuster provision of the Food Security Act.

CHAPTER 5: LIST OF PREPARERS, REVIEWERS, AND PERSONS CONSULTED

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APPENDIX A
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APPENDIX B

METHODS AVAILABLE FOR RESOLVING OR PREVENTING MAMMAL DAMAGE IN GEORGIA

The most effective approach to resolving animal 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 animals while minimizing harmful effects of damage reduction measures on people, other species, and the environment. An adaptive plan allows for the modification of strategies 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 animal 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 Georgia relative to the management or reduction of damage caused by mammals. Various federal, state, and local statutes and regulations would govern WS' use of methods, including WS' directives. WS would develop and recommend or implement strategies for each request for assistance. 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 Georgia. Many of the methods described would also be available to other entities in the absence of any involvement by WS. When WS receives a request for assistance, personnel consider the range of limitations as they apply the WS decision-making process described in Slate et al. (1992) and WS Directive 2.201 to determine what method(s) to use to resolve an animal damage problem.

Non-chemical Animal Damage Management Methods

Non-chemical methods consist primarily of tools or devices used to repel, exclude, capture, or kill a particular animal or local population of animals to alleviate damage and conflicts. Methods may be non-lethal (*e.g.*, fencing, frightening devices) or lethal (*e.g.*, firearms, body grip traps). WS and the entity requesting assistance would agree upon all methods or techniques applied by WS to resolve damage or threats to human safety by signing a work initiation document, MOU, or another comparable document prior to the implementation of those methods. Non-chemical methods that WS' personnel could use or recommend include:

Structural changes could be methods that WS' employees recommend when providing technical assistance. For example, Jensen et al. (2001) recommended that highway departments install over-sized culverts in areas where beaver may be present. Jensen et al. (2001) stated, "*Due to the effects of stream gradients, culverts should be oversized to at least 2.1 m^2 (inlet opening area) for a 0% gradient stream and at least 0.8 m^2 for streams with gradients up to 3% to reduce the probability of plugging to 50%*". In addition, Jensen et al. (2001) stated, "*These recommendations should be considered minimum sizes, because culverts should be enlarged to at least a size that maintains the natural stream width*." Structural changes would be methods the requester implements without any direct involvement by WS' personnel. Over the service life of a culvert, Jensen et al. (2001) speculated that installing oversized culverts by highway departments would be more cost-effective than trapping, debris removal, or other short-term options to manage damage to roads associated with beaver.

Exclusion pertains to preventing access to resources through fencing or other barriers. Fencing can sometimes prevent animals that cannot climb from entering areas of protected resources. Fencing of culverts, drainpipes, and other water control structures can sometimes prevent beaver from building dams that plug those devices. Fencing installed with an underground skirt can prevent access to areas for many mammal species that dig, including coyotes, fox, raccoons, feral cats, and striped skunks. Areas, such as airports, yards, gardens, or hay meadows, may be fenced. Using hardware cloth or other metal barriers can sometimes prevent girdling and gnawing of valuable trees and prevent the entry of mammals into buildings through existing holes or gaps. Construction of concrete spillways may reduce or prevent damage to dams by burrowing aquatic rodent species. Riprap used on dams and levees can sometimes deter woodchucks, beaver, muskrats, and other burrowing rodents. Exclusion and one-way devices such as netting or nylon window screening can exclude bats from a building or an enclosed structure (Greenhall and Frantz 1994). Electric fences may effectively reduce damage to various crops by several wildlife species (*e.g*., see Boggess 1994*b*, Craven and Hygnstrom 1994). In many cases, WS could recommend the use of exclusion but the implementation of specific methods would be the responsibility of the property owner or manager.

WS could recommend or implement beaver exclusion and the use of water control devices to alleviate flooding damage without removing beaver. Although beaver dams could be breached/removed manually or with binary explosives, those methods are usually ineffective because beaver quickly repair or replace the dam (McNeely 1995). In some situations, installing exclusion and water control devices can effectively reduce damage. WS could design exclusion and water control devices to maintain the beaver-created impoundment at a level that eliminates or minimizes damage while retaining the ecological and recreational benefits derived from beaver impoundments. WS could also recommend that modifications occur to culvert design (Jensen et al. 1999) as a non-lethal way of reducing problems with beaver dams at culverts.

Beaver exclusion generally involves the placement of fencing to prevent beaver from accessing water intake areas, such as culverts. WS' personnel could recommend or implement a variety of exclusion systems, including the Beaver Deceiver™, Beaver Bafflers™, and pre-dams (Lisle 1996, Brown and Brown 1999, Lisle 1999, Brown et al. 2001, Partington 2002, Lisle 2003). The Beaver Deceiver™ is a fencing system that people can install to prevent beaver blockage of culverts by minimizing environmental cues that stimulate beaver to construct dams, and by making culverts less attractive as dam construction sites (Lisle 1996, Lisle 1999, Lisle 2003). Blocking culverts by installing a fence on the upstream end of the culvert can sometimes deter beaver from building dams at the entrance to or inside the culvert. Installation of a fence increases the length of the area that must be dammed to impound water, and if beaver build along the fence, may increase the distance between the beaver and the source of the cues that stimulate damming behavior (*e.g*., water moving through culvert) (Lisle 1996, Lisle 1999, Lisle 2003, Callahan 2005). Beaver prefer to build dams perpendicular to water flow, so fences can be oriented at odd angles to water flow and can be set so that they do not block the stream channel. WS may also use fencing to cover the up and downstream ends of the culverts to prevent beaver from entering the deceiver from the downstream side of the culvert and to prevent any beaver that might make it past the outer fence from plugging the interior of the culvert. Efforts can also be made to reduce the sound of water flowing through the culvert by raising the water level on the down-stream side of the culvert with dam boards or beaver-made dams, by constructing flumes to replace waterfalls, or, in extreme cases, by resetting the culvert (Lisle 1996). Using Beaver Deceivers™ in combination with water control devices can ensure sufficient water flow through the culvert (see discussion on Beaver Deceivers™ below).

Attaching cylindrical exclusion devices, like Beaver Bafflers™, to culvert openings can reduce the likelihood that beaver plug a culvert by spreading the water intake over a larger area (Brown et al. 2001). While cylindrical exclusion devices can be effective in some situations (Partington 2002), in a study of beaver exclusion and water control devices, cylindrical shapes attached in-line with a culvert had a higher failure rate (40%) than trapezoidal shapes (*e.g.*, Beaver Deceivers™; 3% failure rate) and use of the cylindrical devices was discontinued in favor of trapezoidal fences (Callahan 2005).

Unlike Beaver Deceivers™ and cylindrical fences, pre-dam fences (*e.g.*, deep-water fences, diversion dams) (Brown and Brown 1999) can be designed with the specific intention that the beaver build the dam along the fence. Pre-dam fences can be short semicircular or circular fences built in an arc around a water inlet. The fence serves as a dam construction platform that allows beaver to build a dam at the site but prevents beaver from plugging the water intake. If the size of the upstream impoundment created from the impounded water were not a concern, no further modifications of the pre-dam would be needed. However, in most cases, pre-dams would be used in combination with water control devices to manage the size of the upstream pond to alleviate flooding concerns.

Fence mesh size can be selected to minimize risks to beaver and non-target species. Brown et al. (2001) noted that beaver occasionally became stuck in 6-inch mesh and that the risk of beaver entrapment was lower with 5-inch mesh. Lisle (1999) noted that the size of the mesh on the fence of the Beaver Deceivers™ (6-inch mesh) was such that it allowed most species to pass through the fence except beaver and big turtles. In some remote areas where vehicular traffic is infrequent, it may be acceptable for animals that cannot pass through the fence mesh to travel across the road. However, for culverts under busy roads, it may be necessary to design special "*doors*" that allow the passage of beaver, large turtles, and other non-target animals through the device. For example, T-joints 30 centimeters in diameter have been used to allow access through Beaver Deceiver™ fences. The T-shape reduces the likelihood that beaver can haul woody debris for dam construction inside the device (Lisle 2003). Fence caps would not be attached to the up and down-stream ends of a culvert when it is necessary to allow passage of species like large turtles and beavers through a culvert.

Exclusionary fences constructed of woven wire or multiple strands of electrified wire can be effective in keeping animals from some areas, such as a sheep pasture or an airport. For example, Matchett et al. (2013) found that electronet could exclude coyotes from black-tailed prairie dog (*Cynomys ludovicianus*) colonies. The size of the wire grid and height of the fence must be able to keep the animals out. In addition, an underground apron (*e.g.*, fencing in the shape of an "*L*" going outward) about 2 feet down and 2 feet out helps make a fence more wildlife proof; the "*L*" keeps animals out that dig crawl holes under the fence. However, fencing has limitations. Even an electrified fence is not always animal-proof and the expense of the fencing can often exceed the benefit. In addition, if large areas are fenced, the wildlife being excluded has to be removed from the enclosed area to make it useful. Some fences inadvertently trap, catch or affect the movement of non-target wildlife and may not be practical or legal in some areas (*e.g.*, restricting access to public land).

Water control devices (*e.g.*, pond levelers) are systems that allow the passage of water through a beaver dam. The devices could be used in situations where the presence of impounded water is desired but it is necessary to manage the level of water in the pond. Various types of water control devices have been described (Arner 1964, Roblee 1984, Laramie and Knowles 1985, Miller and Yarrow 1994, Wood et al. 1994, Lisle 1996, Organ et al. 1996, Brown and Brown 1999, Lisle 1999, Brown et al. 2001, Close 2003, Lisle 2003, Simon 2006, Spock 2006, Taylor and Singleton 2014). Water control devices such as the corrugated plastic drainage tubing (Roblee 1984), the T-culvert guard (Roblee 1987), wire mesh culvert (Roblee 1983), and the Clemson beaver pond leveler (Miller and Yarrow 1994) can sometimes be used to control the water in beaver impoundment to desirable levels that do not cause damage. Taylor and Singleton (2014) provide a comprehensive summary of the evolution of flow devices to reduce flooding by beaver. The devices generally involve the use of one or more pipes installed through the beaver dam to increase the flow of water through the dam. Height and placement of pipes can be adjusted to achieve the desired water level in the beaver pond. Beaver generally only check the dam for leaks, so, when site conditions permit, the inlet of the pipe is placed away from the dam to make the source of the water flow more difficult to detect and decrease the likelihood that beaver will attempt to plug the device. To minimize the sound/sensation of water movement and the associated beaver damming behavior, the end of the pipe may be capped with a series of holes or notches cut in the pipe, which allows water to flow into the pipe. Holes and notches may be placed on the underside of the pipe to reduce the sound of water movement. Alternatively, 90-degree elbow joints can be placed facing downward on the upstream end of the pipes to prevent the noise of running water and attracting beaver. A protective cage can be placed around the upstream end of the inlet pipe to prevent beaver from blocking the pipe and to reduce problems with debris blocking the pipe. As noted above, water control systems can be combined with exclusion devices to prevent beaver from blocking culverts while still maintaining a water impoundment at an acceptable level.

Cultural Methods include the application of practices that seek to minimize exposure of the protected resource to damaging animals through processes other than exclusion. They may include animal husbandry practices, such as employing guard dogs, herders, shed lambing, carcass removal, or pasture selection. Strategies may also include minimizing cover where damaging mammals might hide, manipulating the surrounding environment through barriers or fences to deter animals from entering a protected area, or planting lure crops on fringes of protected crops. Removal of trees from around buildings can sometimes reduce damage associated with tree squirrels and raccoons.

Some mammals that cause damage are attracted to homes by the presence of garbage or pet food left outside and unprotected. Removal or sealing of garbage in tight trash receptacles, and elimination of all pet foods from outside areas can reduce the presence of unwanted mammals. If raccoons are a problem, making trash and garbage unavailable, and removing all pet food from outside during nighttime hours can reduce their presence. Altering how bird feeders are hung and constructing mounting poles for the feeders that cannot be climbed by tree squirrels can reduce the presence of localized populations along with their associated damage.

Guard Animals are used in damage management to protect a variety of resources, primarily livestock, and can provide adequate protection at times (Andelt 2004, Gehring et al. 2010*a*, VerCauteren et al. 2012). Gehring et al. (2010*b*) provides a historically overview of the use of guard animals to protect livestock from predation. Guard animals (*e.g.*, dogs, burros, and llamas) have proven successful in many sheep and goat operations. The effectiveness of guarding animals may not be sufficient in areas where there is a high density of wildlife to be deterred, where the resource (*e.g.*, sheep foraging on open range) is widely scattered, or where the guard animal to resource ratios are less than recommended. WS Directive 2.440 provides guidelines for the activities of WS' personnel relating to the use of livestock guarding dogs for protecting livestock from predation. WS' field personnel will be knowledgeable in the use and application of livestock guarding dogs and will assist producers who may be interested in using livestock guarding dogs by providing information and/or referring them to other WS' personnel for further assistance. WS was instrumental in the introduction and adoption of livestock guarding dogs in the late 1980s and early 1990s and continues to recommend use of livestock guarding dogs where appropriate (Green and Woodruff 1983, Green and Woodruff 1988). The NWRC continues to conduct research into new breeds of livestock guarding dogs (Marlow 2016).

Habitat Management would involve localized manipulation of habitats to minimize the presence of animals. Localized habitat management is often an integral part of damage management. The type, quality, and quantity of habitat are directly related to the wildlife produced or attracted to an area. Habitat can be managed to not produce or attract certain wildlife species. For example, WS' personnel could recommend limited habitat management in urban and suburban areas, such as at golf courses, city drainage ditches, and airports, where requesters can plant vegetation that is less palatable to beaver and muskrats. Limitations of habitat management as a method of reducing animal damage are determined by the characteristics of the species involved, the nature of the damage, economic feasibility, and other factors. Legal constraints may also exist that preclude altering particular habitats.

Animal Husbandry Techniques includes modifications in the level of care and attention given to livestock, shifts in the timing of breeding and births, indoor birthing areas, selection of less vulnerable livestock species to be produced, shifting grazing locations, and the introduction of human custodians (herders) to protect livestock. The level of care or attention given to livestock may range from daily to seasonal. Generally, as the frequency and intensity of livestock handling increase, so does the degree of protection (Robel et al. 1981). In operations where livestock are left unattended for extended periods, the risk of depredation is greatest. The risk of depredation can be reduced when operations permit nightly gathering so livestock are unavailable during the hours when predators are most active. It is also possible to reduce predation of sheep by concentrating sheep in smaller areas (Sacks and Neale 2002). Additionally, the risk of depredation is usually greatest with immature livestock. This risk diminishes as age and size increase and can be minimized by holding expectant females in pens or sheds to protect births and by holding newborn livestock in pens for the first two weeks. Shifts in breeding schedules can also reduce the risk of depredation by altering the timing of births to coincide with the greatest availability of natural prey to predators or to avoid seasonal concentrations of predators. The use of herders can also provide some protection from predators, especially those herders accompanying bands of sheep on open range where they are highly susceptible to predation.

Beaver dam breaching/removal would involve the removal of debris deposited by beaver that impedes the flow of water. Removing or breaching a dam is generally conducted to maintain existing stream channels and drainage patterns, and reduce floodwaters behind the dam. Beaver dams are made from natural debris such as logs, sticks and mud that beaver take from the immediate area and impound water, creating habitat that they utilize to build lodges and bank dens to raise their young and/or provide protection from predators. The impoundments that WS removes or breaches would typically be created by recent beaver activity and would not have been in place long enough to take on the qualities of a true wetland (*e.g*., hydric soils, aquatic vegetation, pre-existing function). Unwanted beaver dams could be removed by hand with a rake or power tools (*e.g.*, a winch), or with explosives. Explosives would be used only by WS' personnel specially trained and certified to conduct such activities, and only binary explosives would be used (*i.e*., they are comprised of two parts that must be mixed at the site before they can be detonated as an explosive material). Beaver dam removal or breaching by hand or with binary explosives would not affect the substrate or the natural course of the stream. Removing or breaching dams would return the area back to its pre-existing condition with similar flows and circulations. Because beaver dams involve waters of the United States, removal is regulated under Section 404 of the CWA (see Appendix E).

Most beaver dam breaching, if considered discharge, would be covered under exemptions in 33 CFR 323 or under a NWP issued pursuant to 33 CFR 330 and do not require a permit. A permit would be required if the beaver dam breaching activity was not covered by a Section 404 permitting exemption or a NWP and the area affected by the beaver dam was considered a true wetland. The State of Georgia may require additional permits (see Appendix E). WS' personnel would survey the site or impoundment to determine if conditions exist for classifying the site as a true wetland. If the site appears to have conditions over 3 years old or appeared to meet the definition of a true wetland, the landowner or cooperator would be required to obtain a permit before proceeding (see Appendix E for information that explains Section 404 permit exemptions and conditions for breaching/removing beaver dams).

Animal behavior modification refers to tactics that deter or repel damaging mammals and thus, reduce damage to the protected resource. Those techniques are usually aimed at causing target animals to respond by fleeing from the site or remaining at a distance. They usually employ extreme noise or visual stimuli. Unfortunately, many of these techniques are only effective for a short time before animals habituate to them (*e.g*., see Conover 1982, Mitchell et al. 2004). Harassment methods have generally proven ineffective in reducing beaver damage (Jackson and Decker 2004). Devices used to modify behavior in mammals include fladry (Mettler and Shivik 2007, Young et al. 2015), electronic guards (siren strobe-light devices) (Linhart et al. 1992), propane exploders, pyrotechnics, laser lights, human effigies, effigies of predators, and the noise associated with the discharge of a firearm.

The success of frightening methods depends on an animal's fear of, and subsequent aversion to, offensive stimuli (Shivik and Martin 2001, Shivik et al. 2003, Mettler and Shivik 2007). A persistent effort is usually required to effectively apply frightening techniques and the techniques must be sufficiently varied to prolong their effectiveness. Over time, animals often habituate to commonly used scare tactics and ignore them (*e.g*., see Dolbeer et al. 1986, Bomford 1990, Shivik et al. 2003, Mitchell et al. 2004, Shivik 2006). In addition, in many cases, animals frightened from one location become a problem at another. Scaring devices, for the most part, are directed at specific target species. However, several of these devices, such as scarecrows and propane exploders, are automated.

Harassment and other methods to frighten animals are probably the oldest methods of combating wildlife damage. These devices may be either auditory or visual and provide short-term relief from damage. A number of sophisticated techniques have been developed to scare or harass wildlife from an area. The use of noise-making devices (*e.g*., electronic distress sounds, propane cannons, and pyrotechnics) is the most popular. Other methods include harassment with visual stimuli (*e.g*., flashing or bright lights, scarecrows, human effigies), vehicles, or people. Some methods such as the electronic guard use a combination of stimuli (siren and strobe light). These are used to frighten predators from the immediate vicinity of the damage prone area. As with other damage management efforts, these techniques tend to be more effective when used collectively in a varied regime rather than individually. However, the continued success of these methods frequently requires reinforcement by limited shooting or other local population reduction methods.

Live Capture and Translocation can be accomplished using hand capture, hand nets, catch poles, cage traps, suitcase type traps, some cable devices, or with foothold traps to capture some mammal species for the purpose of translocating them for release in other areas. WS could employ those methods in Georgia when the target animal(s) can legally be translocated or can be captured and handled with relative safety by WS' personnel. Live capture and handling of mammals poses an additional level of human health and safety threat if target animals are aggressive, large, or extremely sensitive to the close proximity of people. For that reason, WS may limit this method to specific situations and certain species. In addition, moving damage-causing individuals to other locations can typically result in damage at the new location, or the translocated individuals can move from the relocation site to areas where they are unwanted. In addition, translocation can facilitate the spread of diseases from one area to another. Although translocation is not necessarily precluded in all cases, it would be logistically impractical, in most cases, and biologically unwise in Georgia due to the risk of disease transmission. 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 GDNR.

Trapping can utilize a number of devices, including nets, foothold traps, cage-type traps, and body-gripping traps, foot snares, and cable devices. Capture methods are often methods that would be set to confine or restrain target animals after the animal triggers the trap. Personnel would strategically place traps at locations likely to capture a target animal and minimize the threat to non-target species by placement in those areas frequently used by target animals, using baits or lures that are as species specific as possible, and modification of individual methods to exclude non-target animals from capture.

WS' personnel would check methods in accordance with WS Directive 2.210, WS Directive 2.450, and Georgia laws and regulations. Checking live-traps frequently would help ensure that WS' personnel could release live-captured non-target species in a timely manner. WS would monitor activities to ensure those activities do not negatively affect non-target species.

While WS' personnel would take precautions to safeguard against taking non-target animals during operational use of trapping methods and techniques for resolving damage and reducing threats caused by mammals, the use of such methods could result in the incidental lethal removal of unintended species. The unintentional removal and capture of animals during damage management activities conducted under the proposed activities would primarily be associated with the use of body-gripping traps cable devices, and in some situations, with live-capture methods, such as foothold traps and cage traps. However, WS' personnel have not captured or killed any threatened or endangered species previously using trapping methods.

Drop nets are nylon or cloth nets that would be suspended above an area actively used by an animal or group of animals where target individuals have been conditioned to feed (Ramsey 1968). The area would be baited and once feeding occurs under the net, the net would be released. Drop nets require constant supervision by personnel to drop the net when target individuals were present and when animals were underneath the net. This method has limited use due to the time and effort required to condition animals to feed in a location and the required monitoring of the site to drop the net when target animals were present. Nets are used to live-capture target individuals and if any non-target animals are present, they can be released on site unharmed. Drop nets allow for the capture of several animals during a single application. Injuries to animals do occur from the use of nets. Injuries to deer occurred when using drop nets with the rate of injury being correlated with the number of deer captured during a single application of the net (Haulton et al. 2001). Nets would generally be available to the public.

Cannon nets use nylon or cloth nets to capture animals that have been conditioned to feed in a given area through baiting (Hawkins et al. 1968). When using cannon nets, the net is fully deployed to determine the capture area when fired. Once the capture zone has been established, the net is rolled up upon itself and bait is placed inside the zone to ensure feeding animals are captured. When target animals are feeding at the site and within the capture zone of the net, the launcher is activated by personnel near the site, which launches the net over the target animals. The net is launched using small explosive charges and weights or compressed air. Only personnel trained in the safe handling of explosive charges would be allowed to employ rocket nets when explosive charges were used. Pneumatic cannon nets could also be used, which propels the net using compressed air instead of small explosive charges. Cannon nets require personnel to be present at the site continually to monitor for feeding. Similar to drop nets, cannon nets can be used to capture multiple animals during a single application. Similar to drop nets, injury rates for cannons nets appear to be correlated with the number of animals captured during a single application of the net (Haulton et al. 2001). Non-target animals incidentally captured can be released on site unharmed. Cannon nets would generally not be available for use by the public and would not be available for use by the public under Alternative 2 and Alternative 3 except by the GDNR or other natural resource agencies. An entity may be required to obtain authorization from the GDNR to use cannon nets.

Foothold traps can be effectively used to capture a variety of mammals. Foothold traps can be placed beside, or in some situations, in travel ways being actively used by the target species. Placement of traps is contingent upon the habits of the respective target species, habitat conditions, and presence of non-target animals. Effective trap placement and adjustment and the use and placement of appropriate baits and lures by trained WS' personnel also contribute to the selectivity of foothold traps. An additional advantage is that foothold traps can allow for the on-site release of non-target animals since animals are captured alive. The use of foothold traps requires more skill than some methods. For beaver and muskrats, foothold traps are often placed just under the surface of the water in travel ways and are intended to capture the target beaver or muskrat as they exit or enter the water. Foothold traps would generally be available for use by the public and other state or federal agencies.

WS could also attach a foothold trap to a submersion cable or rod that WS anchors at the trap set and in deep water. Attaching the trap to the cable or rod with a locking mechanism allows the trap to slide down the cable or rod into deeper water, but prevents a captured animal from returning to the surface. In this type of foothold set, death from drowning or submersion hypoxia occurs in a short time.

Cable devices are typically made of single or multi-strand cable, and can be set to capture an animal by the neck, body, or foot. They can be used effectively to catch most species, but are most frequently used to capture coyotes, fox, feral swine, and beaver. Cable devices are much lighter and easier to use than other methods and are not generally affected by inclement weather. Cable devices may be used as either lethal or live-capture devices depending on how or where they are set. Cable devices set to capture an animal by the neck are usually lethal but stops can be attached to the cable to increase the probability of a live capture depending on the trap check interval. Cable devices positioned to capture the animal around the body can be a useful live-capture device, but are more often used as a lethal control technique. Cable devices can incorporate a breakaway feature to release non-target animals and livestock where the target animal is smaller than potential non-target animals (Phillips et al. 1990, Phillips 1996). Cable devices can be effectively used wherever a target animal moves through a restricted travel lane (*e.g.*, under fences or trails through vegetation). When an animal moves forward into the loop formed by the cable, the noose tightens and the animal is held. Cable devices must be set in locations where the likelihood of capturing non-target animals would be minimized. Steel cable snares are also prohibited on land, except that powered foot snares less than 5.5 inches are legal.

The foot or leg snare can be set as a spring-powered non-lethal device, activated when an animal places its foot on the trigger or pan. In some situations, using cable devices to capture animals is impractical due to the behavior or morphology of the animal, or the location of many animal conflicts. In general, cable devices would be available to all entities to alleviate damage.

Cage-type traps come in a variety of styles to live-capture animals. The most commonly known cage traps are box traps, suitcase traps, and corral traps. Box traps are usually rectangular and are made from various materials, including metal, wire mesh, plastic, and wood. These traps are used to capture animals alive and can often be used where many lethal tools were impractical. These traps are well suited for use in residential areas and work best when baited with foods attractive to the target animal. Box traps are generally portable and easy to set-up.

Corral traps for feral swine are generally large circular traps consisting of panels anchored to the ground using steel posts with a door allowing entrance. Side panels are typically woven metal fencing referred to as swine panels or cow panels. The entrances into the traps generally consist of a door that allows entry into the trap but prevents exit. The doors are often designed to allow swine to continually enter the trap, which allows for the possibility of capturing multiple swine. Cage traps would be available to all entities to alleviate damage.

The disadvantages of using cage traps are: 1) some individual target animals may avoid cage traps; 2) some non-target animals may associate the traps with available food and purposely get captured to eat the bait, making the trap unavailable to catch target animals; 3) cage traps must be checked frequently to ensure that captured animals are not subjected to extreme environmental conditions; 4) some animals will fight to escape and may become injured; and 5) the expense of purchasing traps. Disadvantages associated with corral traps include: 1) the expense of purchasing the materials to construct trap, 2) once constructed, corral traps are not moveable until disassembled and transported, and 3) in remote areas, getting all the required equipment to the location can be difficult.

Trap monitors are devices that send a radio signal to a receiver if a set trap is disturbed and alerts field personnel that an animal may be captured. Trap monitors can be attached directly to the trap or attached to a string or wire and then placed away from the trap in a tree or shrub. When the monitor is hung above the ground, it can be detected from several miles away, depending on the terrain in the area. There are many benefits to using trap monitors, such as saving considerable time when checking traps, decreasing fuel usage, prioritizing trap checks, and decreasing the need for human presence in the area. Trap monitors could be used when using cage traps. Wireless trail (game) cameras could also be used to monitor traps where cell service is available. Some trail cameras allow images to be sent to cellular phones, which permits for fewer site visits and reduced cost associated with travel.

Trap monitoring devices could be employed, when applicable, that indicate when a trap has been activated. Trap monitoring devices would allow personnel to prioritize trap checks and decrease the amount of time required to check traps, which decreases the amount of time captured target or non-target animals would be restrained. By reducing the amount of time target and non-target animals are restrained, pain and stress can be minimized and captured animals can be addressed in a timely manner, which could allow non-target animals to be released unharmed. Trap monitoring devices could be employed where applicable to facilitate monitoring of the status of traps in remote locations to ensure any captured animals was removed promptly to minimize distress and to increase the likelihood non-target animals could be released unharmed.

Hancock/Bailey Traps (suitcase/basket type cage traps) are designed to live-capture beaver. The trap is constructed of a metal frame that is hinged with springs attached and covered with chain-link fence. The trap's appearance is similar to a large suitcase when closed. When set, the trap is generally baited and opened to allow an animal to enter. When tripped, the panels of the trap close around the animal capturing the animal. One advantage of using the Hancock or Bailey trap is the ease of release of beaver or non-target animals. Beaver caught in Hancock or Bailey traps could also be humanely euthanized. Disadvantages are that those traps are very expensive, cumbersome, and difficult to set (Miller and Yarrow 1994). The trap weighs about 25 pounds and is relatively bulky to carry and maneuver. Hancock and Bailey traps can also be dangerous to set (*i.e.*, hardhats are recommended when setting suitcase traps), are less cost and time-efficient than cable devices, foothold traps, or body-grip traps, and may cause serious and debilitating injury to river otters (Blundell et al. 1999).

Body-grip Traps are designed to cause the quick death of the animal that activates the trap. The body-grip trap consists of a pair of rectangular wire frames that close like scissors when triggered, killing the captured animal with a quick body blow. For body-grip traps, the traps should be placed to ensure the rotating jaws close on either side of the neck of the animal to ensure a quick death. Body-grip traps are lightweight and easily set. Safety hazards and risks to people are usually related to setting, placing, checking, or removing the traps. Body-gripping traps present a minor risk to non-target animals. Selectivity of body-grip traps can be enhanced by placement, trap size, trigger configurations, and baits. When using body-gripping traps, risks of non-target capture can be minimized by using recessed sets (placing trap inside a cubby, cage, or burrow), restricting openings, or by elevating traps. For example, body-grip traps set to capture beaver can be placed underwater to minimize risks to non-target animals. Choosing appropriately sized traps for the target species can also exclude non-target animals by preventing larger non-target animals from entering and triggering the trap. The trigger configurations of traps can be modified to minimize non-target capture. For example, offsetting the trigger can allow non-target animals to pass through body-grip traps without capture. Body-grip traps cannot exceed five inches in spread when utilized on land. Body-grip traps would be available for use by all entities. Body-grip traps would also include snap traps, which are common household rat or mouse traps.

Shooting with firearms is very selective for the target species and could be conducted with rifles, handguns, and shotguns. Methods and approaches used by WS may include use of vehicles or aircraft, illuminating devices, bait, firearm suppressors, night vision/thermal equipment, and elevated platforms. Shooting can be an effective method in some circumstances, and can often provide immediate relief from the problem. Shooting may at times be one of the only methods available to effectively and efficiently to resolve damage. Shooting would be limited to locations where it is legal and safe to discharge a weapon. In addition, WS' personnel could use firearms to euthanize live-captured target animals.

Ground shooting is sometimes used as the primary method to alleviate damage or threats of damage. Shooting would be limited to locations where it is legal and safe to discharge a weapon. A shooting program, especially conducted alone, can be expensive because it often requires many staff hours to complete.

Shooting can also be used in conjunction with an illumination device at night, which is especially useful for nocturnal mammals, such as deer or feral swine. Spotlights may or may not be covered with a red lens, which nocturnal animals may not be able to see, making it easier to locate them undisturbed. Night shooting may be conducted in sensitive areas that have high public use or other activity during the day, which would make daytime shooting unsafe. The use of night vision and Forward Looking Infrared (FLIR) devices can also be used to detect and shoot mammals at night, and is often the preferred equipment due to the ability to detect and identify animals in complete darkness. Night vision and FLIR equipment aid in locating animals at night when animals may be more active. Night vision and FLIR equipment could be used during surveys and in combination with shooting to remove target mammals at night. WS' personnel most often use this technology to target mammals in the act of causing damage or likely responsible for causing damage. Those methods aid in the use of other methods or allow other methods to be applied more selectively and efficiently. Night vision and FLIR equipment allow for the identification of target species during night activities, which reduces the risks to non-target animals and reduces human safety risks. Night vision equipment and FLIR devices only aid in the identification of animals and are not actual methods of removal. The use of FLIR and night vision equipment to remove target mammals would increase the selectivity of direct management activities by targeting those mammals most likely responsible for causing damage or posing threats.

Denning is the practice of locating coyote or fox dens and lethally removing the young, adults, or both to stop an ongoing predation problem or prevent future depredation of livestock. Denning is used in coyote and fox damage management, but is limited because dens are often difficult to locate and den use by the target animal is restricted to about 2 to 3 months during the spring. Coyote and red fox depredations on livestock often increase in the spring and early summer due to the increased food requirements associated with feeding and rearing litters of pups (Till and Knowlton 1983, Till 1992). Removal of pups will often stop depredations even if the adults are not taken (Till 1992). Pups are typically euthanized in the den using a registered gas fumigant cartridge or by digging out the den and euthanizing the pups with sodium pentobarbital. When the adults are removed at or near a known den location, it is customary to euthanize the pups to prevent their starvation because they would be unable to survive on their own. Denning is labor intensive. Denning is very target-specific and is most often used in open terrain where dens are comparatively easy to find. WS Directive 2.425 provides guidelines for the use of denning by WS' personnel to manage animal damage.

Hunting/Trapping is sometimes recommended by WS to resource owners. WS could recommend resource owners consider legal hunting and trapping as an option for reducing mammal damage. Although legal hunting/trapping is impractical and/or prohibited in many urban-suburban areas, it can be used to reduce some local populations of mammals.

Aerial Shooting (*i.e.*, shooting from an aircraft) is a commonly used damage management method for coyotes and feral swine. Aerial shooting can be especially effective in removing offending coyotes that have become "*bait-shy*" to trap sets or are not susceptible to calling and shooting. Aerial shooting is one of the preferred damage management methods for reducing feral swine damage as well, in that local swine populations can quickly be removed when weather and habitat conditions are favorable. Aerial shooting consists of visually sighting target animals in the problem area and personnel shooting the animal from the aircraft. Local depredation problems (*e.g*., feral swine causing damage to crops) can often be resolved quickly through aerial shooting. Aerial shooting is mostly species-selective (there is a slight potential for misidentification) and can be used for immediate control to reduce livestock and natural resource losses if weather, terrain, and cover conditions are favorable. WS has also used aerial shooting for disease surveillance (*e.g*., taking deer samples for chronic wasting disease and searching for carcasses in areas where an anthrax outbreak has occurred). Fixed-wing aircraft are most frequently used in flat and gently rolling terrain whereas helicopters with better maneuverability have greater utility and are safer over brush covered ground, timbered areas, steep terrain, or broken land where animals are more difficult to spot.

Cain et al. (1972) rated aerial shooting as "*very good*" in effectiveness for problem solving, safety, and lack of adverse environmental impacts. Connolly and O'Gara (1987) documented the efficacy of aerial shooting in taking confirmed sheep-killing coyotes. Wagner (1997) and Wagner and Conover (1999) found that aerial shooting might be an especially appropriate tool as it reduces risks to non-target animals and minimizes contact between damage management operations and recreationists. They also stated that aerial shooting was an effective method for reducing livestock predation and that aerial hunting 3 to 6 months before sheep are grazed on an area was cost-effective when compared with areas without aerial hunting.

Good visibility and relatively clear and stable weather conditions are required for effective and safe aerial shooting. Summer conditions limit the effectiveness of aerial shooting as heat can reduce animal activity and visibility is greatly hampered by vegetative ground cover. Air temperature (high temperatures), which influences air density affects low-level flight safety and may restrict aerial shooting activities. In broken timber or deciduous cover, aerial shooting can be more effective in winter when the leaves have fallen or in early spring before the leaves emerge, which improves visibility. The WS program aircraft-use policy helps ensure that aerial shooting is conducted in a safe and environmentally sound manner, in accordance with federal and state laws. Pilots and aircraft must be certified under established WS program procedures and only properly trained WS' employees are approved as gunners. Ground crews are often used with aerial operations for safety reasons. Ground crews can also assist with locating and recovering target animals, as necessary.

Aircraft overflights have created concerns about disturbing wildlife. The National Park Service (1995) reviewed studies on the effects of aircraft overflights on wildlife. Their report revealed that a number of studies documented responses by certain wildlife species that could suggest adverse impacts may occur. Few, if any studies, have proven that aircraft overflights cause adverse impacts to wildlife populations, although the report stated it is possible to draw the conclusion that affects to populations could occur. It appears that some species will frequently, or at least occasionally, show adverse responses to even minor overflight occurrences. In general, it appears that the more serious potential impacts occur when overflights are frequent, such as hourly, and over long periods of time, which represents chronic exposure. Chronic exposure situations generally occur in areas near commercial airports and military flight training facilities. The use of firearms from aircraft would occur in remote areas where tree cover and vegetation allows for visibility of target animals from the air. WS spends relatively little time over any one area.

WS has used fixed-wing aircraft and helicopters for aerial shooting in areas inhabited by wildlife for years. WS conducts aerial activities on areas only under signed agreement and concentrates efforts during certain times of the year and to specific areas. WS' Predator Damage Management Environmental Assessments (*e.g*., see USDA 2015*b*) that have looked at the issue of aerial hunting overflights on wildlife have found that WS has annually flown less than 12 min./mi^2 on properties under agreements. WS flies very little over any one property under agreement in any given year. As a result, no known problems to date have occurred with WS' aerial shooting overflights on wildlife, nor are they anticipated in the future.

Aerial Surveying is a commonly used tool for evaluating and monitoring damage and establishing population estimates and locations of various species of animals. WS uses aerial surveying throughout the United States to monitor damages and/or populations of coyotes, fox, wolves, feral swine, feral goats, feral dogs, bobcats, mountain lions, white-tailed deer, pronghorn antelope, elk, big-horn sheep, and wild horses but any animal species big enough to see from a moving aircraft could be surveyed using this method. As with aerial shooting, the WS program aircraft-use policy helps ensure that aerial surveys are conducted in a safe and environmentally sound manner, in accordance with federal and state laws. Pilots and aircraft must also be certified under established WS program procedures and policies.

Aerial Telemetry is used in research projects studying the movements of various animal species. Biologists will frequently place radio-transmitting collars on selected individuals of a species and then monitor their movements over a specified period. Whenever possible, the biologist attempts to locate the research subject using a hand-held antennae and radio receiver, however, occasionally animals will make large movements that prevent biologists from locating the animal from the ground. In these situations, WS can utilize either fixed wing aircraft or helicopters and elevation to conduct aerial telemetry and locate the specific animal wherever it has moved to. As with any aerial operations, the WS program aircraft-use policy helps ensure that aerial surveys would be conducted in a safe and environmentally sound manner, in accordance with federal and state laws.

Trained Dogs are frequently used in to locate, pursue, or decoy animals, primarily coyotes and feral swine. The WS program could use trailing/tracking, decoy, and trap-line companion dogs. Training and maintaining suitable dogs requires considerable skill, effort, and expense. WS Directive 2.445 establishes standards and responsibilities for WS' use of trained dogs to assist in accomplishing activities. When using trained dogs, WS' personnel would adhere to WS Directive 2.445.

Tracking Dogs or trailing dogs are commonly used to track and "*tree*" or "*bay*" target wildlife species, such as bobcats, raccoons, and feral swine. Although not as common, they sometimes are trained to track coyotes (Rowley and Rowley 1987, Coolahan 1990). Dogs commonly used are different breeds of hounds, such as blue tick, red-bone, and Walker. They become familiar with the scent of the animal they are to track and follow, and the dogs strike (howl) when they detect the scent. Tracking dogs are trained not to follow the scent of non-target species. Personnel of WS typically find the track of the target species in areas with fresh damage or at a location where recent predation has occurred. Personnel would then put their dogs on the tracks of the target animal. Typically, if the track is not too old, the dogs can follow the trail. The animal usually seeks refuge up a tree, in a thicket on the ground, on rocks or a cliff, or in a hole. The dogs stay with the animal until personnel arrive and dispatch, tranquilize, or release the animal, depending on the situation. A possibility exists that dogs could switch to a fresher trail of a non-target species while pursuing the target species. This could occur with any animal that they have been trained to follow, and could occur with an animal that is similar to the target species. For example, dogs on the trail of a coyote could switch to a fox, if they cross a fresher track. With this said, this risk can be minimized greatly by the personnel of the WS looking at the track prior to releasing the dogs and calling them off a track if it is determined that they have switched tracks.

Decoy Dogs are primarily used in coyote damage management in conjunction with calling. Dogs are trained to spot and lure coyotes into close shooting range for personnel of WS. Decoy dogs are especially effective for territorial pairs of coyotes. Decoy dogs are typically medium-sized breeds that are trained to stay relatively close to personnel.

Trap-line Companion Dogs could accompany personnel of WS in the field while they were setting and checking equipment. They would be especially effective in finding sites to set equipment by alerting their owners to areas where coyotes or other predators have traveled, urinated, or defecated, which are often good sites to make sets. Trap-line companion dogs stay with personnel and most always have no effect on non-target animals. Trap-line dogs may increase the selectivity towards territorial coyotes by identifying territorial canine scent locations.

Chemical Animal Damage Management Methods

The EPA through the FIFRA, the GDA, the United States Drug Enforcement Administration, MOUs with land managing agencies, and WS' directives would regulate chemical methods that could be available for use by WS pursuant to the alternatives (see WS Directive 2.401, WS Directive 2.405, WS Directive 2.430, WS Directive 2.465). All pesticides used by WS would be registered under the FIFRA and administered by the EPA and the GDA. All WS' personnel in Georgia who apply restricted-use pesticides would be certified pesticide applicators by the GDA and have specific training by WS for pesticide application. The EPA and the GDA require pesticide applicators to adhere to all certification requirements set forth in the FIFRA. Pharmaceutical drugs, including those used in animal capture and handling, are administrated by the United States Food and Drug Administration and/or the United States Drug Enforcement Administration. Employees of WS that use immobilizing drugs and euthanasia chemicals would be certified for their use and follow the guidelines established in the WS Field Operational Manual for the Use of Immobilization and Euthanasia Drugs (Johnson et al. 2001).

WS would not use chemicals on public or private lands without authorization from the land management agency or property owner/manager. Under certain circumstances, personnel of WS could be involved in the capture of animals where the safety of the animal, personnel, or the public could be compromised and chemical immobilization would provide a good solution to reduce those risks. For example, chemical immobilization could be used to capture coyotes where public safety was at risk. Immobilizing drugs are most often used by WS to remove animals from cage traps to be examined (*e.g.*, for disease surveillance) or in areas, such as urban, recreational, and residential areas, where the safe removal of a problem animal is most easily accomplished with a drug delivery system (*e.g.*, darts from rifle). Immobilization is usually followed by release (*e.g.*, after radio collaring a coyote for a study), translocation, or euthanasia. Chemically euthanized animals would be disposed of by incineration or deep burial to avoid secondary hazards. Immobilizing drugs and euthanasia chemicals would be monitored closely and stored in locked boxes or cabinets according to WS' policies and United States Drug Enforcement Administration guidelines. Most drugs fall under restricted-use categories and must be used under the appropriate license from the United States Drug Enforcement Administration. The following chemical methods have been proven to be selective and effective in reducing damage by mammals.

GonaCon™ was developed by scientists with the NWRC as a reproductive inhibitor. GonaCon™ is a new single dose immunocontraceptive vaccine. Recent studies have demonstrated the efficacy of this single-shot GnRH vaccine on California ground squirrels, Norway rats, feral cats and dogs, feral swine, wild horses, and white-tailed deer. Infertility among treated female swine and white-tailed deer has been documented for up to two years without requiring a booster vaccination (Miller et al. 2000). This vaccine overcomes one of the major obstacles of previous two dose vaccines since target animals need to be captured only once for vaccination instead of twice. A single-injection vaccine would be much more practical as a field delivery system for use on free-ranging animals.

GonaCon™ was officially registered by the EPA in 2009 for use in reducing fertility in female white-tailed deer under EPA registration number 56228-40. GonaCon™ is registered as a restricted-use pesticide available for use by WS' personnel and personnel of a state wildlife management agency or persons under their authority. Additionally, in order for GonaCon™ to be used in any given state, the product must also be registered with the state and approved for use by the appropriate state agency responsible for managing wildlife. GonaCon™, when injected into the body, elicits an immune response that neutralizes the GnRH hormone being produced naturally by deer. The GnRH hormone in deer stimulates the production of other sexual hormones, which leads to the body reaching a reproductive state. The vaccine neutralizes the GnRH hormone being produced, which then prevents the production of other sexual hormones in the deer vaccinated; thereby, preventing the body of the deer from entering into a reproductive state (USDA 2010).

Ketamine (Ketamine HCl) is a fast acting dissociative anesthetic (*i.e.*, loss of sensation with or without loss of consciousness) that is used to capture animals. Ketamine produces catatonia (*i.e.*, lack of movement, activity, or expression) and profound analgesia (*i.e.*, insensibility to pain without loss of consciousness), but not muscle relaxation. It is used to eliminate pain, calm fear, and allay anxiety. Ketamine is possibly the most versatile drug for chemical capture, and it has a wide safety margin (Johnson et al. 2001). When used alone, this drug may produce muscle tension, resulting in shaking, staring, increased body heat, and, on occasion, seizures. Usually, ketamine is combined with other drugs, such as Xylazine. The combination of such drugs is used to control an animal, maximize the reduction of stress and pain, and increase human and animal safety.

Telazol is a more powerful anesthetic and usually used for larger animals. Telazol is a combination of equal parts of tiletamine hydrochloride and zolazepam hydrochloride (a tranquilizer). Telazol produces a state of unconsciousness in which protective reflexes, such as coughing and swallowing, are maintained during anesthesia. Schobert (1987) listed the dosage rates for many wild and exotic animals. Before using Telazol, the size, age, temperament, and health of the animal are considered. Following a deep intramuscular injection of Telazol, onset of anesthetic effect usually occurs within 5 to 12 minutes. Muscle relaxation is optimum for about the first 20 to 25 minutes after the administration, and then diminishes. Recovery varies with the age and physical condition of the animal and the dose of Telazol administered, but usually requires several hours.

Xylazine is a sedative (analgesic) that calms nervousness, irritability, and excitement, usually by depressing the central nervous system. Xylazine is commonly used with ketamine to produce a relaxed anesthesia. It can also be used alone to facilitate physical restraint. Because Xylazine is not an anesthetic, sedated animals are usually responsive to stimuli. Therefore, personnel should be even more attentive to minimizing sight, sound, and touch. When using ketamine/Xylazine combinations, Xylazine will usually overcome the tension produced by ketamine, resulting in a relaxed, anesthetized animal (Johnson et al. 2001). This reduces heat production from muscle tension, but can lead to lower body temperatures when working in cold conditions.

Sodium Pentobarbital is a barbiturate that rapidly depresses the central nervous system to the point of respiratory arrest. Barbiturates are a recommended euthanasia drug for free-ranging wildlife (AVMA 2013). Sodium pentobarbital would only be administered after target animals were live-captured and properly immobilized to allow for direct injection. There are United States Drug Enforcement Administration restrictions on who can possess and administer this drug. Certified WS' personnel are authorized to use sodium pentobarbital and dilutions for euthanasia in accordance with United States Drug Enforcement Administration and state regulations. All animals euthanized using sodium pentobarbital and all of its dilutions (*e.g.* Beuthanasia-D, Fatal-Plus) are disposed of through incineration or deep burial to prevent secondary poisoning of scavenging animals and introduction of these chemicals to non-target animals.

Potassium Chloride used in conjunction with prior general anesthesia is used as a euthanasia agent for animals, and is considered acceptable and humane by the AVMA (2013). Animals that have been euthanized with this chemical experience cardiac arrest followed by death, and are not toxic to predators or scavengers.

Beuthanasia®-D combines pentobarbital with another substance to hasten cardiac arrest. Intravenous (IV) and intracardiac (IC) are the only acceptable routes of injection. As with pure sodium pentobarbital, IC injections with Beuthanasia®-D are only acceptable for animals that are unconscious or deeply anesthetized. With other injection routes, there are concerns that the cardiotoxic properties may cause cardiac arrest before the animal is unconscious. It is a Schedule III drug, which means it can be obtained directly from the manufacturer by anyone with a United States Drug Enforcement Administration registration. However, Schedule III drugs are subject to the same security and record-keeping requirements as Schedule II drugs.

Fatal-Plus® combines pentobarbital with other substances to hasten cardiac arrest. IV is the preferred route of injection; however, IC is acceptable as part of the two-step procedure used by WS. Animals are first anesthetized and sedated using a combination of ketamine/Xylazine and once completely unresponsive to stimuli and thoroughly sedated, Fatal-Plus® is administered. Like Beuthanasia®-D, it is a Schedule III drug requiring a United States Drug Enforcement Administration registration for purchase and is subject to the security and record-keeping requirements of Schedule II drugs.

Carbon dioxide is sometimes used to euthanize mammals that are captured in live traps and when relocation is not a feasible option. Live mammals would be placed in a sealed chamber. Carbon dioxide gas is released into the chamber and the animal quickly dies after inhaling the gas. This method is approved as a euthanizing agent by the 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 the gas released 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.

Zinc phosphide could be available for use by WS when managing damage associated with woodchucks, muskrats, and roof rats. Zinc phosphide decomposes slowly and releases phosphine gas (PH_3) when exposed to moisture. When zinc phosphide treated bait encounters acids in the stomach, bait releases phosphine (PH_3) gas, which may account in a large part for observed toxicity. Animals that ingest lethal amounts of bait usually succumb overnight with terminal symptoms of convulsions, paralysis, coma, and death from asphyxia. If death is prolonged for several days, intoxication that occurs is similar to intoxication with yellow phosphorous, in which the liver is heavily damaged. Prolonged exposure to phosphine can produce chronic phosphorous poisoning.

Although zinc phosphide baits have a strong, pungent, phosphorous-like odor (garlic like), this characteristic seems to attract rodents, particularly rats, and apparently makes the bait unattractive to some other animals. For many uses of zinc phosphide formulated on grain or grain-based baits, pre-baiting is recommended or necessary for achieving good bait acceptance. Primary toxicity risks to non-target species from the direct consumption of treated bait can be minimized by using bait placement to prevent access by non-target species, such as birds.

Because zinc phosphide is not stored in muscle or other tissues of poisoned animals, there is no secondary poisoning with this rodenticide. The bait however, remains toxic up to several days in the gut of the dead rodent. Other animals can be poisoned if they eat enough of the gut content of rodents recently killed with zinc phosphide.

Aluminum phosphide is an inorganic phosphide used to control insects and rodents in a variety of settings. It is mainly used as an indoor fumigant at crop transport, storage or processing facilities (or in shipholds, railcars) for both food and non-food crops. It may also be used as an outdoor fumigant for burrowing rodent and mole control, or in baits for rodent control in crops. Aluminum phosphide is available in pellet and tablet form, and is available in porous blister packs, sachets, or as dusts. WS could use aluminum phosphide as a fumigant when alleviating damage associated with woodchucks. WS' personnel would use products in accordance with label restrictions in a manner defined by application guidelines on the label. Use in Georgia by WS would be infrequent and amounts used would be very small.

Aluminum phosphide causes acute toxicity with the main routes of exposure occurring through ingestion and inhalation. Dermal absorption is not known to occur. Aluminum phosphide ingested orally reacts with water and stomach acids to produce phosphine gas, which may account in a large part for the observed toxicity. Phosphine generated in the gastrointestinal tract is readily absorbed in to the bloodstream, and it is readily absorbed through the lung epithelium. Similarly, products for use as fumigants are generally available as tablets that applicators place inside burrows. The tablets react with the moisture in the soil, producing phosphine gas, which the target animal then inhales.

In chronic toxicity studies, rats fed chow fumigated with aluminum phosphide that averaged 0.51 ppm phosphine residues (approximately 0.43 mg/kg/day) showed no differences from the control animals with respect to blood or urine chemistry and no observable differences in tissue structure. It was reported that workers had probably encountered similar exposures on an intermittent basis (in some cases over as long as a 20-year period) and had yet to show signs of toxicity, which suggests that chronic effects may be minor or have a very long latency period. Inhalation studies were conducted on the effects of phosphine gas on male and female rats exposed at levels of 0.5, 1.5, and 4.5 mg/meters cubed for six hours per day over a 13-week period. Higher exposure groups (7.5 and 15 mg/meters cubed) were added following preliminary acute test results.

Results indicated that 15 mg/m^3 were lethal to 4 out of 10 female rats following 3 days of exposure. Significant treatment-related effects on body weight and decreased food consumption were seen across all treatment groups and sexes, but were reversible. Decreases in red-blood cell counts, hemoglobin, hematocrit, and increased platelet counts were seen in male rats of the 4.5 mg/m^3 group. Dose-related changes in blood urea nitrogen and other clinical parameters were also seen across exposure groups. Post-mortem examination of test animals revealed microscopic lesions in the outer cortex of the kidneys of rats exposed to 15 mg/m^3, but not at lower exposure levels. All of those effects were apparently reversible following a four-week recovery period.

Repellents are usually naturally occurring substances or chemicals formulated to be distasteful or to elicit pain or discomfort for target animals when they are smelled, tasted, or contacted. Repellents are non-lethal chemical formulations used to discourage or disrupt particular animal behaviors. Olfactory repellents must be inhaled to be effective. These are normally gases, or volatile liquids and granules, and require application to areas or surfaces that need protecting. Taste repellents are compounds (*e.g.*, liquids, dusts, granules) that are normally applied to trees, shrubs, and other materials that are likely to be eaten or gnawed by the target species.

Only a few repellents are commercially available for mammals, and are registered for only a few species. Repellents would not be available for many species that may present damage problems, such as some predators or furbearing species. For example, Miller et al. (2014) found a commonly available mammal repellent was not effective at repelling coyotes. Repellents are variably effective and depend largely on the resource to be protected, time and length of application, and sensitivity of the species causing damage. Acceptable levels of damage control would usually not be realized unless repellents were used in conjunction with other techniques. Repellents often contain different active ingredients with most ingredients occurring naturally in the environment. The most common ingredients of repellents are coyote urine, putrescent whole egg solids, capsaicin, or sand (Silica) mixed with a non-toxic carrier for application to surfaces. Repellents for animals are not generally restricted-use products; therefore, a person does not need a pesticide applicators license to purchase or apply those products. People generally apply repellents directly to affected resources, which elicits an adverse taste or texture response when the target animal ingests the treated resource or the ingestion of the repellent causes temporary sickness (*e.g.*, nausea). Products containing coyote urine or other odors associated with predatory wildlife are intended to elicit a fright response in target wildlife by imitating the presence of a predatory animal (*i.e.*, wildlife tend to avoid areas where predators are known to be present). If repellents were registered for use in the State to reduce damage caused by mammals, WS could employ or recommend for use those repellents that were available.

Gas cartridges (EPA Reg. No. 56228-21, EPA Reg. No. 56228-2) are often used to treat dens or burrows of coyotes, fox, skunks, or woodchucks. When ignited, the cartridge burns in the den of an animal and produces large amounts of carbon monoxide, a colorless, odorless, and tasteless, poisonous gas. The combination of oxygen depletion and carbon monoxide exposure kills the animals in the burrow or den. Sodium nitrate is the principle active chemical in gas cartridges and is a naturally occurring substance. Although stable under dry conditions, it is readily soluble in water and likely to be highly mobile in soils. In addition, dissolved nitrate is very mobile, moving quickly through the vadose zone to the underlying water table (Bouwer 1989). However, burning sodium nitrate, as in the use of a gas cartridge as a fumigant in a rodent burrow, is believed to produce mostly simple organic and inorganic gases, using all of the available sodium nitrate. In addition, the human health drinking water tolerance level for this chemical is 10 mg / L, a relatively large amount, according to EPA Quality Criteria for Water (EPA 1986, Wallace 1987). The gas along with other components of the cartridge, are likely to form oxides of nitrogen, carbon, phosphorus, and sulfur. Those products are environmentally non-persistent because they are likely to be metabolized by soil microorganisms or they enter their respective elemental cycles. In rodent cartridges, sodium nitrate is combined with seven additional ingredients: sulfur, charcoal, red phosphorus, mineral oil, sawdust, and two inert ingredients. None of the additional ingredients in this formulation is likely to accumulate in soil, based on their degradation into simpler elements by burning the gas cartridge. Sodium nitrate is not expected to accumulate in soils between applications, nor does it accumulate in the tissues of target animals (EPA 1991). The EPA stated sodium nitrates "...*as currently registered for use as pesticides, do not present any unreasonable adverse effects to humans*" (EPA 1991). WS would only use gas cartridges in dens or burrows that show signs of active target animal use to minimize risks to non-target species.

Explosives are defined as any chemical mixture or device that serves as a blasting agent or detonator. The procedures and accountability for WS' use of explosives for removing beaver dams and training requirements for explosives certification would adhere to WS Directive 2.435. Explosives are generally used to breach beaver dams that are too large to remove by digging using hand tools. Explosives would be used to remove dams after the beaver were removed using other methods. WS would only use binary explosives to remove beaver dams. Binary explosives consist of two components that are contained separately. The two components of binary explosives are ammonium nitrate and nitro-methane or nitro-methane and aluminum powder, which are not classified as explosives until the two components are mixed. Therefore, binary explosives are subject to fewer regulations and controls because they are packaged separately. However, once mixed, binary explosives are considered high explosives and subject to all applicable federal and state requirements. When used to remove beaver dams, the two components would not be mixed until ready for use at the site where the dam was located. Detonating cord and detonators are also considered explosives and WS must adhere to all applicable state and federal regulations for storage, transportation, and handling. All WS' explosive specialists are required to attend extensive explosive safety training and spend time with a certified explosive specialist in the field prior to obtaining certification. Only well trained, certified WS' employees and closely supervised professional wildlife biologist would use explosives. Explosive handling and use procedures follow the rules and guidelines set forth by the Institute of Makers of Explosives, which is the safety arm of the commercial explosive industry in the United States and Canada. WS also adheres to transportation and storage regulations from state and federal agencies, such as Occupational Safety and Health Association, Bureau of Alcohol, Tobacco, and Firearms, and the Department of Transportation.

APPENDIX C
FEDERAL THREATENED, ENDANGERED, OR CANDIDATE SPECIES IN GEORGIA

Common Name	Scientific Name	Status†	Determination‡
Animals			
Invertebrates			
Purple bankclimber	*Elliptoideus sloatianus*	T	MANLAA
Fine-lined pocketbook	*Hamiota altilis*	T	MANLAA
Alabama moccasinshell	*Medionidus acutissimus*	T	MANLAA
Fat three-ridge	*Amblema neislerii*	E	MANLAA
Upland combshell	*Epioblasma metastriata*	E	MANLAA
Southern acornshell	*Epioblasma othcaloogensis*	E	MANLAA
Shiny-rayed pocketbook	*Hamiota subangulata*	E	MANLAA
Coosa moccasinshell	*Medionidus parvulus*	E	MANLAA
Gulf moccasinshell	*Medionidus penicillatus*	E	MANLAA
Ochlockonee moccasinshell	*Medionidus simpsonianus*	E	MANLAA
Southern clubshell	*Pleurobema decisum*	E	MANLAA
Southern pigtoe	*Pleurobema georgianum*	E	MANLAA
Oval pigtoe	*Pleurobema pyriforme*	E	MANLAA
Triangular kidneyshell	*Ptychobranchus greeni*	E	MANLAA
Altamaha spinymussel	*Elliptio spinosa*	E	MANLAA
Georgia pigtoe	*Pleurobema hanleyianum*	E	MANLAA
Interrupted rocksnail	*Leptoxis foremani*	E	MANLAA
Reptiles and Amphibians			
Green sea turtle	*Chelonia mydas*	T	MANLAA
Loggerhead sea turtle	*Caretta caretta*	T	MANLAA
Hawksbill sea turtle	*Eretmochelys imbricata*	E	MANLAA
Kemp’s Ridley sea turtle	*Lepidochelys kempii*	E	MANLAA
Leatherback sea turtle	*Dermochelys coriacea*	E	MANLAA
Frosted Flatwoods salamander	*Ambystoma cingulatum*	T	MANLAA
Reticulated Flatwoods salamander	*Ambystoma bishopi*	E	MANLAA
Striped Newt	*Notophthalmus perstriatus*	C	MANLAA
Eastern indigo snake	*Drymarchon corais couperi*	T	MANLAA
Gopher tortoise	*Gopherus polyphemus*	C	--*
Bog turtle	*Clemmys muhlenbergii*	T	MANLAA
Fish			
Blue shiner	*Cyprinella caerulea*	T	MANLAA
Cherokee darter	*Etheostoma scotti*	T	MANLAA
Goldline darter	*Percina aurolineata*	T	MANLAA
Snail darter	*Percina tanasi*	T	MANLAA
Etowah darter	*Etheostoma etowahae*	E	MANLAA
Amber darter	*Percina antesella*	E	MANLAA
Conasauga logperch	*Percina jenkinsi*	E	MANLAA
Sicklefin redhorse	*Moxostoma* sp.	C	MANLAA
Smalltooth sawfish	*Pristis pectinata*	E	NE
Shortnose sturgeon	*Acipenser brevirostrum*	E	NE
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	T	NE
Mammals			

Common Name	Scientific Name	Status[†]	Determination[‡]
Gray bat	*Myotis grisescens*	E	NE
Indiana bat	*Myotis sodalis*	E	MANLAA
Northern long-eared bat	*Myotis septentrionalis*	T	MANLAA
West Indian manatee	*Trichechus manatus*	E	NE
Humpback whale	*Megaptera novaeangliae*	E	NE
Right whale	*Eubalaena glacialis*	E	NE
Finback whale	*Balaenoptera physalus*	E	NE
Birds			
Piping plover	*Charadrius elodus*	T	MANLAA
Kirtland's warbler	*Dendroica kirtlandii*	E	NE
Wood stork	*Mycteria americana*	E	MANLAA
Red-cockaded woodpecker	*Picoides borealis*	E	MANLAA
Red Knot	*Calidris canutus rufa*	T	MANLAA
Flowering Plants			
Little Amphianthus	*Amphianthus pusillus*	T	MANLAA
Swamp pink	*Helonias bullata*	T	MANLAA
Small whorled pogonia	*Isotria medeoloides*	T	MANLAA
Mohr's Barbara button	*Marshallia mohrii*	T	MANLAA
Kral's water-plantain	*Sagittaria secundifolia*	T	MANLAA
Large-flowered skullcap	*Scutellaria montana*	T	MANLAA
Virginia spiraea	*Spiraea virginiana*	T	MANLAA
Hairy rattleweed	*Baptisia arachnifera*	E	MANLAA
Smooth coneflower	*Echinacea laevigata*	E	MANLAA
Black-spored quillwort	*Isoetes melanospora*	E	MANLAA
Mat-forming quillwort	*Isoetes tegetiformans*	E	MANLAA
Pondberry	*Lindera melissifolia*	E	MANLAA
Canby's dropwort	*Oxypolis canbyi*	E	MANLAA
Harperella	*Ptilimnium nodosum*	E	MANLAA
Michaux's sumac	*Rhus michauxii*	E	MANLAA
Green pitcher plant	*Sarracenia oreophila*	E	MANLAA
American Chaffseed	*Schwalbea americana*	E	MANLAA
Fringed campion	*Silene polypetala*	E	MANLAA
Cooley's meadowrue	*Thalictrum cooleyi*	E	MANLAA
Florida torreya	*Torreya taxifolia*	E	MANLAA
Persistent trillium	*Trillium persistens*	E	MANLAA
Relict trillium	*Trillium reliquum*	E	MANLAA
Tennessee yellow-eyed grass	*Xyris tennesseensis*	E	MANLAA
Alabama leather flower	*Clematis socialis*	E	MANLAA
Georgia rockcress	*Arabis georgiana*	T	MANLAA
White fringeless orchid	*Platanthera integrilabia*	PT	MANLAA
Whorled sunflower	*Helianthus verticillatus*	E	MANLAA
Lichens			
Rock gnome lichen	*Gymnoderma lineare*	E	NE

[†]T=Threatened; E=Endangered; C=Candidate; PT=Proposed Threatened

[‡]NE=No effect; MANLAA=May affect, not likely to adversely affect

*If the USFWS places the gopher tortoise on the List of Endangered and Threatened Wildlife, the WS program in Georgia would re-initiate consultation with the USFWS.

APPENDIX D
STATE THREATENED AND ENDANGERED SPECIES

Amphibians		
Ambystoma cingulatum	Frosted Flatwoods Salamander	T
Ambystoma bishop	Reticulated Flatwoods Salamander	T
Amphiuma pholeter	One-toed Amphiuma	R
Aneides aeneus	Green Salamander	R
Cryptobranchus alleganiensis	Hellbender	T
Gyrinophilus palleucus	Tennessee Cave Salamander	T
Haideotriton wallacei	Georgia Blind Salamander	T
Notophthalmus perstriatus	Striped Newt	T
Plethodon petraeus	Pigeon Mountain Salamander	R
Lithobates capito	Gopher Frog	R
Fishes		
Acipenser brevirostrum	Shortnose Sturgeon	E
Acipenser oxyrinchus	Atlantic Sturgeon	E
Alosa alabamae	Alabama Shad	T
Ameiurus serracanthus	Spotted Bullhead	R
Chrosomus tennesseensis	Tennessee Dace	E
Cyprinella caerulea	Blue Shiner	E
Cyprinella callitaenia	Bluestripe Shiner	T
Cyprinella xaenura	Altamaha Shiner	T
Ellasoma okatie	Bluebarred Pygmy Sunfish	E
Enneacanthus chaetodon	Blackbanded Sunfish	E
Erimystax insignis	Blotched Chub	E
Etheostoma brevirostrum	Holiday Darter	E
Etheostoma chlorobranchium	Greenfin Darter	T
Etheostoma chuckwachatte	Lipstick Darter	E
Etheostoma ditrema	Coldwater Darter	E
Etheostoma duryi	Blackside Snubnose Darter	R
Etheostoma etowahae	Etowah Darter	E
Etheostoma parvipinne	Goldstripe Darter	R
Etheostoma rupestre	Rock Darter	R
Etheostoma scotti	Cherokee Darter	T
Etheostoma tallapoosae	Tallapoosa Darter	R
Etheostoma trisella	Trispot Darter	E
Etheostoma vulneratum	Wounded Darter	E

Fundulus bifax	Stippled Studfish	E
Fundulus catenatus	Northern Studfish	R
Hemitremia flammea	Flame Chub	E
Hybopsis lineapunctata	Lined Chub	R
Ichthyomyzon bdellium	Ohio Lamprey	R
Lucania goodei	Bluefin Killifish	R
Macrhybopsis sp.	Coosa Chub	E
Micropterus notius	Suwannee Bass	R
Moxostoma carinatum	River Redhorse	R
Moxostoma robustum	Robust Redhorse	E
Moxostoma sp.	Sicklefin Redhorse	E
Notropis ariommus	Popeye Shiner	E
Notropis asperifrons	Burrhead Shiner	T
Notropis hypsilepis	Highscale Shiner	R
Notropis photogenis	Silver Shiner	E
Notropis scepticus	Sandbar Shiner	R
Noturus eleutherus	Mountain Madtom	E
Noturus munitus	Frecklebelly Madtom	E
Percina antesella	Amber Darter	E
Percina aurantiaca	Tangerine Darter	E
Percina aurolineata	Goldline Darter	E
Percina jenkinsi	Conasauga Logperch	E
Percina lenticula	Freckled Darter	E
Percina sciera	Dusky Darter	R
Percina shumardi	River Darter	E
Percina crypta	Halloween Darter	T
Percina sp. cf. macrocephela	Muscadine Darter	R
Percina kusha	Bridled Darter	E
Percina squamata	Olive Darter	E
Percina tanasi	Snail Darter	E
Phenacobius crassilabrum	Fatlips Minnow	E
Phenacobius uranops	Stargazing Minnow	T
Pteronotropis euryzonus	Broadstripe Shiner	R
Pteronotropis welaka	Bluenose Shiner	T
Typhlichthys subterraneus	Southern Cavefish	E
Birds		
Peucaea aestivalis	Bachman's Sparrow	R

Ammodramus henslowii	Henslow’s Sparrow	R
Calidris canutus	Red Knot	R
Campephilus principalis	Ivory-billed Woodpecker	E
Charadrius melodus	Piping Plover	T
Charadrius wilsonia	Wilson's Plover	T
Corvus corax	Common Raven	R
Setophaga cerulean	Cerulean Warbler	R
Setophaga kirtlandii	Kirtland's Warbler	E
Elanoides forficatus	Swallow-tailed Kite	R
Falco peregrinus	Peregrine Falcon	R
Falco sparverius paulus	Southeastern American Kestrel	R
Haematopus palliatus	American Oystercatcher	R
Haliaeetus leucocephalus	Bald Eagle	T
Mycteria americana	Wood Stork	E
Picoides borealis	Red-cockaded Woodpecker	E
Rynchops niger	Black Skimmer	R
Sterna antillarum	Least Tern	R
Gelochelidon nilotica	Gull-billed Tern	T
Vermivora chrysoptera	Golden-winged Warbler	E
Invertebrates		
Alasmindonta arcula	Altamaha Arcmussel	T
Alasmindonta triangulate	Southern Elktoe	E
Amblema neislerii	Fat Threeridge	E
Anodonta heardi	Apalachicola Floater	R
Anodontoides radiatus	Rayed Creekshell	T
Cambarus coosawattae	Coosawattee Crayfish	E
Cambarus cryptodytes	Dougherty Plain Cave Crayfish	T
Cambarus cymatilis	Conasauga Blue Burrower	E
Cambarus doughertyensis	Dougherty Burrowing Crayfish	E
Cambarus englishi	Tallapoosa Crayfish	R
Cambarus extraneus	Chickamauga Crayfish	T
Cambarus fasciatus	Etowah Crayfish	T
Cambarus georgiae	Little Tennessee Crayfish	E
Cambarus harti	Piedmont Blue Burrower	E
Cambarus howardi	Chattahoochee Crayfish	T
Cambarus parrishi	Hiwassee Headwaters Crayfish	E
Cambarus scotti	Chattooga River Crayfish	T

Cambarus speciosius	Beautiful Crayfish	E
Cambarus strigosus	Lean Crayfish	T
Cambarus truncatus	Oconee Burrowing Crayfish	T
Cambarus unestami	Blackbarred Crayfish	T
Cordulegaster sayi	Say's Spiketail	T
Distocambarus devexus	Broad River Burrowing Crayfish	T
Elliptio arca	Alabama Spike	E
Elliptio arctata	Delicate Spike	E
Elliptio purpurella	Inflated Spike	T
Elliptio spinosa	Altamaha Spinymussel	E
Elliptoideus sloatianus	Purple Bankclimber	T
Epioblasma metastriata	Upland Combshell	E
Epioblasma othcaloogensis	Southern Acornshell	E
Fusconaia masoni	Atlantic Pigtoe Mussel	E
Gomphus cansanguis	Cherokee Clubtail	T
Hamiota altilis	Fine-lined Pocketbook	T
Hamiota subangulata	Shinyrayed Pocketbook	E
Leptoxis foremani	Interrupted Rocksnail	E
Medionidus acutissimus	Alabama Moccasinshell	T
Medionidus parvulus	Coosa Moccasinshell	E
Medionidus penicillatus	Gulf Moccasinshell	E
Medionidus simpsonianus	Ochlockonee Moccasinshell	E
Nicrophorus americanus	American Burying Beetle	E
Ophiogomphus edmundo	Edmund's Snaketail	E
Pleurobema decisum	Southern Clubshell	E
Pleurobema georgianum	Southern Pigtoe	E
Pleurobema hanleyianum	Georgia Pigtoe	E
Pleurobema pyriforme	Oval Pigtoe	E
Procambarus gibbus	Muckalee Crayfish	T
Procambarus verrucosus	Grainy Crayfish	R
Procambarus versutus	Sly Crayfish	R
Ptychobranchus foremanianus	Rayed Kidneyshell	E
Strophitus connasaugaensis	Alabama Creekmussel	E
Toxolasma pullus	Savannah Lilliput	T
Mammals		
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	R
Eubalaena glacialis	Northern Atlantic Right Whale	E

Geomys pinetis	Southeastern Pocket Gopher	T
Megaptera novaeangliae	Humpback Whale	E
Myotis grisescens	Gray Bat	E
Myotis septentrionalis	Northern Bat	T
Myotis sodalis	Indiana Bat	E
Neofiber alleni	Round-tailed Muskrat	T
Puma concolor coryi	Florida Panther	E
Sylvilagus obscurus	Appalachian Cottontail	R
Trichechus manatus	West Indian Manatee	E
Plants		
Acmispon helleri	Carolina Trefoil	E
Allium speculae	Flatrock Onion	T
Alnus maritime subsp. georgiansis	Georgia Alder	T
Amorpha georgiana	Georgia Indigo-bush	E
Amphianthus pusillus	Pool Sprite	T
Arabis georgiana	Georgia Rockcress	T
Arnoglossum diversifolium	Variable-leaf Indian-plantain	T
Asclepias purpurascens	Purple Milkweed	R
Asplenium heteroresiliens	Marl Spleenwort	T
Astragalus michauxii	Sandhill Milk-vetch	T
Aureolaria patula	Spreading Yellow Foxglove	T
Balduina atropurpurea	Purple Honeycomb Head	R
Baptisia arachnifera	Hairy Rattleweed	E
Berberis Canadensis	American Barberry	E
Brickellia cordifolia	Heartleaf Brickellia	T
Calamagrostis porteri	Porter's Reed-grass	R
Calamintha ashei	Ohoopee Dunes Wild Basil	T
Carex baltzellii	Baltzell Sedge	E
Carex biltmoreana	Granite Dome Sedge	T
Carex dasycarpa	Velvet Sedge	R
Carex misera	Wretched Sedge	T
Carex rodfordii	Radford's Sedge	T
Carya myristiciformis	Nutmeg Hickory	R
Ceratiola ericoides	Sandhill Rosemary	T
Chamaecyparis thyoides	Atlantic White-cedar	R
Chelone cuthbertii	Cuthbert's Turtlehead	T
Clematis fremontii	Fremont's Leatherflower	E

Clematis morefieldii	Morefield's Leatherflower	E
Clematis socialis	Alabama Leatherflower	E
Convallaria majuscule	American Lily-of-the-valley	R
Coreopsis integrifolia	Floodplain Tickseed	T
Coreopsis latifolia	Broadleaf Tickseed	R
Coreopsis triflora	Three-flowered Hawthorn	T
Croomia pauciflora	Croomia	T
Cuscuta harperi	Harper Dodder	E
Cymophyllus fraserianus	Fraser Sedge	T
Cypripedium acaule	Pink Ladyslipper	U
Cyripedium kentuckiense	Kentucky Ladyslipper	E
Cypripedium parviflorum	Yellow Ladyslipper	R
Desmodium ochroleucum	Cream-flowered Trick-trefoil	T
Dichanthelium hirstii	Hirst's Witch Grass	E
Dicerandera radfordiana	Radford's Mint	E
Draba aprica	Sun-loving Draba	E
Echinacea laevigata	Smooth Purple Coneflower	E
Elliottia racemosa	Georgia Plume	T
Epidendrum conopseum	Greenfly Orchid	U
Eriocaulon koernickianum	Dwarf Hatpins	E
Fimbristylis perpusilla	Harper Fimbry	E
Forestiera godfreyi	Godfrey's Wild Privet	E
Foresteria segregate	Florida Wild Privet	R
Fothergilla gardenii	Dwarf Witch-alder	T
Fothergilla major	Mountain Witch-alder	T
Gentianopsis crinita	Fringed Gentian	T
Gymnoderma lineare	Rock Gnome Lichen	E
Hartwrightia floridana	Hartwrightia	T
Helianthus verticillatus	Whorled Sunflower	E
Hydrastis canadensis	Goldenseal	E
Hymenocallis coronaria	Shoals Spiderlily	T
Illicium floridanum	Florida Anise	E
Isoetes melanospora	Black-spored Quillwort	E
Isoetes tegetiformans	Mat-forming Quillwort	E
Isotria medeoloides	Small Whorled Pogonia	T
Jamesianthus alabamensis	Alabama Warbonnet	E
Jeffersonia diphylla	Twinleaf	R

Kalmia carolina	Carolina Bog Laurel	T
Leavenworthia exigua var. exigua	Least Gladecress	T
Leiophyllum buxifolium	Sand-myrtle	T
Leitneria floridana	Corkwood	T
Lilium michiganense	Michigan Lily	R
Lilium philadelphicum	Wood Lily	E
Lindera melissifolia	Pondspicebush	E
Litsea aestivalis	Pondspice	R
Lysimachia fraseri	Fraser Loosestrife	R
Lythrum curtissii	Curtiss Loosestrife	T
Macbridea caroliniana	Carolina Bogmint	R
Macranthera flammea	Hummingbird Flower	T
Marshallia mohrii	Coosa Barbara Buttons	T
Marshallia ramosa	Pineland Barbara Buttons	R
Matelea alabamensis	Alabama Milkvine	T
Matelea pubiflora	Trailing Milkvine	R
Megaceros aenigmaticus	Bighorn Hornwort	T
Monotropis odorata	Sweet Pinesap	T
Morella inodora	Odorless Bayberry	T
Myriophyllum laxum	Lax Water Milfoil	R
Naja filifolia	Narrowleaf Naiad	E
Nestronia umbellula	Indian Olive	R
Neviusia alabamensis	Alabama Snow-wreath	T
Oxypolis canbyi	Canby Dropwort	E
Pachysandra procumbens	Allegheny-spurge	R
Packera millefolia	Blue Ridge Golden Ragwort	T
Paronychia virginica	Yellow Nailwort	T
Pedicularis lanceolata	Swamp Louswort	E
Pediomelum peidmontanum	Dixie Mountain Breadroot	E
Penstemon dissectus	Cutleaf Beardtongue	R
Pinguicula primuliflora	Clearwater Butterwort	T
Pityopsis pinifolia	Sandhill Golden-aster	R
Platanthera integrilabia	Monkeyface Orchid	T
Prenanthes barbata	Barbed Rattlesnake Root	R
Pteroglossaspis ecristata	Crestless Plume Orchid	T
Ptilimnium nodosum	Harperella	E
Quercus oglethorpensis	Oglethorpe Oak	T

Rhododendron prunifolium	Plumleaf Azalea	T
Rhus michauxii	Dwarf Sumac	E
Rhynchospora solitaria	Solitary Breakrush	E
Rudbeckia auriculata	Swamp Black-eyed Susan	E
Rudbeckia heliopsidis	Little River Black-eyed Susan	T
Sabatia capitata	Cumberland Rose Gentian	R
Sageretia minutiflora	Climbing Buckthorn	T
Sagittaria secundifolia	Kral's Water-plantain	T
Salix floridana	Florida Willow	E
Sanguisorba canadensis	Canada Burnet	T
Sapindus marginatus	Soapberry	R
Sarracenia flava	Yellow Flytrap	U
Sarracenia leucophylla	Whitetop Pitcherplant	E
Sarracenia minor	Hooded Pitcherplant	U
Sarracenia oreophila	Green Pitcherplant	E
Sarracenia psittacina	Parrot Pitcherplant	T
Sarracenia purpurea	Purple Pitcherplant	E
Sarracenia rosea	Rose Pitcherplant	E
Sarracenia rubra	Sweet Pitcherplant	T
Schisandra glabra	Bay Starvine	T
Schwalbea americana	Chaffseed	E
Scutellaria montana	Large-flowered Skullcap	T
Scutellaria ocmulgee	Ocmulgee Skullcap	T
Sedum nevii	Nevius Stonecrop	T
Sedum pusillum	Granite Stonecrop	T
Shortia galacifolia	Oconee Bells	E
Sibbaldiopsis tridentata	Mountain Cinquefoil	E
Sideroxulon macrocarpum	Ohoopee Bumelia	R
Sideroxylon thornei	Swamp Buckthorn	E
Silene ovata	Ovate Catchfly	R
Silene polypetala	Fringed Campion	E
Silene regia	Royal Catchfly	E
Solidago simulans	Cliffside Goldenrod	E
Spiraea virginiana	Virginia Spirea	T
Spiranthes magnicamporum	Great Plains Ladies-tresses	E
Stewartia malacodendron	Silky Camellia	R
Streptopus lanceolatus	Rosy Twisted Stalk	T

Stylisma pickeringii var. pickeringii	Pickering Morning-glory	T
Symphyotrichum georgianum	Georgia Aster	T
Thalictrum cooleyi	Cooley Meadowrue	E
Thalictrum debile	Trailing Meadowrue	T
Thaspium pinnatifidum	Glade Meadowparsnip	E
Torreya taxifolia	Florida Torreya	E
Trientalis borealis	Starflower	E
Trillium persistens	Persistent Trillium	E
Trillium pusillum	Dwarf Trillium	E
Trillium reliquum	Relict Trillium	E
Tsuga caroliniana	Carolina Hemlock	E
Veratrum woodii	Ozark Bunchflower	R
Viburnum bracteatum	Limerock Arrow-wood	E
Waldsteinia lobata	Barren Strawberry	R
Xerophyllum asphodeloides	Eastern Turkeybeard	R
Xyris tennesseensis	Tennessee Yellow-eyed Grass	E
Reptiles		
Caretta caretta	Loggerhead Sea Turtle	E
Chelonia mydas	Green Sea Turtle	T
Clemmys guttata	Spotted Turtle	U
Dermochelys coriacea	Leatherback Sea Turtle	E
Drymarchon couperi	Eastern Indigo Snake	T
Eretmochelys imbricata	Hawksbill Sea Turtle	E
Glyptemys muhlenbergii	Bog Turtle	E
Gopherus polyphemus	Gopher Tortoise	T
Graptemys barbouri	Barbour's Map Turtle	T
Graptemys geographica	Common Map Turtle	R
Graptemys pulchra	Alabama Map Turtle	R
Heterodom simus	Southern Hognose Snake	T
Lepidochelys kempii	Kemp's Ridley Sea Turtle	E
Macrochelys temminckii	Alligator Snapping Turtle	T
Malaclemys terrapin	Diamondback Terrapin	U
Ophisaurus mimicus	Mimic Glass Lizard	R

T=Threatened; R=Rare; E=Endangered; U=Unusual

APPENDIX E
CRITERIA FOR BEAVER DAM BREACHING/REMOVAL

Beaver dam breaching is generally conducted to maintain existing stream channels and drainage patterns, and reduce flooding. Beaver dams are made from natural debris such as logs, sticks, and mud that beaver take from the area. This portion would be dislodged during a beaver dam breaching operation. The impoundments that WS could remove would normally be from recent beaver activity and would not have been in place long enough to take on the qualities of a true wetland (*i.e*., hydric soils, aquatic vegetation, preexisting function). Beaver dam breaching and removal by hand does not affect the substrate or the natural course of the stream and returns the area back to its preexisting condition with similar flows and circulations since the impounded water can be released slowly over time.

Wetlands are recognized by three characteristics: hydric soils, hydrophytic vegetation, and general hydrology. Hydric soils either are composed of, or have a thick surface layer of, decomposed plant materials (muck); sandy soils have dark stains or streaks from organic material in the upper layer where plant material has attached to soil particles. In addition, hydric soils may be bluish gray or gray below the surface or brownish black to black and have the smell of rotten eggs. Wetlands also have hydrophytic vegetation present such as cattails, bulrushes, willows, sedges, and water plantains. The final indicator is general hydrology which includes standing and flowing water or waterlogged soils during the growing season; high water marks are present on trees and drift lines of small piles of debris are usually present. Beaver dams usually will develop a layer of organic material at the surface because siltation can occur rapidly, but aquatic vegetation and high water marks (a new high water mark is created by the beaver dam) are usually not present. However, cattails and willows can show up rapidly if they are in the vicinity, but most hydrophytic vegetation takes time to establish.

When a dam is removed or breached, debris could be discharged into the water. The debris that ends up in the water would be considered "*incidental fallback*" or discharge fill. However, in most beaver dam removal or breaching operations, the material that would be displaced, if considered to be discharge, would be exempt from permit requirements under exemptions in 33 CFR 323 or under the NWP discussed in 33 CFR 330. If beaver dams could not be breached or removed under exemptions in 33 CFR 323 or pursuant to a NWP, then the property owner or manager would be responsible for seeking the necessary permit under Section 401 and Section 404 of the CWA. WS' personnel would survey the beaver dam site and impoundment and determine whether conditions exist suggesting that the area may be a wetland as defined above. In addition, WS' personnel would work to estimate the age of the beaver dam (*e.g*., asking the landowner, using aerial photos). The characteristics of the impoundment and the age of the dam would be used to determine whether Swampbuster, Section 404 permit exemptions, or NWPs allow removal of the dam. If not, the landowner would be required to obtain a Section 404 permit before the dam could be removed. In those cases, the EPA and/or the United States Army Corps of Engineers would be responsible for determining if the beaver dam and associated areas were actual wetlands and if so, whether to issue a permit to remove the dam.

Federal Regulations- United States Army Corps of Engineers

Under Section 404 of the CWA, the Corps of Engineers regulates all waters of the United States. Because beaver dams involve waters of the United States, dam breaching is regulated under Section 404 of the CWA. In most beaver dam breaching operations, the material that is displaced would be exempt from permitting or included in a NWP in accordance with Section 404 of the CWA (see 33 CFR Part 323, 33 CFR 330). A permit would be required if the impoundment caused by a beaver dam was not covered under a NWP or permitting exemption and was considered jurisdictional based on the Corps of Engineers 1987 Delineation Manual.

The following explains Section 404 exemptions and conditions that pertain to the breaching of beaver dams and are WS' interpretation of the NWPs.

33 CFR 323 - Permits For Discharges of Dredged or Fill Material into Waters of the United States. This regulation provides guidance to determine whether certain activities require permits under Section 404.

Part 323.4 Discharges not requiring permits. This section establishes exemptions for discharging certain types of fill into waters of the United States without a permit. Certain minor drainage activities connected with normal farming, ranching, and silviculture activities where they have been established do not require a permit as long as these drainages do not include the immediate or gradual conversion of a wetland to a non-wetland. Specifically, part (a)(1)(iii)(C)(i) states, "*...fill material incidental to connecting upland drainage facilities (e.g., drainage ditches) to waters of the United States, adequate to effect the removal of excess soil moisture from upland croplands...*". This indicates that beaver dams that block ditches, canals, or other structures designed to drain water from upland crop fields can be breached without a permit.

Moreover, (a)(1)(iii)(C)(iv) states the following types of activities do not require a permit "*The discharges of dredged or fill materials incidental to the emergency removal of sandbars, gravel bars, or other similar blockages which are formed during flood flows or other events, where such blockages close or constrict previously existing drainage ways and, if not promptly removed, would result in damage to or loss of existing crops or would impair or prevent the plowing, seeding, harvesting or cultivating of crops on land in established use for crop production. Such removal does not include enlarging or extending the dimensions of, or changing the bottom elevations of, the affected drainage way as it existed prior to the formation of the blockage. Removal must be accomplished within one year of discovery of such blockages in order to be eligible for exemption*."; this allows the breaching of beaver dams in natural streams to restore drainage of agricultural lands within one year of discovery.

Part 323.4 (a) (2) allows "*Maintenance, including emergency reconstruction of recently damaged parts, of currently serviceable structures such as dikes, dams, levees, groins, riprap, breakwaters, causeways, bridge abutments or approaches, and transportation structures. Maintenance does not include any modification that changes the character, scope, or size of the original fill design. Emergency reconstruction must occur within a reasonable period of time after damage occurs in order to qualify for this exemption*."; this allows beaver dams to be breached without a permit where they have resulted in damage to roads, culverts, bridges, or levees if it is done in a reasonable amount of time.

33 CFR 330 - Nationwide Permit Program. The United States Army Corps of Engineers, Chief of Engineers is authorized to grant certain dredge and fill activities on a nationwide basis if they have minimal impact on the environment. The NWPs are listed in Appendix A of 33 CFR 330 and permittees must satisfy all terms and conditions established to qualify for their use. Individual beaver dam breaching by WS may be covered by any of the following NWPs if not already exempted from permit requirements by the regulations discussed above. WS complies with all conditions and restrictions placed on NWPs for any instance of beaver dam breaching done under a specific NWP.

NWPs can be used except in any component of the National Wild and Scenic River System such as waterways listed as an "*Outstanding Water Resource*", or any water body, which is part of an area designated for "*Recreational or Ecological Significance*".

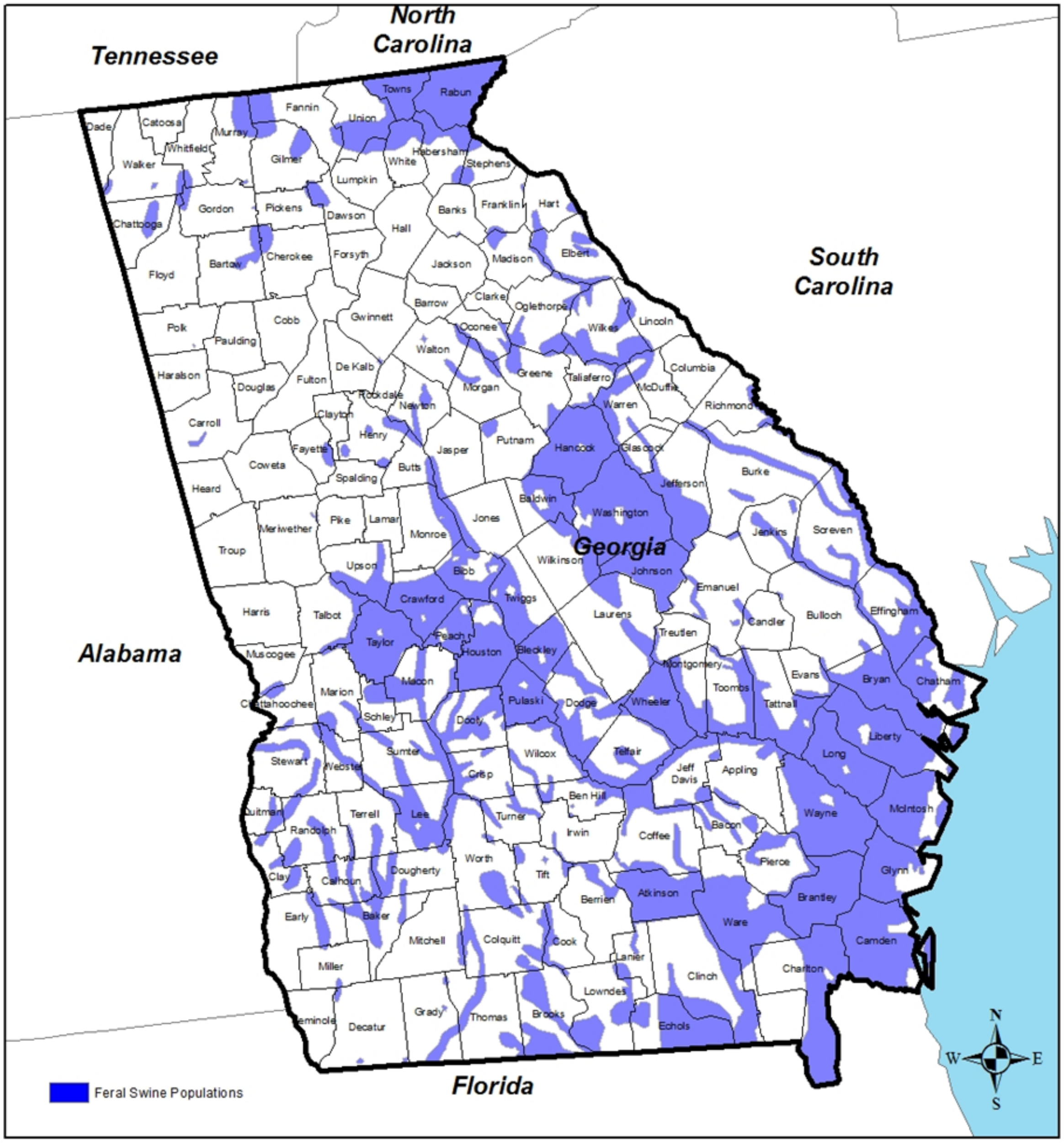
The United States Army Corps of Engineers reissue the NWPs every 5 years with some modifications to the NWPs and their general conditions. The effective date of the current NWPs is March 19, 2012. These NWPs will expire on March 18, 2017.

NWP 18 - Minor Discharges: This NWP authorizes minor discharges of dredged and fill material, including the breaching of beaver dams, into all waters of the United States provided the activity meets specific criteria. One of the criteria is that the quantity of discharge and the volume of excavated area does not exceed 10 cubic yards below the plane of the ordinary high water mark (this is normally well below the level of the beaver dam) or is in a "*special aquatic site*" (wetlands, mudflats, vegetated shallows, riffle and pool complexes, sanctuaries, and refuges). The District Engineer must be "*notified*" (general conditions for notification apply), if the discharge is between 10-25 cubic yards for a single project or the project is in a special aquatic site and less than 1/10 of an acre is expected to be lost. If the values are greater than those given, a permit is required. Beaver dams rarely would exceed 5 cubic yards of backfill into the waters of the United States. Beaver dams periodically may be breached in a special aquatic area, but normally the aquatic site will be returned to normal. However, if beaver dam breaching is going to exceed the noted impact to waters of the United States for the NWP, including wetlands, then an Individual Permit must be obtained from the District Engineer.

NWP 27 - Aquatic Habitat Restoration, Establishment, and Enhancement Activity: This NWP allows for the discharge of dredge and fill in waters of the United States for activities associated with the restoration of wetland and riparian areas with certain restrictions. On non-federal public and private lands, the owner must have: a binding agreement with the USFWS or the USDA-Natural Resources Conservation Service to conduct restoration; a voluntary wetland restoration project documented by Natural Resources Conservation Service; or notify the District Engineer according to "*notification*" procedures. On federal lands, including United States Army Corps of Engineers and USFWS, wetland restoration can take place without any contract or notification. This NWP "*...applies to restoration projects that serve the purpose of restoring "natural" wetland hydrology, vegetation, and function to altered and degraded non-tidal wetlands and "natural" functions of riparian areas. This NWP does not authorize the conversion of natural wetlands to another aquatic use...*". If operating under this permit, the breaching of a beaver dam would be allowed as long as it was not a true wetland, and for non-federal public and private lands the appropriate agreement, project documentation, or notification is in place.

A quick response immediately resulting from permitting requirements can be critical to the success of minimizing or preventing damage. Exemptions contained in the above regulations or NWPs provide for the breaching of the majority of beaver dams that WS encounters. The primary determination that must be made by WS personnel is whether a beaver impounded area has become a true wetland or is just a flooded area. The flexibility allowed by these exemptions and NWPs is important for the efficient and effective resolution of many beaver damage problems because damage escalates rapidly in many cases the longer an area remains flooded.

APPENDIX F
CURRENT DISTRIBUTION OF FERAL SWINE IN GEORGIA, 2013



Feral/Wild Swine Populations 2013
Georgia

This feral swine distribution map was prepared from data independently compiled by state and territorial fish and wildlife management agencies, agriculture agencies, and universities of the United State in cooperation with the Southeastern Cooperative Wildlife Disease Study, College of Veterinary Medicine, University of Georgia. Support for this project was through Cooperative Agreement Numbers 11-9113-1156-CA and 13-9613-0032-CA, Veterinary Services, Animal and Plant Health Inspection Service, U.S. Department of Agriculture.

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