ENVIRONMENTAL ASSESSMENT

MAMMAL DAMAGE MANAGEMENT IN THE KENTUCKY WILDLIFE SERVICES PROGRAM

UNITED STATES DEPARTMENT OF AGRICULTURE (USDA)
ANIMAL AND PLANT HEALTH INSPECTION SERVICE (APHIS)
WILDLIFE SERVICES (WS)

IN COOPERATION WITH

U. S. TENNESSEE VALLEY AUTHORITY (TVA)

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ACRONYMS

ADC	Animal Damage Control
AMDUCA	Animal Medicinal Drug Use Clarification Act of 1994
AP	Aluminum Phosphide
APHIS	Animal and Plant Health Inspection Service
ATF	Bureau of Alcohol, Tobacco, and Firearms
AVMA	American Veterinary Medical Association
BMP	Best Management Practice
BO	Biological Opinion
CDC	Centers for Disease Control and Prevention
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CY	Calendar Year
DEA	Drug Enforcement Agency
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FY	Fiscal Year
GnRH	Gonadotropin-Releasing Hormone
IWDM	Integrated Wildlife Damage Management
KAR	Kentucky Administrative Regulations
KDA	Kentucky Department of Agriculture
KDEP	Kentucky Department for Environmental Protection
KDF	Kentucky Department of Forestry
KDFWR	Kentucky Department of Fish and Wildlife Resources
KRS	Kentucky Revised Statutes
KSNPC	Kentucky State Nature Preserves Commission
MDM	Mammal Damage Management
MIS	Management Information System
MOU	Memorandum of Understanding
MSDS	Material Safety Data Sheets
NASS	National Agricultural Statistical Services
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOA	Notice of Availability
NRCS	Natural Resources Conservation Service
NWCO	Nuisance Wildlife Control Officer
NWP	Nationwide Permit
NWRC	National Wildlife Research Center
OSHA	Occupational Safety and Health Administration
PEP	Post - Exposure Prophylaxis
PZP	Porcine Zona Pellida
RPA	Reasonable and Prudent Alternative
RPM	Reasonable and Prudent Measures
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
TVA	Tennessee Valley Authority
USACE	United States Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
WDM	Wildlife Damage Management
WS	Wildlife Services
ZP	Zinc Phosphide

1.0 CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

Across the United States (U.S.), wildlife habitat has substantially changed as human populations have expanded and land has been transformed to meet varying human needs. Those changes often compete with wildlife and have inherently increased the potential for conflicts between wildlife and people. Some species of wildlife have adapted to, and thrive in, the presence of humans and the changes that have been made. Those species, in particular, are often responsible for the majority of conflicts between humans and wildlife. The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control (ADC) Final Environmental Impact Statement (FEIS) summarizes the relationship in American culture of wildlife values and wildlife damage in this way (USDA 1997):

> *"Wildlife has either positive or negative values, depending on varying human perspectives and circumstances . . . Wildlife generally is regarded as providing economic, recreational and aesthetic benefits . . . , and the mere knowledge that wildlife exists is a positive benefit to many people. However, the activities of some wildlife may result in economic losses to agriculture and damage to property . . . Sensitivity to varying perspectives and values is required to manage the balance between human and wildlife needs. In addressing conflicts, wildlife managers must consider not only the needs of those directly affected by wildlife damage but a range of environmental, sociocultural, and economic considerations as well."*

The USDA is authorized to protect American agriculture and other resources from damage associated with wildlife. This function is carried out by the USDA, APHIS, Wildlife Services (WS) [1] program. The primary authorities for the WS' program come from the Act of March 2, 1931 (46 Stat. 1468; 7 U.S.C. 426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 U.S.C. 426c. WS' activities are conducted in cooperation with other federal, state, and local agencies, as well as private organizations and individuals. This Environmental Assessment (EA) evaluates a portion of this responsibility, specifically, management of damage caused by mammals in Kentucky.

Wildlife damage management (WDM) is defined as the alleviation of damage or other problems caused by wildlife (Leopold 1933, The Wildlife Society 1990, Berryman 1991). WS uses an Integrated WDM (IWDM) approach, which is described in Volume 4, Chapter 1, pages 1-7 of the WS' FEIS (USDA 1997). This includes non-lethal strategies such as the modification of habitat and lethal removal of the target animal(s) or local populations.

This EA documents the analysis of the potential environmental effects of a proposed mammal damage management (MDM) program. This analysis relies on data contained in published documents (Appendix A), including WS' FEIS (USDA 1997). The FEIS contains detailed discussions of potential environmental impacts from methods that are used for MDM in Kentucky. The FEIS may be obtained by contacting the USDA, APHIS, WS Operational Support Staff at 4700 River Road, Unit 87, Riverdale, MD 20737-1234.

WS' mission, developed through a strategic planning process, is to *"provide leadership in wildlife damage management for the protection of America's agricultural, industrial and natural resources, and to safeguard public health and safety"* (USDA 1989). This is accomplished through:

- training of WDM professionals;
- development and improvement of strategies to reduce economic losses and threats to humans from wildlife;
- the collection, evaluation, and dissemination of management information;
- cooperative WDM programs;
- informing and educating the public on how to reduce wildlife damage; and

[1] Wildlife Services was previously known as the Animal Damage Control program. The name change became effective in 1997. Throughout this document, the acronyms "ADC" and "WS" refer to the same federally authorized program.

- providing technical advice and a source for limited-use management materials and equipment such as pesticides, cage traps, and pyrotechnics.

WS' Policy Manual[2] reflects this mission and provides guidance for engaging in WDM activities. Before WDM is conducted, WS and the appropriate landowner, administrator, or agency representative must sign *Agreements for Control* or WS' *Annual Work Plans*. WS cooperates with land managers and wildlife management agencies when appropriate and as requested, to combine efforts to effectively and efficiently resolve wildlife damage problems in compliance with all applicable federal, state, and local laws and Memoranda of Understanding (MOU) between WS and other agencies.

1.2 PURPOSE

This EA analyzes effects of a MDM program in Kentucky as it relates to the protection of agriculture, property, natural resources, and human health and safety. Normally, according to the APHIS procedures for implementing NEPA, individual WDM actions may be categorically excluded (7 CFR 372.5(c), 60 Fed. Reg. 6,000-6,003, 1995). This EA is being prepared to facilitate interagency coordination, to streamline program management, and to clearly communicate with the public the analysis of cumulative effects.

Mammal species addressed in this EA include: beaver (*Castor canadensis*), red and gray fox (*Vulpes vulpes* and *Urocyon cinereoargenteus*), muskrat (*Ondatra zibethicus*), raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), coyotes (*Canis latrans*), groundhogs (*Marmota monax*), Virginia opossums (*Didelphis virginianus*), cottontail rabbits (*Sylvilagus floridanus mearnsii*), feral cats (*Felis domesticus*), feral dogs (*Canis familiaris*), river otter (*Lutra canadensis*), tree squirrels (*Sciurus* spp.), black bear (*Ursus americanus*), bobcat (*Lynx rufus*), feral swine (*Sus scrofa*), mink (*Mustela vison*), chipmunk (*Tamiass striatus*), moles (*Scalopus aquaticus* and *Condylura cristata*), spotted skunk (*Spilogale putoris*), various bat species (See Table 4-2), and small rodents including voles (*Microtus* spp.), rats (*Rattus* spp.), and mice (*Mus musculus*, *Peromyscus* spp.).

1.3 NEED FOR ACTION

1.3.1 Summary of Proposed Action

The proposed action is to continue the current portion of the WS' program in Kentucky that responds to requests for MDM to protect agriculture, human health and safety, natural resources, and property in Kentucky. The WS' program in Kentucky responds to requests for assistance to minimize human health and safety threats and property damage in urban and rural environments. Primary species of concern related to damage in those environments are raccoons, coyotes, groundhogs, skunks, opossums, and beaver. Damage by those or other mammal species also may be addressed by WS in MDM programs aimed at reducing losses or the risk of loss to agricultural crops, livestock, timber, and any other agriculture-related resource. In addition, damage caused by any mammal species to natural resources, including threatened and endangered (T&E) species, wildlife, natural flora, parklands, recreation areas, and peculiar habitats may be addressed through programs conducted by WS. Elimination or alleviation of damage to property such as residential and non-residential buildings, water resources, dikes, dams, impoundments, drainages, landscape plantings, golf courses, grasses and turf, pets, zoo animals, trees, or any other properties would be an objective of WS' MDM programs considered under this EA.

To meet the goals previously described, WS' objective would be to attempt to respond to all requests for assistance with, at a minimum, technical assistance or self-help advice, or, where appropriate and when funding is available, direct damage management assistance in which WS conducts damage management actions. An IWDM approach would be implemented, which would allow use of any legal technique or method, used singly or in combination, to meet requester needs for resolving conflicts with mammals. Lethal methods used by WS could include shooting, trapping, snaring, and Food and Drug Administration (FDA) or Environmental Protection Agency (EPA)-approved chemicals. Non-lethal methods used by WS could include fencing, netting,

[2]WS Policy Manual - Provides guidance for WS' personnel to conduct wildlife damage management activities through Directives. WS' Directives referenced in this EA can be found in the manual but will not be referenced in the Literature Cited Section.

deterrents/repellents, exclusion, harassment, habitat alteration, or live-capture and translocation for some individuals of some species. Definitive objectives of WS' MDM program in Kentucky are discussed in Chapter 3 of this document. Appendix B provides a more detailed description of the methods that could be used under the proposed action.

1.3.2 Need for Mammal Damage Management to Protect Human Health and Safety

A considerable threat to human health is sometimes presented by disease organisms or parasites carried by some mammals, which are transmissible or infectious to humans. Those include viral, bacterial, mycotic (fungal), protozoal and rickettsial diseases. Several of those diseases are transmittable to humans. Table 1.1 shows the more typical diseases affecting humans that can be transmitted by mammals, in addition to diseases, which affect other animals, including domestic species.

Table 1.1 - Wildlife Diseases That Pose Potential Human Health Risks in the Southeastern United States (Davidson and Nettles 1997).

Disease	Causative Agent	Hosts
Anthrax	bacterium (*Bacillus antracis*)	cattle, sheep, horses, swine, white-tailed deer, dogs, cats
Dermatophilosis	bacterium (*Dermatophilus congolensis*)	mammals (wild and domestic)
Demodectic mange	mange mite (*Demodex odocoilei*)	white-tailed deer
Sarcoptic mange	mite *(Sarcoptes scabiei)*	red fox, coyotes, domestic dogs
Swine brucellosis	bacterium (*Brucella suis)*	swine
Trichinosis	nematode *(Trichinella spiralis)*	swine, bears, raccoons, fox, rats
Rabies	virus (Rhabidovirus)	all mammals (high risk wildlife: raccoons, fox, skunks, bats)
Visceral larval migrans	nematode (*Baylisascaris procyonis)*	raccoons, skunks
Leptospirosis	bacteria (*Leptospira interrogans*) over 180 different serovars	all mammals
Echinococcus infection	tapeworm (*Echinococcus multilocularis)*	fox, coyotes
Bovine Brucellosis	bacterium (*Brucela abortus)*	cattle (evidence from Texas that organism has infected coyotes that scavenged aborted fetuses and placentas of infected cattle)
Toxoplasmosis	protozoan parasite (*Toxoplasma ondii)*	cats are definitive hosts, mammals and birds are intermediate hosts
Spirometra infection	tapeworm, (*Spirometra mansonoides)*	bobcats, raccoons, fox, dogs, cats
Murine typhus	bacteria (*Rickettsia mooseri = R. typhi*)	rats, mice, as hosts for primary flea, louse or mite host
Giardiasis	protozoan parasite (*Giardia lamblia, G. Duodenalis*, and other Giardia sp.-taxonomy controversial)	beaver, coyotes, dogs, cats

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 associated with them. In the majority of those types of situations, MDM is requested because of a perceived risk to human health or safety associated with

wild animals living in close association with humans, or from animals acting out of character by roving in human-inhabited areas during daylight, or showing no fear when humans are present. Under the proposed action, WS could agree to assist in resolving those types of requests for assistance.

In the majority of cases in which human health concerns are a major reason for requesting MDM, there may have been no actual cases of transmission of disease to humans by mammals to prompt the request. Thus, it is the risk of disease transmission that is the primary reason for requesting and conducting MDM. Situations in Kentucky where the threat of disease associated with wild or feral mammal populations might occur could be:

- Exposure by residents to the threat of raccoon rabies due to high populations of raccoons in urban settings or from companion animals coming in contact with infected raccoons in any environment.
- Concern about the threat of histoplasmosis from the disturbance of a large deposit of guano in an attic where a colony of bats routinely roosts or raises young.
- Accumulated droppings from denning or foraging raccoons and subsequent exposure to raccoon roundworm in fecal deposits in a suburban community or at an industrial site where humans must work or live in areas of accumulation.
- Exposure of humans to threats of rabies posed by skunks denning and foraging in a residential community.
- Threats of parasitic infections to humans from *Giardia* spp. resulting from high beaver populations in a park or recreation area where swimming is allowed.

In Kentucky, raccoons are abundant in urban environments. They have been associated with the spread of rabies in other states throughout the eastern U.S., including states adjacent to Kentucky (USDA 2005, B. Dunlap, WS, pers. comm. 2007). Rabies poses a direct threat to humans. Rabies is an acute, fatal viral disease of mammals most often transmitted through the bite of a rabid animal. The disease can be effectively prevented in humans and many domestic animals species, but abundant and widely distributed reservoirs among wild mammals complicate 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) (USDA 2005).

Over the last 100 years, rabies in the U.S. has changed dramatically. About 90% of all animal cases reported annually to CDC now occur in wildlife (Krebs et al. 2000, CDC 2006). Before 1960, the majority of cases were reported in domestic animals. The principal rabies hosts today are wild carnivores and bats. The number of rabies-related human deaths in the U.S. 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 2006). In the U.S., 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 2006).

Accurate estimates of the aforementioned expenditures are not available. Although the number of PEPs given in the U.S. each year is unknown, it is estimated to be about 40,000. When rabies becomes epizootic or enzootic (i.e., present in an area over time but with a low case frequency) in a region, the number of PEPs administered in that area increases. Although the cost varies, a course of rabies immune globulin and five doses of vaccine given over a 4-week period typically exceeds $1,000 (CDC 2006) and has been reported to be as high as $3,000 or more (Meltzer 1996). As epizootics spread in wildlife populations, the risk of “mass” human exposures requiring treatment of a large number of people that came into contact with an 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 persons (CDC 2001). 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 U.S. occurred in 1994, when a kitten from a pet store in Concord, NH tested positive for rabies after a brief illness. Because of potential exposure to this 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).

Rabies in raccoons was virtually unknown prior to the 1950s. It was first described in Florida and spread slowly during the next three decades into Georgia, Alabama, and South Carolina. It was unintentionally introduced into the Mid-Atlantic States, probably by translocation of infected animals (Krebs et al. 1998). The first cases appeared in West Virginia and Virginia in 1977 and 1978. Since then, raccoon rabies in the area expanded to form the most intensive rabies outbreak in the U.S. The strain 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). In the past 21 years, all of the mid-Atlantic and New England states have experienced at least one outbreak. The raccoon rabies epizootic front reached Maine in 1994, reflecting a movement rate of about 30-35 miles per year.

Raccoon 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. In March 2003, a 25-year-old Virginia man died from rabies infection, representing the first confirmed human death from the raccoon rabies variant. 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 all greater when raccoon rabies is present in the 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.

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 of rabies to the eastern U.S. (USDA 2005). If the “immune barrier” is breached by raccoon rabies, research suggests that raccoon populations are sufficient (Sanderson and Huber 1982, Glueck et al. 1988, Hasbrouck et al. 1992, Mosillo et al. 1999) for rabies to spread westward along a front at a rate similar to or greater than the rate at which this rabies strain has spread in the eastern U.S. (USDA 2005). No cases of raccoon rabies have been reported in Kentucky, but the raccoon variant is present in several states bordering Kentucky, including Ohio, West Virginia, and Tennessee.

Burrowing mammals, such as groundhogs, muskrats, voles, field rats, and moles (Family Talpidae) 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 humans living downstream from the dam. For that reason, managers of such sites are concerned with preventing excessive burrowing by those animals at dam sites. WS performs burrowing MDM activities for owners and managers of earthen dams in Kentucky, and could be requested to provide services at such a site, for any requester anywhere in the State. 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 dig burrows into banks, levees, and where higher ground is available, for dens (Perry 1982, Linzey 1998). Muskrats dig burrows with underwater entrances along shorelines and burrowing may not be readily evident until serious damage has occurred. When water levels drop, the muskrat holes are expanded to keep pace with the retreating water level. Additionally, when water levels rise muskrats expand the burrows upward. Those burrows can collapse when walked upon by people or animals and crossed over with heavy equipment (i.e., mowers, tractors).

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 (De Almeida 1987, Loeb 1994). Beaver damming activity also creates conditions favorable to mosquitoes and can hinder mosquito control efforts or result in population increases (Wade and Ramsey 1986). While the presence of those insects is largely a nuisance, mosquitoes can transmit diseases, such as encephalitis (Mallis 1982) and West Nile Virus (CDC 2000). In addition, beaver are carriers of the intestinal parasite *Giardia lamblia*, which can contaminate human water supplies and cause outbreaks of the disease Giardiasis in humans (Woodward 1983, Beach and McCulloch 1985, Wade and Ramsey 1986, Miller and Yarrow 1994). The CDC has recorded at least 41 outbreaks of waterborne Giardiasis, affecting more than 15,000 people. Beaver are also known carriers of tularemia, a bacterial disease that is transmittable to humans through bites by insect vectors or infected animals

or by handling animals or carcasses, which are infected (Wade and Ramsey 1986). Skinner et al. (1984) found that in cattle-ranching sections of Wyoming, the fecal bacterial count was much higher in beaver ponds than in other ponds, something that can be a concern to ranchers and recreationists. On rare occasions, beaver may contract the rabies virus and attack humans. In February 1999, a beaver attacked and wounded a dog and chased children that were playing near a stream in Vienna, Virginia. Approximately a week later, a beaver was found dead at the site and tested positive for rabies (T. Menke, WS, pers. comm. 2003). Furthermore, damming of streams may increase the number of aquatic snakes, including the venomous cottonmouth (*Agkistrodon piscivorus*) (Wade and Ramsey 1986).

Norway rats (*Rattus norvegicus*) and black, or roof rats (*Rattus rattus*) present disease threats to humans. They live in close association to human habitations and provide a potential source of disease transmission. Many of those diseases are transmitted to humans and animals through primary hosts such as fleas, lice, and mites, which live on rats (Schmidt and Roberts 1989). Among the diseases rats may transmit to humans or livestock are murine typhus, leptospirosis, trichinosis, salmonellosis (food poisoning), and ratbite fever (Timm 1994). Plague is a disease that can be carried by a variety of rodents, but it is more commonly associated with roof rats than with Norway rats (Timm 1994). Some diseases associated with rats are listed in Table 1.1.

Black bears occasionally threaten human health and safety. Herrero (1985) documented 500 injuries to humans resulting from encounters with black bears from 1960 to 1980. Of those, 90% were minor injuries (minor bites, scratches, and bruises). Only 23 fatalities were recorded from 1900 to 1980 due to black bear attacks. The number of bear attacks could be considered low considering the geographic overlap of human and black bear populations. Ninety percent of all incidents were likely associated with habituated, food-conditioned bears. There have been no documented fatalities to humans caused by black bears in Kentucky.

A study in France determined that feral cats serve as major reservoirs for the bacterium *Bartonella*. Consequently, feral cats and their fleas (*Ctenocephalides felis*) are the only known vectors for infecting housebound cats and humans with this bacterium. Humans are not infected via the flea, but pet cats often are infected by fleabites. Human infections that may result from exposure to the bacterium via feral 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 most significant animal transmitting rabies to humans (Vaughn 1976, Eng and Fishbein 1990, Krebs et al. 1996).

WS could provide operational MDM, upon request, involving virtually any mammal species that poses a threat to human health and safety to any requester experiencing such damage anywhere in Kentucky.

1.3.3 Need for Mammal Damage Management at Airports

The risk that mammals pose to aircraft is well-documented (Federal Aviation Administration (FAA) 1997) and data kept by the FAA shows that civil aircraft incurred 2,228 strikes with mammals between 1990 and 2005 (FAA 2007). The number of mammal strikes actually occurring is likely to be much greater, since an estimated 80% of civil wildlife strikes go unreported (Cleary et al. 2000). Civil and military aircraft have collided with a diversity of mammal species, including, white-tailed deer, coyotes, raccoons, and a number of other species. Costs of those collisions vary, but FAA data reveals that mammal strikes in the U.S. cost the civil aviation industry approximately 235,100 hours of down time and $34.8 million in direct monetary losses between 1990 and 2005 (FAA 2007).

In addition to the aircraft damages caused by striking mammals at airports, those incidents sometimes pose serious threats to human safety. Only one human death in the U.S. has resulted from aircraft striking a mammal species since 1990. However, mammal strikes can cause significant aircraft damage leading to catastrophic failure of aircraft systems that could lead to a plane crash resulting in human fatalities. Data indicates a much higher percentage of mammal strikes resulted in aircraft damage then did bird strikes. About 68% of mammal strikes resulted in damage, compared to 19% for birds (FAA 2000). In Kentucky, 21 mammals have been struck by aircraft from 1992-2007 (FAA 2007).

WS receives several requests annually for assistance regarding MDM at airports in Kentucky. Those requests are considered serious because of the potential for loss of human life, and because damage to aircraft can be costly. WS could provide operational MDM involving virtually any mammal species that poses a strike hazard at the request of any aviation facility in the State.

1.3.4 Need for Mammal Damage Management to Protect Agriculture

A number of mammal species cause damage to a variety of agricultural resources in Kentucky. Losses related to aquaculture, field crops, orchards, nurseries, gardens, commercial timber, and livestock are reported yearly to Kentucky Department of Fish and Wildlife Resources (KDFWR) (D. McChesney, KDFWR, pers. comm. 2002) and to WS (USDA 2007).

Groundhogs are routinely reported to cause damage to field crops such as row and forage crops, orchards, nursery plants, and commercial gardens (KDFWR 1997, KDFWR 1998, USDA 2007). Economic loss due to muskrat damage can be very high in some areas, particularly in aquaculture producing areas. In some states damage may be as much as $1 million per year (Miller 1994). Elsewhere, economic losses because of muskrat damage may be rather limited and confined primarily to burrowing in farm pond dams. Muskrats eat a variety of natural emergent vegetation (Perry 1982, Linzey 1998) and cultivated crops (Perry 1982). Some of the cultivated crops eaten by muskrats include corn, alfalfa, carrots, and soybeans.

Beaver are reported to damage field crops, commercially grown standing timber and seedling trees. Populations of beaver are abundant in Kentucky where appropriate habitat occurs. Beaver activities cause flooding of prime bottomland crop fields, causing severe economic losses to agricultural producers. Similar flooding and subsequent killing of trees occurs in some commercial forest tracts, killing harvestable trees or seedlings. In addition, feeding by beaver on bark, and felling of some trees results in the loss of stands of all age classes (D. Allsbrooks, TVA, pers. comm. 2003). From Fiscal Year (FY)[3] 1998 to FY 2006, $1,305,870 in losses/damage to hardwood timber, reclamation/restoration sites, roads/bridges, and other types of property (i.e., wetlands) associated with beaver damage was reported to WS in Kentucky (USDA 2007).

Cottontail rabbits and voles are reported to damage orchard trees by gnawing at the base of the tree. Trees are badly damaged or the bark is girdled and trees die when feeding by rabbits and voles is severe. Similar damage occurs in nurseries, which grow landscape ornamentals and shrubs (USDA 2007).

River otters prey on fish at aquaculture facilities in the State (M. Hearn, KDFWR, pers. comm. 2001, J. Murdock, Purchase Area Aquaculture Cooperative, pers. comm. 2001). Magnitude of losses related to depredations by otter are unknown, but appear to be widespread and of considerable concern by managers of such facilities.

Bears, red fox, gray fox, coyotes, and feral dogs can cause predation losses or injury to livestock (e.g. sheep, goats, cattle, pigs, horses) and poultry (e.g. chickens, turkeys, geese ducks). Sheep and lamb losses from predators in the U.S. totaled 224,200 head in 2004 with a reported $18.3 million economic loss (National Agricultural Statistical Services (NASS) 2005). Coyotes and dogs accounted for 60.5% and 13.3% of those predator losses, respectively. In 2005, cattle and calf losses from predators in the U.S. totaled 190,000 head with an estimated $92.7 million in economic loss (NASS 2006). NASS (2006) reported 7,200 cattle and calves were lost to predation in Kentucky during 2005, with the value of those cattle and calves losses totaling approximately $3.4 million. Coyotes and dogs accounted for 57% and 10% of those predator losses, respectively. Coyotes were also the most commonly reported predator of goats in the U.S., accounting for 35.6% of predator losses (NASS 2000). The value of goats and kids lost from all predators in the U.S. in 2004 was $16 million (NASS 2005). Cattle and calves are most vulnerable to predation at calving time and less vulnerable as they get older and larger (Horstman and Gunson 1982).

Calves remain vulnerable to black bear predation during the spring through autumn if they are grazed in areas that typically represent suitable habitat for bears. Black bears have been reported to injure livestock and destroy

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

beehives in Kentucky (J. Plaxico, KDFWR, pers. comm. 2000, D. McChesney, KDFWR, pers. comm. 2000, USDA 2007).

Rats cause damage to stored grain through feeding and contamination with droppings. They may damage crops in fields and containers and packaging materials in stored food. They cause structural damage to commodity storage structures and foundations by burrowing and gnawing.

The domestic cat has been found to transmit *Toxoplasma gondii* to both domestic and wild animal species. Fitzgerald et al. (1984) documented that feral and free-ranging cats transmitted *T. gondii* to sheep in New Zealand, resulting in abortion in ewes. The authors also found *Sarcocystis* spp. contamination in the musculature of sheep. Dubey et al. (1995) found cats to be 68.3% positive for seroprevalence of *Toxoplasma 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. Cats were believed to be the cause of disease transmission (*T. gondii*) and the death of kangaroos, wallabies, and potaroos at the Knoxville Zoological Park in Tennessee (Patton et al. 1986). 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, *Toxoplasmosis gondii* (Dubey 1973, Teutsch et al. 1979). This protozoan may infect both stray and domiciled cats, but this infection is more common in stray cats. Diseases that may be communicable from free-ranging or feral cats to pet 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 considered 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, and it is more prevalent between July and September.

1.3.5 Need for Mammal Damage Management to Protect Natural Resources Including Threatened and Endangered Species

Natural resources may be described as those assets belonging to the public and often managed and held in trust by government agencies as representatives of the people. Such resources may be plants or animals, including T&E species, historic properties, or habitats in general. Examples of natural resources in Kentucky are historic structures and places; parks and recreation areas; natural areas, including unique habitats or topographic features; T&E plants or animals; and any plant or animal populations which have been identified by the public as a natural resource.

Sometimes the activities of mammals cause damage to natural resources. This most frequently occurs in relation to plants or other animals, including but not limited to, trees, natural vegetation of other types, other mammals, and birds. Mammals causing damage are usually locally overabundant at the damage site, and threaten the welfare of a species population identified as a natural resource. Examples of this might be a groundhog burrowing under a historic building or ground-nesting game bird populations which are being impacted by the presence of mammalian carnivores, such as raccoons, coyotes, or fox.

Massey (1971) and Massey and Atwood (1979) found that predators can prevent least terns (*Sterna antillarum*) from nesting or cause them to abandon previously occupied sites. In another study, mammalian predators were found to have significantly affected the nesting success of least terns on sandbars and sandpits (Kirsch 1996). Skunks (Massey and Atwood 1979), red fox (Minsky 1980), coyotes (Grover and Knopf 1982), and raccoons (Gore and Kinnison 1991) are common predators of least terns. During one 2-year study, coyotes destroyed 25.0 to 38.5% of all interior least tern nests (Grover 1979). Raccoons are considered a major predator of ground-nesting upland bird nests and poults (Speake et al. 1969, Johnson 1970, Speake 1980, Speake et al. 1985). In Massachusetts, predators destroyed 52 to 81% of all active piping plover (*Charadrius melodus*) nests from 1985-1987 (MacIvor et al. 1990). Red fox accounted for 71 to 100% of the nests destroyed by predators at the site. During FY 1995-1998, WS removed coyotes, striped skunks, opossums, and mink from nesting sites along the Platte River in central Nebraska to protect threatened piping plovers and endangered least terns. As expected, the removal of predators increased plover and tern nesting success and chick survival rates (USDA 1999). Balser et al. (1968) recommended that predator damage management programs target the entire predator complex or compensatory predation may occur by a species not under control, a phenomena also observed by Greenwood (1986). Trautman et al. (1974) concluded that a single species predator damage management program showed some promise for enhancing ring-necked pheasant (*Phasianus colchicus)* populations.

Clearly, predator damage management can be an important tool for achieving and maintaining game, nongame, and T&E species production and management objectives.

Some of the species listed as threatened or endangered under the Endangered Species Act (ESA) of 1973 are preyed upon or otherwise adversely affected by certain mammal species. In FY 2006, the WS' program nationwide actively protected approximately 118 federal and state listed T&E species. In 2001, Alaska's Aleutian Canada goose (*Branta canadensis leucopareia*) was officially removed from the list of federally threatened species, due in part to WS' efforts to prevent predation by the artic fox (*Alopex lagopus*). WS could provide operational MDM involving virtually any mammal species that poses a threat to wildlife, including T&E species, to any requester experiencing such damage anywhere in Kentucky.

Feral hogs cause damage to natural areas such as parks and wildlife management areas in Kentucky. Those sites suffer erosion and local loss of critical ground plants and roots, as well as destruction of seedlings because of feral hog feeding and rooting (Barrett and Birmingham 1994). Many state and federal natural resource managers are now in the process of controlling hog numbers because of their known impact to endangered plants and animals (Thompson 1977). Feral hogs are not native to North America, and many native species have not evolved to deal with hog competition or predation. Feral hogs are known to feed on many smaller animals (some threatened or endangered), disrupt ecosystems via rooting, and to feed on rare and endangered plants. Many experts in the fields of botany and herpetology have observed marked declines in some rare species of plants, reptiles, amphibians, and soil invertebrates (Singer et al. 1982) in areas inhabited by feral hogs. It has been well documented that feral hogs disturb large areas of vegetation and soils through rooting, and it is documented that hogs inhabiting coastal, upland, and wetland ecosystems are uprooting, damaging, and feeding on rare native species of plants and animals (Means 1999). Hogs 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).

Beaver cause extensive damage to timber, seedling trees, and other vegetation in natural areas, park and recreation areas, and wetland mitigation sites in Kentucky. Beaver activities also destroy critical habitat types (e.g. free-flowing water, riparian areas, and bird roosting and nesting areas) which are important to many wildlife species, including certain species of fish and mussels. Patterson (1951) and Avery (1992) reported the presence of beaver dams could negatively affect fisheries. Beaver dams may adversely affect stream ecosystems by increasing sedimentation in streams, and thereby negatively affecting wildlife that depend on low turbidity. Beaver activity has been suggested to cause serious degradation to riparian habitat, which might otherwise support populations of endangered mussel species in Kentucky (B. Harrell, USFWS, pers. comm. 2002).

Groundhogs often cause damage to the grounds of historic sites. They can damage the earthworks of historic battlefields by their burrowing activity. The burrows create large tunnels that accelerate erosion and may lead to the collapse of those features. They allow rainwater to enter which further undermines the structures. The burrows themselves are also a trip hazard to visitors at those sites (T. Hogan, NPS, pers. comm. 2003).

Muskrats are largely herbivores; however, they also eat other animals as part of their diet (Perry 1982). Schwartz and Schwartz (1959), Neves and Odom (1989), and Miller (1994) reported muskrats also ate animal matter including mussels, clams, snails, crustaceans (i.e., crawfish), and young birds. Some mussels consumed by muskrats may be listed as federal T&E species under the ESA. Neves and Odom (1989) reported that muskrats appeared to be inhibiting the recovery of endangered mussels, and are likely placing pigtoe mussels in further jeopardy in the Clinch and Holston Rivers in Virginia. Muskrats can negatively affect native vegetation. When muskrats become over-populated an "eat-out" may occur which denudes large areas of aquatic vegetation. Those events may result in the feeding area being unsuitable for other wildlife species for a number of years (O'Neil 1949). The loss of vegetation removes food and cover for muskrats and other wildlife. Marsh damage from muskrats is inevitable when areas heavily populated by muskrats are under-trapped (Lynch et al. 1947). While overgrazing of vegetation can be beneficial to some bird species, it can also result in stagnant water, which predisposes the same birds to diseases (Lynch et al. 1947).

WS has received requests in the past for assistance in resolving damage caused to natural resources by mammals, and could be requested to provide services for management of damage to natural resources caused by any mammal at any location in Kentucky.

1.3.6 Need for Mammal Damage Management to Protect Property

Mammals cause damage to a variety of property types in Kentucky each year. During FY 1998-2006, complainants who contacted WS reported $1,973,733 in damage caused by all mammal species to all types of property in Kentucky (a portion of the damage total was verified by WS' personnel) (USDA 2007). Reported damage to electrical utilities was considerable, estimated at approximately $819,400. Damage to structures, which included residential and non-residential buildings, water control structures, and other human-constructed property, totaled $292,073 in damages from FY 1998-2006. Damage was caused by a variety of mammals, including beaver, groundhogs, opossums, raccoons, bats, squirrels, muskrats, Norway rats, and others (USDA 2007).

Most damage caused by beaver is a result of dam building, bank burrowing, tree cutting, obstructing overflow structures and spillways, or flooding. Some cases of beaver damage include roads being flooded, reservoir dams being destroyed by bank den burrows, and train derailments being caused by continued flooding and burrowing (Miller and Yarrow 1994). Housing developments have been threatened by beaver dam flooding. Some small bridges also have been destroyed because of beaver dam-building activity. Miller (1983) estimated that the annual damage by beaver in the U.S. was $75-$100 million. The estimated value of beaver damage is perhaps greater than that of any other single wildlife species in the U.S., with economic damage estimated to have exceeded $4 billion in the southeastern U.S. over a 40-year period (Arner and Dubose 1980). In certain southeastern states, losses from beaver damage have been estimated at $3 million to $5 million dollars annually (Miller and Yarrow 1994), with timber losses as the most common type of damage (Hill 1982). Tracts of bottomland hardwood timber up to several thousand acres in size may be lost to beaver activity (Miller and Yarrow 1994). Surveys in North Carolina and Alabama indicated that the majority of landowners with beaver damage on their property desire damage management via beaver removal (Hill 1976, Lewis 1979, 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, which are viewed as damage result in adverse impacts that often outweigh benefits (Miller and Yarrow 1994). 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, roads and railroads may be damaged by saturation of the roadbed from beaver flooding or by beaver burrowing into the banks that comprise roadbeds and railroad beds.

1.4 WS' MAMMAL DAMAGE MANAGEMENT RECORD KEEPING

WS maintains a Management Information System (MIS) database to document assistance that the agency provides in addressing wildlife damage conflicts. MIS data is limited to information that is collected from people who have requested services or information from WS. It does not include requests received or responded to by local, state or other federal agencies, and it is not a complete database for all wildlife damage occurrences. The number of requests for assistance does not necessarily reflect the extent of need for action, but this data does provide an indication that needs exist. The database includes, but is not limited to, the following information: species of wildlife involved, the number of individuals involved in a damage situation; tools and methods used or recommended to alleviate the conflict; and the resource that is in need of protection.

1.5 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS

1.5.1 WS' Programmatic Environmental Impact Statement

WS has developed a programmatic FEIS that analyzes and addresses potential environmental impacts from programmatic activities and various WDM methods employed by WS (USDA 1997). WS' FEIS may be

obtained by contacting: USDA-APHIS-WS, Operational Support Staff, 4700 River Rd., Unit 87, Riverdale, MD 20737-1234. Pertinent information from the EA and supplements has been incorporated by reference into this EA.

1.5.2 Environmental Assessment and Finding of No Significant Impact – Oral Vaccination to Control Specific Rabies Virus Variants in Raccoons, Gray Fox, and Coyotes in the United States

An EA (USDA 2001b) was developed to analyze the environmental effects of WS' involvement in the funding of and participation in Oral Rabies Vaccination programs to eliminate or stop the spread of raccoon rabies in a number of eastern states (including Kentucky) and gray fox and coyote rabies in Texas. The EA has been supplemented with additional information and analyses. The EA, supplements, and associated Decision documents can be viewed by visiting the APHIS website at http://www.aphis.usda.gov/wildlife_damage/nepa.shtml. Pertinent information from the EA and supplements has been incorporated by reference into this EA.

1.5.3 Environmental Assessment and Finding of No Significant Impact – Oral Vaccination to Control Specific Rabies Virus Variants in Raccoons on National Forest System Lands in the United States

An additional EA (USDA 2005) was developed to analyze the environmental effects of WS' involvement in the funding of and participation in Oral Rabies Vaccination programs to eliminate or stop the spread of raccoon rabies on Forest Service lands in a number of eastern states (including Kentucky). The EA, supplements, and associated Decision documents can be viewed by visiting the website at http://www.aphis.usda.gov/wildlife_damage/nepa.shtml. Pertinent information from the EA and supplements has been incorporated by reference into this EA.

1.5.4 Environmental Assessment and Finding of No Significant Impact - Cervid Damage Management in Kentucky

WS has completed an EA and issued a Finding of No Significant Impact for WS' cervid damage management activities in KY (USDA 2001a). WS determined the action would not have significant impact on the quality of the human environment. The EA and Decision/FONSI documents can be viewed by visiting the APHIS website at http://www.aphis.usda.gov/wildlife_damage/nepa.shtml. Pertinent information from this document has been incorporated by reference into this EA.

1.6 DECISION TO BE MADE

Based on the scope of this EA, the decisions to be made are:

- Should MDM as currently implemented by the WS program be continued in the State?
- If not, how should mammal damage in the State be managed and what role should WS play in this management?
- Might the continuing of WS' current MDM program have significant effects requiring preparation of an Environmental Impact Statement (EIS)?

1.7 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

1.7.1 Actions Analyzed

This EA evaluates MDM by WS to protect agriculture; human health and safety; natural resources, including T&E species and other wildlife; and property on private land or public facilities within the State wherever such management is requested.

1.7.2 Period for Which This EA is Valid

This EA will remain valid until WS and/or the Tennessee Valley Authority (TVA) determines that new needs for action or new alternatives having different environmental effects must be analyzed. At that time, this analysis and document will be reviewed and revised as necessary. This process ensures the EA is complete and

still appropriate to the scope of WS' MDM activities. Review of the EA will be conducted each year to ensure that the EA is sufficient.

1.7.3 Site Specificity

This EA analyzes potential effects of WS' MDM activities that will occur or could occur on private property or at public facilities within any of the 120 Kentucky counties. Because the proposed action is to continue the current program, and because the current program's goal and responsibility are to provide service when requested within the constraints of available funding and personnel, it is conceivable that MDM activity by WS could occur anywhere in the State.

Planning for the management of mammal damage must be viewed as being conceptually similar to the actions of federal or other agencies whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they will occur are unknown but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire and police departments, emergency clean-up organizations, and insurance companies. Although some of the sites where mammal damage will occur can be predicted, all specific locations or times where such damage will occur in any given year cannot be predicted. Thus, this EA analyzes the potential effects of such efforts wherever and whenever they might occur as part of the current program. The EA emphasizes important issues as they relate to specific areas whenever possible. However, the issues that pertain to the various types of mammal damage and resulting management are the same, for the most part, wherever they occur, and are treated as such. The standard WS' Decision Model (Slate et al. 1992) and WS Directive 2.105 is the routine thought process that is the site-specific procedure for determining methods and strategies to use or recommend for individual actions conducted by WS in the State (See USDA 1997, Chapter 2 and Appendix N for a more complete description of the WS' Decision Model and examples of its application). Decisions made using this undocumented thought process will be in accordance with any mitigation measures and standard operating procedures (SOP) described herein and adopted or established as part of the decision.

The analyses in this EA are intended to apply to any action that may occur *in any locale* and at *any time* within the analysis area. In this way, WS believes it meets the intent of NEPA with regard to site-specific analysis and that this is the only practical way for WS to comply with NEPA and still be able to accomplish its mission.

1.7.4 Native American Lands and Tribes

Currently, the WS' program in Kentucky has no MOUs with any Native American tribes. If WS enters into an agreement with a tribe for MDM, this EA would be reviewed and supplemented if appropriate to ensure compliance with NEPA. MOUs, agreements, and NEPA compliance would be conducted as appropriate before conducting MDM on tribal lands.

1.7.5 Summary of Public Involvement

WS and TVA initially developed issues related to the proposed action. Issues were defined and preliminary alternatives were identified. As part of this process and as required by the Council on Environmental Quality (CEQ) and APHIS-NEPA implementing regulations, this document is being made available to the public through "Notices of Availability" (NOA) published in local media, and through direct mailings of NOA to parties that have specifically requested to be notified. The NOA and the EA will also be made available via the APHIS website at http://www.aphis.usda.gov/wildlife_damage/nepa.shtml. New issues or alternatives raised after publication of public notices will be fully considered to determine whether the EA and its Decision should be revisited and, if appropriate, revised.

1.8 AUTHORITY AND COMPLIANCE

1.8.1 Authority of Federal and State Agencies in Mammal Damage Management in Kentucky[4]

1.8.1.1 WS' Legislative Authorities

The USDA is authorized to protect agriculture and other resources from damage caused by wildlife. This function is carried out by the WS' program. The primary statutory authorities for WS' program are the Act of March 2, 1931 (46 Stat. 1468; 7 U.S.C. 426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 U.S.C. 426c).

1.8.1.2 Kentucky Department of Fish and Wildlife Resources

The KDFWR is responsible under Kentucky Revised Statute (KRS) 150 Title XII initiated by Acts 1952 ch. 200 for managing most wildlife species in the State under the direction of the Kentucky State Game Commission. In addition, the KDFWR participates with WS and a number of state agencies in a MOU whereby participating agencies have agreed to collaborate in resolving wildlife damage issues.

1.8.1.3 Kentucky Department of Agriculture (KDA)

The KDA, Division of Pesticide Regulation (Pesticide Division) regulates the sale, distribution, storage, and application of pesticides in Kentucky. The Division strives to educate the pest control industry and the consumer about the proper use of pesticides through education and training programs conducted across the state.

The Pesticide Division's Structural Branch is responsible for the Licensing and Certification of all pest control companies/individuals performing work in Kentucky. The licensing process is renewed annually. Certification renewals are done annually as an individual's certification expires. Certification is valid for 5 years and renewed at the end of that time period if two approved training courses have been attended during the five-year period. A company must have a licensed pest control operator to legally perform work in Kentucky. The Branch coordinates training programs for maintaining professional competence within the regulated community.

The Branch has pesticide inspectors assigned to various regions of the state that investigate problem situations, detected in the field or referred by the Frankfort office, or referred by the EPA. The Branch investigates and takes appropriate measures consistent with law, regulations and procedures. This Branch enforces KRS 21 7B and Administrative Regulations, Title 302, Chapter 31, and federal laws.

Field Inspectors also perform routine daily inspections to determine if compliance with state and federal laws have been met.

WS obtains certification for all its employees who apply pesticides in Kentucky. Licenses are also maintained through the Pesticide Division for performing work related to pesticide applications in the state.

The Pesticides Division's Product Registration Program is responsible for the registration of each and every pesticide product sold and/or distributed in Kentucky. A fee is assessed for each new pesticide registration (prior to sale or distribution) and the renewal of each pesticide registration. Product registrations expire December 31st of every calendar year.

KRS 217.570 states that every pesticide product must be registered with the KDA, Division of Pesticide Regulation, prior to being sold or distributed in this state. All Federal Insecticide, Fungicide, Rodenticide Act (FIFRA) Section (3) registrations expire on December 31 of each calendar year. According to KRS 217.544(26), "Pesticide" means any substance or mixture of substances intended to prevent, destroy,

[4]See Chapter 1 of USDA (1997) for a complete discussion of federal laws pertaining to WS.

control, repel, attract, or mitigate any pest; any substance or mixture of substances intended to be used as a plant regulator, defoliant, or desiccant; and any substance or mixture of substances intended to be used as a spray adjuvant.

1.8.1.4 U.S. Fish and Wildlife Service (USFWS)

The USFWS is responsible for managing and regulating take of bird species that are protected under the Migratory Bird Treaty Act and those species, subspecies, and populations that are listed as threatened or endangered under the ESA. Section 1.8.2.2 below describes WS' interactions with the USFWS under this law.

1.8.1.5 Natural Resources Conservation Service (NRCS)

The NRCS is responsible for certifying wetlands under the Wetland Conservation provisions of the Food Security Act (16 U.S.C. 3821 and 3822). Topographic maps are available through their offices that identify the presence of wetlands.

1.8.1.6 U.S. Army Corps of Engineers (USACE)

The USACE regulates and permits activities regarding waters of the U.S., including protection and utilization under Section 404 of the Clean Water Act.

1.8.1.7 U.S. Environmental Protection Agency

The EPA is responsible for implementing and enforcing 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 with the USACE; this established a permit program for the review and approval of water quality standards that directly affect wetlands.

1.8.1.8 Tennessee Valley Authority

TVA is a federal corporation created by an Act of Congress in May 18, 1933 [48 Stat. 58-59, 16 U.S.C. Sec. 831, as amended], provides electrical power to 8.6 million people, businesses, and industries and manages 293,000 acres of public land and 11,000 miles of reservoir shoreline in the 7-state Tennessee Valley region. In Kentucky, TVA operates 1 hydroelectric dam, 2 coal-fired power plants, and 1 solar facility. TVA's Kentucky Reservoir, a portion of which lies in southwestern Kentucky, has 160,000 surface acres, 2,000 miles of shoreline, and 66,000 acres of managed land in Kentucky and Tennessee. TVA owns and maintains 55 substations and switchyards and 1,787 circuit miles on transmission line in Kentucky (TVA 2006). TVA contracts with WS to provide nuisance WDM on its land and at its facilities. TVA also makes its land available for use for continuation of the WS' Oral Rabies Vaccination/Rabies Management program in all the Valley states of Kentucky, Alabama, Tennessee, Georgia, Mississippi, North Carolina, and Virginia.

1.8.2 Compliance with Other Federal Laws

Several other federal laws authorize, regulate, or otherwise affect WS' WDM. WS complies with those laws, and consults and cooperates with other agencies as appropriate.

1.8.2.1 National Environmental Policy Act (NEPA)

All federal actions are subject to NEPA (Public Law 9-190, 42 U.S.C. 4321 et seq.). WS follows CEQ regulations implementing NEPA (40 CFR 1500 et seq.), USDA (7 CFR 1b), and APHIS Implementing Guidelines (7 CFR 372) as part of the decision-making process. Those laws, regulations, and guidelines generally outline five broad types of activities to be accomplished as part of any project: public involvement, analysis, documentation, implementation, and monitoring. NEPA also sets forth the requirement that all major federal actions be evaluated in terms of their potential to significantly affect the

quality of the human environment for the purpose of avoiding or, where possible, mitigating and minimizing adverse impacts. Federal activities affecting the physical and biological environment are regulated in part by CEQ through regulations in 40 CFR, Parts 1500-1508. In accordance with CEQ and USDA regulations, APHIS guidelines concerning Implementation of NEPA Procedures, as published in the Federal Register (44 CFR 50381-50384) provide guidance to APHIS regarding the NEPA process.

Pursuant to NEPA and CEQ regulations, this EA documents the analyses of a proposed impact resulting from 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 the policies and goals of NEPA are infused into federal agency actions. This EA was prepared by integrating as many of the natural and social sciences as warranted, based on the potential effects of the proposed actions. The direct, indirect, and cumulative impacts of the proposed action are analyzed.

1.8.2.2 Endangered Species Act

Under the ESA, all federal agencies will seek to conserve T&E species and will utilize their authorities in furtherance of the purposes of the Act (Sec.2(c)). WS conducts Section 7 consultations with the USFWS to use the expertise of the USFWS to ensure that "*any action authorized., funded or carried out by such an agency . . . is not likely to jeopardize the continued existence of any endangered or threatened species . . . Each agency will use the best scientific and commercial data available*" (Sec.7 (a) (2)). WS obtained a Biological Opinion (BO) from the USFWS in 1992 describing potential effects on T&E species, and prescribing reasonable and prudent measures (RPM) for avoiding jeopardy for WS' programmatic activities (USDA 1997, Appendix F).

1.8.2.3 Federal Insecticide, Fungicide, and Rodenticide Act

FIFRA requires the registration, classification, and regulation of all pesticides used in the U.S. through the EPA. The EPA is responsible for implementing and enforcing FIFRA. All chemical methods used or recommended by the WS' program in Kentucky are registered with and regulated by the EPA and KDA and are used by WS in compliance with labeling procedures and requirements.

1.8.2.4 National Historic Preservation Act (NHPA) of 1966 as Amended

The NHPA of 1966, and its implementing regulations (36 CFR 800), requires federal agencies to: 1) determine whether activities they propose constitute "undertakings" that have the potential to cause effects on historic properties and, 2) if so, to evaluate the effects of such undertakings on such historic resources and consult with the Advisory Council on Historic Preservation (i.e. State Historic Preservation Office, Tribal Historic Preservation Officers), as appropriate. WS' actions on tribal lands are only conducted at the tribe's request and under signed agreement; thus, the tribes have control over any potential conflict with cultural resources on tribal properties.

Each of the MDM methods described in this EA that might be used operationally by WS do not cause major ground disturbance, do not cause any physical destruction or damage to property, do not cause any alterations of property, wildlife habitat, or landscapes, and do not involve the sale, lease, or transfer of ownership of any property. In general, such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas in which they are used that could result in effects on the character or use of historic properties. Therefore, the methods that would be used by WS under the proposed action are not generally the types of activities that would have the potential to affect historic properties. If an individual activity with the potential to affect historic resources were planned under an alternative selected because of a decision on this EA, then site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary.

There is potential for audible effects on the use and enjoyment of a historic property when methods such as propane exploders, pyrotechnics, firearms, or other noise-making methods are used at or in close proximity to such sites for purposes of hazing or removing animals. However, such methods would only be used at a historic site at the request of the owner or manager of the site to resolve a damage or nuisance problem,

which means such use would be to benefit the historic property. A built-in mitigating factor for this issue is that virtually all of the methods involved would only have temporary effects on the audible nature of a site and can be ended at any time to restore the audible qualities of such sites to their original condition with no further adverse effects. Site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary in those types of situations.

1.8.2.5 The Clean Water Act (33 U.S.C. 1344)

The Clean Water Act provides regulatory authority and guidelines for the EPA and the USACE related to wetlands. Several sections of the Clean Water Act pertain to regulating effects on wetlands. Section 101 specifies the objectives of this Act, which are implemented largely through Subchapter III (Standards and Enforcement), Section 301 (Prohibitions). The discharge of dredged or fill material into waters of the U.S. is subject to permitting specified under Subchapter IV (Permits and Licenses) of this Act. Section 401 (Certification) specifies additional requirements for permit review particularly at the State level. WS consults with appropriate regulatory authorities when wetlands exist in proximity to proposed activities or when such activities might impact wetland areas. Such consultations are designed to determine if any wetlands will be affected by proposed actions.

1.8.2.6 Executive Order 13112 on Invasive Species

Executive Order 13112 - Invasive Species directs 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. To comply with Executive Order 13112, WS may cooperate with other federal, state, or local government agencies, or with industry or private individuals to reduce damage to the environment or threats to human health and safety.

1.8.2.7 Food Security Act

The Wetland Conservation provision (Swampbuster) of the 1985 (16 U.S.C. 3801-3862), 1990 (as amended by PL 101-624), and 1996 Food Security Act require (as amended by PL 104-127) 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 as a result 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 5 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 Clean Water Act. NRCS is responsible for certifying wetland determinations according to this Act.

1.8.2.8 Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act require federal agencies to notify the Secretary of the Department that manages the federal lands upon the discovery of Native American cultural items on federal or tribal lands. Federal projects would discontinue work until a reasonable effort had been made to protect the items and the proper authority had been notified.

1.8.2.9 Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Environmental Justice has been defined as the pursuit of equal justice and equal 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. A critical goal of Executive Order 12898 is to improve the scientific basis for decision-making by conducting assessments that identify and prioritize environmental health risks and procedures

for risk reduction. Environmental Justice is a priority within both APHIS and WS. APHIS implements Executive Order 12898 principally through its compliance with the provisions of NEPA.

WS' activities are evaluated for their effect on the human environment and compliance with Executive Order 12898 to ensure Environmental Justice. WS' personnel use WDM methods as selectively and environmentally conscientiously as possible. All chemicals used by WS are regulated by the EPA through the FIFRA, KDA, by MOUs with federal land managing agencies, and by WS' directives. Based on a thorough Risk Assessment, APHIS concluded that when WS uses chemicals according to label directions, they are highly selective to target individuals or populations, and such use has negligible effects on the environment (USDA 1997, Appendix P). The WS' operational program properly disposes of any excess solid or hazardous waste. It is not anticipated that the proposed action would result in any adverse or disproportionate environmental effects to minority and low-income persons or populations.

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

Children may suffer disproportionately from environmental health and safety risks, including the development of their physical and mental status. Because WS makes it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children, WS has considered the impacts that alternative analyzed might have on children. A Risk Assessment (USDA 1997) concluded that when non-chemical and chemical methods are used according to label directions and in compliance with normally accepted safety practices and WS' SOPs, such use has negligible impacts on the environment or on human health and safety, including the health and safety of children.

1.8.2.11 Federal Food, Drug, and Cosmetic Act (21 U.S.C. 360)

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

1.8.2.12 Controlled Substances Act of 1970 (21 U.S.C. 821 et seq.)

This law requires an individual or agency to have a special registration number from the federal Drug Enforcement Administration (DEA) to possess controlled substances, including those that are used in wildlife capture and handling.

1.8.2.13 Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA)

The AMDUCA and its implementing regulations (21 CFR Part 530) establish several requirements for the use of animal drugs, including those used to capture and handle wildlife in rabies 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 the proposed action. Veterinary authorities in each state have the discretion under this law to establish withdrawal times (i.e., a period of time after a drug is administered that must lapse before an animal may be used for food) for specific drugs. Animals that might be consumed by a human within the withdrawal period must be identified; the Western Wildlife Health Committee of the Western Association of Fish and Wildlife Agencies has recommended that suitable identification markers include durable ear tags, neck collars, or other external markers that provide unique identification. WS establishes procedures in each state for administering drugs used in wildlife capture and handling that must be approved by state veterinary authorities in order to comply with this law.

2.0 CHAPTER 2: ISSUES

Chapter 2 contains a discussion of the issues, including issues that will receive detailed environmental effects analysis in Chapter 4 (Environmental Consequences), issues that have driven the development of SOPs, and issues that will not be considered in detail, with rationale. Pertinent portions of the affected environment will be included in this chapter. Additional description of affected environments will be incorporated into the discussion of the environmental effects in Chapter 4.

Issues are concerns of the public and/or of professional communities about potential environmental problems that might occur from a proposed federal action. Such issues must be considered in the NEPA decision process. Issues relating to the management of wildlife damage were raised during the scoping process in preparing WS' programmatic FEIS (USDA 1997) and were considered in the preparation of this EA. Those issues are fully evaluated within the FEIS, which analyzed data specific to the WS' program in Kentucky.

2.1 AFFECTED ENVIRONMENT

Upon a request for assistance, MDM could be conducted on private, federal, state, tribal, county, and municipal lands in Kentucky to protect agricultural and natural resources, property, and public health and safety. Areas of the proposed action could include, but are not limited to, state, county, municipal and federal natural resource areas, park lands, and historic sites; state and interstate highways and roads; railroads 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, dikes, ditches, ponds, and levees; and public and private properties in rural/urban/suburban areas where mammals cause damage to landscaping and natural resources, property, and pose a threat to human safety through vehicle collisions and the spread of disease. The area of the proposed action would also include airports and military airbases where mammals are a threat to human safety and to property; areas where mammals negatively impacts wildlife, including T&E species; and public property where mammals are negatively impacting historic structures, cultural landscapes and natural resources.

2.1.1 Environmental Status Quo

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

Unprotected wildlife species, such as most non-native invasive species, are not protected under state or federal law. Most state managed wildlife species are managed under state authority or law without any federal oversight or protection. In some states, with the possible exception of restrictions on methods (e.g., firearms restrictions, pesticide regulations), unprotected wildlife species, and certain resident wildlife species are managed with little or no restrictions allowing them to be killed or taken by anyone at any time. For MDM in Kentucky, the KDFWR has the authority to manage and authorize the taking of mammals for damage management purposes (see section 1.8.1.2).

When a non-federal entity takes a management action on a state managed wildlife species or unprotected wildlife species, the action is not subject to NEPA compliance due to the lack of federal involvement in the action. Under such circumstances, the environmental baseline or status quo must be viewed as an environment that includes those species as they are managed or impacted by non-federal entities in the absence of the federal action being proposed. Therefore, in those situations in which a non-federal entity has decided that a management action directed towards a state protected or unprotected wildlife species will occur and even the particular methods that will be used, WS' involvement in the action will not affect the environmental status quo.

WS' decision-making ability is restricted to one of two alternatives: either taking the action using the specific methods as decided upon by the non-federal entity or taking no action at all at which point the non-federal entity will take the same action anyway.

Therefore, based on the discussion above, it is clear that in those situations where a non-federal cooperator has obtained the appropriate KDFWR permit or authority, and has already made the decision to remove or otherwise manage a mammal species to stop damage with or without WS' assistance, WS' participation in carrying out the action will not affect the environmental status quo. In some situations, however, certain aspects of the human environment may actually benefit more from WS' involvement than from a decision not to assist. For example, if a cooperator believes WS has greater expertise to selectively remove a target species than a non-WS entity; WS' management activities may have less of an impact on target and non-target species than if the non-federal entity conducted the action alone. Thus, in those situations, WS' involvement may actually have a beneficial effect on the human environment when compared to the environmental status quo in the absence of such involvement.

2.2 SUMMARY ISSUES ADDRESSED IN THE ANALYSIS OF ALTERNATIVES

The issues related to the Alternatives will be analyzed in detail in Chapter 4. The following issues have been identified as areas of concern requiring consideration in this EA:

2.2.1 Effects on Wildlife

2.2.1.1 Effects on Target Mammal Populations

A common issue is whether WDM actions adversely affect the viability of target species populations. The target species selected for analysis in this EA are the primary species, which may be affected by WS' MDM activities in Kentucky. Mammal species addressed in this EA include: beaver, red and gray fox, muskrat, raccoons, striped skunks, coyotes, groundhogs, Virginia opossums, cottontail rabbits, feral cats, feral dogs, river otter, tree squirrels, black bear, bobcat, feral swine, mink, chipmunk, mole, spotted skunk, various bat species (See Table 4.2), and small rodents including voles, rats and mice.

2.2.1.2 Effects on Non-target Species Populations, Including T&E Species

Similar to issues with target wildlife species is the impact of damage management methods and activities on non-target species, particularly T&E Species. WS' SOPs include measures intended to mitigate or reduce the effects on non-target species populations and are presented in Chapter 3.

Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or mitigation measures. WS has consulted with the USFWS under Section 7 of the ESA concerning potential effects of MDM methods on T&E species and has obtained a BO on WS' programmatic activities (USDA 1997). WS is also in the process of reinitiating Section 7 consultation at the program level to assure that potential effects on T&E species have been adequately addressed. WS in Kentucky has also initiated consultation with the USFWS under Section 7 of the ESA to determine potential effects of conducting MDM activities in Kentucky. WS will abide by those RPMs identified to ensure MDM activities do not jeopardize T&E species in Kentucky. As stated is Section 1.3.5, WS' activities often help to enhance or maintain populations of T&E species that are adversely affected by mammalian predators. For a complete list of federally listed T&E species, please see Appendix D. Additional information on federally listed mussels in Kentucky is contained in Appendix E.

Kentucky does not have an official state T&E list (T. Wethington, KDFWR, pers. comm. 2003, J. Lane, KDFWR, pers. comm. 2005), but the Kentucky T&E listings are developed and published by the Kentucky State Nature Preserves Commission (KSNPC). This is not considered an official regulated list of species by KDFWR (T. Wethington, KDFWR, pers. comm. 2003) but is used by the KSNPC to define recommended management considerations for such species (B. Palmer-Ball, KSNPC, pers. comm. 2001).

2.2.2 Effects on Human Health and Safety

2.2.2.1 Safety and Efficacy of Chemical Methods

Issues are often raised about chemicals used in MDM programs because of potential adverse effects on people from being exposed either to the chemicals directly or to mammals that have died as a result of the chemical used. Under the alternatives proposed in this EA, chemical use is regulated by the EPA through FIFRA, by Kentucky State Pesticide Control Laws, by DEA, by FDA, and by WS' directives. Based on a thorough Risk Assessment, APHIS concluded that when WS uses chemicals according to label directions, they are selective to target individuals or populations, and such use has negligible impacts on the environment (USDA 1997, Appendix P). One specific method not addressed in the assessment was the use of explosives to remove beaver dams.

WS' personnel that use explosives are required to take and pass in-depth training and must be able to demonstrate competence and safety in their use of explosives. WS' personnel adhere to WS' policies, as well as regulations from the Bureau of Alcohol, Tobacco and Firearms (ATF), the Occupational Safety and Health Administration (OSHA), and the U.S. Department of Transportation (USDOT) concerning explosives use, storage, and transportation. WS uses binary explosives that require two components to be mixed before they can be actuated, which virtually eliminates the hazard of accidental detonation during storage and transportation. Storage and transportation of mixed binary explosives is illegal. When explosives are used, signs are placed to stop public entry and other safety measures are taken to avoid public exposure to explosives. Therefore, WS expect no adverse effects to public safety from the use of explosives under any alternative.

Other issues with chemical methods include the potential for drugs used in animal capture, handling, and euthanasia to cause adverse health effects in humans that hunt and eat the species involved. Among the species to be captured and handled under the proposed action, this issue is expected to only be of concern for wildlife, which are hunted and sometimes consumed by people as food.

2.2.2.2 Effects on Human Health and Safety from Non-Chemical MDM Methods

Issues have been raised that WS' use of firearms, traps, snares, and pyrotechnic scaring devices could cause injuries to people. WS' personnel occasionally use traps, snares, and firearms to remove mammals that are associated with damage. There is some potential fire hazard to agricultural sites and private property from pyrotechnic use and they could cause injuries to people if handled inappropriately. A formal risk assessment of WS' operational management methods found that risks to human safety were low (USDA 1997, Appendix P).

Safety issues related to the misuse of firearms and the potential human hazards associated with firearms use are concerns expressed during public scoping processes. To ensure safe use and awareness, WS' personnel who use firearms to conduct official duties are required to attend an approved firearm safety and use training program, and repeat safety training biannually (WS Directive 2.615). WS' personnel who carry and use firearms as a condition of employment, are required to sign a form certifying that they meet the criteria as stated in the *Lautenberg Amendment*, which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence. Additionally, USDA runs thorough background checks on all new employees entering the agency.

The use of restraining devices such as foothold traps, body-grip traps, or snares is a sensitive issue because some people believe they could be captured and restrained by those methods. Some believe those methods indiscriminately and automatically capture people who may unknowingly approach locations where those traps or snares are placed. When conducting activities that require using such devices, WS' personnel provide information about the techniques used to the appropriate landowners or land management personnel. WS is also assisting with the development of Best Management Practices (BMP) for improving traps and trapping programs. Those BMP evaluate the animal welfare and efficiency of various traps for species, which can be legally harvested in North America.

2.2.2.3 Effects on Human Health and Safety from not Conducting MDM

An issue raised is that the absence of adequate MDM would result in an increased risk of transmission of mammal-borne diseases and aircraft striking mammals resulting in the loss of human life. The potential impacts of not conducting such work could lead to increased incidence of injuries, illness, or human deaths.

As discussed in subsection 1.3.2, in Kentucky raccoons are abundant in urban environments. They have been associated with the spread of rabies in other states throughout the east, including states adjacent to Kentucky (USDA 2001b, B. Dunlap, WS, pers. comm. 2007). Rabies can pose a direct threat to humans. However, in Kentucky no cases of raccoon rabies have been reported. Rabies is most often transmitted through the bite of a rabid animal. The disease can be effectively prevented in humans and many domestic animals species, but abundant and widely distributed reservoirs among wild mammals complicate rabies control. The vast majority of rabies cases reported to the CDC each year occur in raccoons, skunks (primarily *Mephitis mephitis*), and bats (Order *Chiroptera*). However, 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 all greater when raccoon rabies is present in the area.

Increased populations of raccoons have been implicated in the outbreak of distemper in certain areas. However, distemper has not been identified as transmissible to humans, but urban residents who observe sick raccoons on their property feel threatened. Further, people could be bitten by those affected animals, which lose their fear of humans, and can act aggressively at times.

Beaver activity in certain situations can become a threat to public health and safety. In urban areas, beaver activity can cause increased water levels in urban areas resulting in unsanitary conditions and potential health problems by flooding septic systems and sewage treatment facilities. Beaver damming activity also creates conditions favorable to mosquitoes and can hinder mosquito control efforts or result in population increases of those insects (Wade and Ramsey 1986). In addition, beaver are carriers of the intestinal parasite *Giardia lamblia*, which can contaminate human water supplies and cause outbreaks of the disease Giardiasis in humans (Woodward 1983, Beach and McCulloch 1985, Wade and Ramsey 1986, Miller and Yarrow 1994). The CDC has recorded at least 41 outbreaks of waterborne Giardiasis, affecting more than 15,000 people. Beaver are also known carriers of tularemia, a bacterial disease that is transmittable to humans through bites by insect vectors or infected animals, or by handling animals or carcasses, which are infected (Wade and Ramsey 1986). On rare occasions, beaver may contract the rabies virus and attack humans (Todd Menke, WS, pers. comm. 2002).

As discussed in subsection 1.3.3, WS frequently assists airports in Kentucky that seek to resolve wildlife hazards to air passengers. Airport managers and air safety officials are concerned that the absence of a WS MDM program would inadequately address the complex wildlife hazard problems faced by those facilities. Hence, potential effects of not conducting such work could lead to an increased incidence of injuries or loss of human lives from aircraft striking mammals.

2.2.3 Effects on the Socio-cultural Elements and Economics of the Human Environment

2.2.3.1 Effects on Human Affectionate-Bonds and Aesthetic Values of Wild Mammal Species

Aesthetics is a philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics is subjective in nature and is dependent on what an observer regards as beautiful.
The human attraction to animals has been well documented throughout history and started when humans began domesticating animals. The American public is no exception, and today a large percentage of households have pets.

Some individual members or groups of wild and feral domestic mammal species habituate and learn to live in close proximity to humans. Some people in those situations feed such mammals and/or otherwise develop emotional attitudes toward such animals that result in aesthetic enjoyment. In addition, some people consider individual wild mammals as “pets,” or exhibit affection toward those animals. Examples

would be people who visit state or national parks to feed deer, or visit a city park to feed squirrels or raccoons, or homeowners who have wildlife feeders or bat houses. Many people do not develop emotional bonds with individual wild animals, but experience aesthetic enjoyment from observing them. Therefore, the public reaction is variable and mixed to WDM because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to reduce conflicts/problems between humans and wildlife. There may be some concern that the proposed action or alternatives would result in the loss of aesthetic benefits to the public, resource owners, or neighboring residents. Wildlife generally is regarded as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exists is a positive benefit to many people.

Wildlife populations provide a range of social and economic benefits (Decker and Goff 1987). Those include direct benefits related to consumptive and non-consumptive use (e.g., wildlife-related recreation, observation, harvest, sale), indirect benefits derived from vicarious wildlife related experiences (e.g., reading, television viewing), and the personal enjoyment of knowing wildlife exists and contributes to the natural ecosystems (e.g., ecological, existence, bequest values) (Bishop 1987). Direct benefits are derived from a user's personal relationship to animals and may take the form of direct consumptive use (using the animal or intending to) or non-consumptive use (viewing the animal in nature or in a zoo, photography) (Decker and Goff 1987).

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

Public reaction to damage management actions is variable because individual members of the public can have widely different attitudes toward wildlife. Some individuals negatively affected by wildlife support removal or relocation of damaging wildlife, while other individuals affected by the same wildlife may oppose removal or relocation. Individuals unaffected by wildlife damage may be supportive, neutral, or opposed to wildlife removal depending on their individual personal views and attitudes.

Some people do not believe that mammals should even be harassed to stop or reduce damage problems. Some of them are concerned that their ability to view mammals is lessened by non-lethal harassment efforts. Those totally opposed to MDM want WS to teach tolerance for damage and threats to public health or safety, and that wildlife should never be killed. Some people would strongly oppose removal of mammals regardless of the amount and type of damage. Some members of the public who oppose removal of wildlife 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.

Some individuals are offended by the presence of overabundant mammal species, such as rats, mice, and even raccoons, opossums, deer, or feral species, such as feral cats and feral hogs. To such people, those species represent nuisance pests that upset the natural order in ecosystems, and serve as reservoirs of diseases transmissible to humans or other wildlife. Their overall enjoyment of other mammals is diminished 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 unchecked.

2.2.3.2 Effects on Aesthetics and Value of Property Damaged by Mammals

Property owners that have herbivores browsing and killing landscape vegetation and natural plants on their holdings, or have beaver damming, flooding and destroying their trees, or voles or rabbits killing expensive ornamentals and shrubs by girdling them are generally concerned about the negative aesthetic appearance of such sites, and loss of valuable property as a result of such activities. Business owners are particularly concerned because negative aesthetics can result in lost business. Recovery of aesthetic appearance of business property might include labor and costs of replacement plants and trees, costs of methods to

mitigate flooding or reduce erosion, and costs associated with implementation of WDM methods. They are also concerned about direct loss of the use of property and of income which might have been gained from the sale of commercially valuable resources, loss of aesthetic value of flowers, plants, and gardens consumed by herbivores, and lost time contacting local health departments and wildlife management agencies on health and safety issues.

2.2.4 Effects on Wetlands

The issue of WS' potential impacts to wetlands stems from beaver damage management, primarily from the removal of beaver dams. Beaver dam removal during activities to manage damage caused by beaver sometimes occurs in areas inundated by water resulting from flooding. Beaver build dams primarily in smaller riverine systems (intermittent and perennial streams and creeks). Dam material usually consists of mud, sticks, and other vegetative material. Their dams obstruct the normal flow of water and typically change the preexisting hydrology from flowing or circulating waters to slower, deeper, more expansive waters that accumulate bottom sediment. The depth of the bottom sediment depends on the length of time an area is covered by water 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 USACE 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."*

The preexisting habitat and the altered habitat have different ecological values to the fish and wildlife native to the area. Some species will abound by the addition of a beaver dam, while others will diminish. For example, some species of darters listed as federally endangered require fast moving waters over gravel or cobble beds, which beaver dams can eliminate, thus reducing the habitat's value for those species. In areas where bottomland forests are flooded by beaver, if left unchecked, a change is species composition over time will occur. Hardwood trees are killed from flooding and mast production declines. Conversely, beaver dams can potentially be beneficial to some wildlife such as river otter, Neotropical birds, and waterfowl.

If a beaver dam is not removed and water is allowed to stand, hydric soils and hydrophytic vegetation eventually form. This process can 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 are met, then a wetland has developed that will have different wildlife habitat values than an area that has been more recently impounded by beaver dam activity.

The intent of most dam removal operations is not to drain old established wetlands. With few exceptions, requests from public and private individuals and entities that WS receives involve dam removal to return an area to the condition that existed before the dam had been built, or before it had been affecting the area for more than a few years. WS' beaver damage management activities are primarily conducted to address damage to agricultural crops, timber resources, public property such as roads and bridges, and water management structures. Beaver dam removal activities are conducted primarily on small watershed streams, tributary drainages, and ditches. Those activities can be described as small, exclusive projects conducted to restore water flow through previously existing channels.

In the majority of instances, beaver dam removal is accomplished by manual methods (i.e., hand tools). In some instances, binary explosives are utilized to breach dams. WS' personnel do not utilize heavy equipment, such as trackhoes or backhoes, for beaver dam removal. Only the portion of the dam blocking the stream or ditch channel is breached. In some instances, WS' activities involve the installation of structures to manage

water levels at the site of a breached beaver dam. In FY 1998-2006, 77 dams were removed in WS' beaver damage management activities. Among those, 63 were removed by hand and 14 were removed with binary explosives (USDA 2007).

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 5 years as indicated by the Swampbuster provision of the Food Security Act. Most beaver dam removal by WS is allowed under exemptions stated in 33 CFR parts 323 and 330 of Section 404 of the Clean Water Act or parts 3821 and 3822 of the Food Security Act. However, the removal of some beaver dams can trigger certain portions of Section 404 that require landowners to obtain permits from the USACE prior to removing a blockage. WS' personnel determine the proper course of action upon inspecting a beaver dam impoundment. Appendix B describes the procedures used by WS to assure compliance with the pertinent laws and regulations.

2.2.5 Humaneness of Methods Used by WS

The issue of humaneness and animal welfare, as it relates to the killing or capturing of wildlife is an important but very complex concept that can be interpreted in a variety of ways. Schmidt (1989) indicated that vertebrate pest 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."*

According to the American Veterinary Medical Association (AVMA) (1987), suffering is described 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 (CDFG) 1991), such as shooting.

Defining pain as a component in humaneness of WS' methods appears to be a greater challenge than that of suffering. Pain obviously occurs in animals. Altered physiology and behavior can be indicators of pain, and identifying the causes that elicit pain responses in humans would *" . . . probably be causes for pain in other animals . . ."* (AVMA 1987). However, pain experienced by individual animals probably ranges from little or no pain to considerable pain (CDFG 1991).

Pain and suffering, as it relates to WS' damage management methods, has both a professional and lay point of arbitration. Wildlife managers and the public would be better served to recognize the complexity of defining suffering, since *" . . . neither medical nor veterinary curricula explicitly address suffering or its relief"* (CDFG 1991). Research suggests that some methods, such as restraint in foothold traps or changes in the blood chemistry of trapped animals, indicate "*stress*" (USDA 1997). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness.

The AVMA states "*... euthanasia is the act of inducing humane death in an animal*" and "*... the technique should minimize any stress and anxiety experienced by the animal prior to unconsciousness*" (Beaver et al. 2001). Some people would prefer AVMA accepted methods of euthanasia to be used when killing all animals, including wild and feral animals. The AVMA states that "*For 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).

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 within the constraints imposed by current technology and funding.

WS has improved the selectivity and humaneness of management techniques through research and development. Research is continuing to bring new findings and products into practical use. Until new findings

and products are found practical, a certain amount of animal suffering could occur when some MDM methods are used in situations where non-lethal damage management methods are not practical or effective.

Kentucky WS' personnel are experienced and professional in their use of WDM methods, so that they are as humane as possible under the constraints of current technology, workforce, and funding. SOPs used to maximize humaneness are listed in Chapter 4.

2.2.5.1 Humaneness of Using Drowning Sets for Euthanizing Beaver and Muskrats

An issue when dealing with aquatic rodent species is the use of drowning methods and the humaneness of drowning. There is considerable debate and disagreement among animal interest groups, veterinarians, wildlife professionals, fur trappers, and nuisance wildlife control specialists on this issue. The debate centers on an uncertainty as to whether the drowning animals are rendered unconscious by high levels of CO_2 and are thus insensitive to distress and pain (Ludders et al. 1999).

The AVMA identifies drowning as an unacceptable method of euthanasia (Beaver et al. 2001, AVMA 2007), but provides no literature citations to support this position. Ludders et al. (1999) concluded drowning is not euthanasia based on the animals not dying from CO_2 narcosis, and reported CO_2 narcosis does not occur until 95 millimeters of mercury in arterial blood is exceeded. Ludders et al. (1999) showed death during drowning is from hypoxia and anoxia; thus, animals experience hypoxemia. Ludders et al. (1999) concluded that animals that drown are distressed because of stress related hormones, epinephrine and norepinephrine, and therefore drowning is not euthanasia.

Carbon dioxide (CO_2) causes death in animals by hypoxemia and some animals (cats, rabbits, and swine) are distressed before death (Beaver et al. 2001). Even though those animals are distressed, the AVMA (Beaver et al. 2001) states this death is an acceptable form of euthanasia. Thus, the AVMA does not preclude distress or pain in euthanasia. In fact, the AVMA supports inducing hypoxemia-related distress when necessary to reduce total distress, because reducing total distress is a more humane death.

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 CO_2-induced narcosis, and the AVMA has stated the use of CO_2 is acceptable (Gilbert and Gofton 1982, Noonan 1998). Gilbert and Gofton (1982) reported that after beaver were trapped and entered the water, they struggled for 2-5 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 may have removed much of the sensory perception by 5-7 minutes post submersion.

However, Gilbert and Gofton (1982) have been criticized because levels of carbon dioxide in the blood were not reported (Ludders et al. 1999) and there was insufficient evidence that the beaver in their study were under a state of CO_2 narcosis when they died (letter from V. Nettles, D.V.M., Ph.D., Southeastern Cooperative Wildlife Disease Study, to W. MacCallum, Massachussetts Division of Fisheries and Wildlife, June 15, 1998). Adding to the controversy, Clausen and Ersland (1970) did measure CO_2 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 CO_2 narcosis. Clausen and Ersland (1970) demonstrated that CO_2 increased in arterial blood while beaver were submersed and CO_2 was retained in the tissues. While Clausen and Ersland (1970) did measure the amounts of CO_2 in the blood of submersed beaver, they did not attempt to measure the analgesic effect of CO_2 buildup to the beaver (letter from V. Nettles, D.V.M., Ph.D., Southeastern Cooperative Wildlife Disease Study, to W. MacCallum, Massachussetts Division of Fisheries and Wildlife, June 15, 1998). When beaver are trapped using foothold traps with intent to "drown", the beaver are exhibiting 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 mammals such as beaver, nutria, and muskrats. Trapper education manuals and other WDM 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 and 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 snares because of unstable banks, deep water, or a marsh with a soft bottom, but those sites would be suitable for foothold traps.

Given the short time period of a drowning event, the possible analgesic effect of CO_2 buildup, the minimal if any pain or distress on drowning animals, the AVMA's acceptance of hypoxemia as euthanasia, the AVMA's acceptance of a minimum of pain and distress during euthanasia, and the acceptance of catching and drowning muskrats approved by International Humane Trapping Standards (Fur Institute of Canada 2000), we conclude that drowning, though rarely used by WS, is acceptable. We recognize some people will disagree.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

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

WS has the discretion to determine the geographic scope of their NEPA analyses (Kleppe v Sierra Club, 427 U.S. 390, 414 (1976), CEQ 1508.25). Ordinarily, according to APHIS procedures implementing the NEPA, individual WDM actions may be categorically excluded (7 CFR 372.5(c), 60 Fed. Reg. 6000-6003, 1995). The intent in developing this EA is to determine if the proposed action would potentially have significant individual and cumulative impacts on the quality of the human environment that would warrant the preparation of an EIS or a finding of no significant impact. This EA addresses impacts for managing damage and threats to human safety caused by certain mammal species in Kentucky to analyze individual and cumulative impacts to provide thorough analyses.

In terms of considering cumulative effects, one EA analyzing impacts for the entire State will provide a more comprehensive and less redundant analysis than multiple EA covering smaller areas. If a determination is made through this EA that the proposed action would have a significant impact on the quality of the human environment, then an EIS would be prepared.

2.3.2 Effects on Public Use of Mammals

Many mammal species offer enjoyment to wildlife watchers and hunters and provide a significant economic contribution in Kentucky. Approximately 233,000 residents participated in hunting activities in Kentucky during 2006 (USFWS 2007). The number of Kentucky residents who participate in some type of wildlife watching activity totals 1,208,000 (USFWS 2007). An additional 558,000 individuals reported some type of wildlife watching activity while visiting Kentucky during 2007 (USFWS 2007). During 2006, almost two million people participated in activities such as wildlife watching and hunting in the State. In pursuit of recreation related to photographing, feeding, watching, and hunting they contributed more than $1.8 billion to the economy of the State for expenses related to travel, equipment, feed, licenses, wildlife club memberships and other associated costs (USFWS 2007). Because mammals are such a substantial economic and recreational resource, there may be concerns that WS' MDM actions related to managing damage by mammals might negatively affect those factors.

WS conducts no program in Kentucky to eradicate native wildlife populations (see section 2.3.3). WS' activities are conducted at the request of an affected resource owner with those activities only affecting those individuals of a the target mammal species identified as responsible for causing specific damage or posing a threat to human safety. The mammal species addressed in this EA are not considered to be of low density in Kentucky. Therefore, the public use of a particular mammal species may be temporarily reduced in a specific area where WS' has been requested to conducted damage management activities. However, since densities of those species are considered high, WS' temporary removal or dispersal of target animals will not affect the ability of those interested to harvest or enjoy viewing mammals in Kentucky.

2.3.3 WS' Effect on Biodiversity

The WS' program does not attempt to eradicate any species of native wildlife in the State of Kentucky. WS operates in accordance with international, federal and state laws and regulations enacted to ensure species viability. The effects of the current WS' program on biodiversity are not significant nationwide or statewide (USDA 1997). In the case of local populations of non-native species such as feral cats, feral dogs, and feral hogs the goal may be to reduce a local population but because such species are not native wildlife, they are not an essential component of the native biodiversity. Rarely, if ever, would MDM result in the long term local reduction of even those non-native species.

2.3.4 A Threshold of Loss Should Be Established Before Conducting Activities

One issued identified through WS' scoping processes is a concern that a threshold of loss should be establish before employing lethal methods to resolve damage and that wildlife damage should be a cost of doing business. Cooperators can tolerate some damage and economic loss until the damage reaches a threshold where damage becomes an economic burden. The appropriate level of allowed tolerance or threshold before employing lethal methods would differ among cooperators and damage situations. Establishing a threshold would be difficult or inappropriate to apply to human health and safety situations.

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

2.3.5 Wildlife Damage Management Should Not Occur at Taxpayer Expense

Another issue identified is a concern that WDM should not be provided at the expense of the taxpayer or that it should be fee-based. WDM is appropriate for government programs, since wildlife management is a government responsibility. A commonly voiced argument for publicly funded WDM is that the public should bear responsibility for damage to private property caused by public wildlife.

Direct damage management activities in Kentucky conducted by WS are fee-based to a high degree. WS does receive federal appropriations to conduct wildlife damage management activities. However, direct damage management activities conducted to resolve or alleviate damage caused by wildlife in Kentucky is almost entirely funded by the requestor. A federal appropriation is allotted for the maintenance of a WS' program in Kentucky, which allows for the dissemination of information and demonstrations of methods through technical assistance. Therefore, WS' activities are funded to a high degree through cooperative agreements in which damage management activities are partially or fully funded by the requestor. With WDM being a component of wildlife management, which is a governmental responsibility, it is appropriate for governmental entities to be involved with damage management activities involving wildlife.

2.3.6 Cost Effectiveness of MDM

The CEQ does not require a formal, monetized cost benefit analysis to comply with NEPA. Consideration of this issue is not essential to making a reasoned choice among the alternatives being considered. However, the methods determined to be most effective to reduce damage and threats to human safety caused by certain mammal species and prove to be the most cost effective will receive the greatest application. Additionally, management operations may be constrained by cooperator funding and/or objectives and needs.

2.3.7 Wildlife Damage Should Be Managed By Private Nuisance Wildlife Control Agents

Private nuisance wildlife control agents could be contacted to reduce mammal damage by resource owners. Some property owners would prefer to use a private nuisance wildlife control agent because the nuisance wildlife agent is located in closer proximity and thus could provide the service at less expense, or because they prefer to use a private business rather than a government agency. However, some property owners would prefer to enter into a Cooperative Service Agreement with a government agency. In particular, large industrial businesses and cities and towns may prefer to use WS because of security and safety issues and reduced administrative burden. Additionally, the use of some damage management methods to effectively resolve or alleviate damage, used alone or as part of an IWDM program, may be restricted to governmental entities. In those circumstances, the requestor may seek the services of WS to most effectively resolve WDM issues.

3.0 CHAPTER 3: ALTERNATIVES INCLUDING THE PROPOSED ACTION

Chapter 3 contains a discussion of the project alternatives, including those that will receive detailed environmental impacts analysis in Chapter 4 (Environmental Consequences), alternatives considered but not analyzed in detail, with rationale, and SOPs for WDM techniques. Pertinent portions of the affected environment will be included in this chapter in the discussion of issues used to develop SOPs. Evaluation of the affected environments will be addressed in more detail in Chapter 4.

Alternatives were developed for consideration using WS' Decision Model (Slate et al. 1992) as described in WS' FEIS (USDA 1997).

The No Action alternative is a procedural NEPA requirement (40 CFR 1502) and is a viable and reasonable alternative that could be selected. This alternative serves as a baseline for comparison with the other alternatives. The No Action alternative, as defined here, is consistent with the CEQ definition (CEQ 1981).

3.1 DESCRIPTION OF THE ALTERNATIVES

Alternatives analyzed in detail are:

3.1.1 Alternative 1 – Adaptive Integrated Mammal Damage Management Program (No Action/Proposed Action)

The proposed action is to continue the current portion of the WS' program in Kentucky that responds to requests for MDM to protect agriculture, human health and safety, natural resources, and property in Kentucky. One component of MDM in the Kentucky WS' program has the goal of minimizing human health and safety threats and property damage in urban and rural environments. Primary species of concern related to damage in those environments are raccoons, coyotes, groundhogs, skunks, and beaver. Damage by those or other mammal species also may be addressed by WS in MDM programs aimed at reducing losses or the risk of loss to agricultural crops, livestock, timber, and any other agriculture-related resource. In addition, damage caused by mammal species to natural resources, including T&E species, wildlife, natural flora, parklands, recreation areas, and peculiar habitats may be addressed through programs conducted by WS. Elimination or alleviation of damage to property such as residential and non-residential buildings, water resources, dikes, dams, impoundments, drainages, landscape plantings, golf courses, grasses and turf, pets, zoo animals, trees, or any other properties would be an objective of WS' MDM programs considered under this EA.

WS' objective would be to attempt to respond to all requests for assistance with, at a minimum, technical assistance or self-help advice, or, where appropriate and when funding is available, direct damage management assistance in which WS' personnel conduct damage management actions. An adaptive IWDM approach would be implemented, which would allow use of any legal lethal or non-lethal technique or method, used singly or in combination, to meet requester needs for resolving conflicts with mammals. WS would provide technical assistance and operational damage management by applying WS' Decision Model (Slate et al. 1992). Lethal methods used by WS could include shooting, trapping, snaring, and FDA and EPA-approved chemicals. Non-lethal methods used by WS could include fencing, netting, deterrents/repellents, exclusion, harassment, habitat alteration, or live-capture and translocation for some individuals of some species.

Non-lethal methods would not always be applied as a first response to each damage problem. 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. 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, WS' involvement would be to implement lethal methods if determined to be necessary. MDM would be conducted in Kentucky when requested on private property or public facilities where a need has been documented upon the completion of an *Agreement for Control*. All management actions would comply with appropriate federal, state, and local laws. Appendix B provides a more detailed description of the methods that could be used under the proposed action.

3.1.2 Alternative 2 – Mammal Damage Management through Technical Assistance Only

Under this alternative WS would provide technical assistance to those requesting information on managing damage and threats caused by mammals in Kentucky. However, WS would not be directly involved with managing damage caused by mammals in the State. Technical assistance would occur through the dissemination of information and providing guidance on methodologies used to manage damage and threats from mammals.

Those experiencing damage or are concerned with threats posed by mammals in Kentucky could seek assistance from other governmental agencies, private entities, or conducted damage managements on their own. This alternative would place the immediate burden of operational damage management work on the resource owner and other governmental agencies. Those entities could implement a damage management program using those methods legally available listed in Appendix B or could take no action.

3.1.3 Alternative 3 - No WS' Involvement in Mammal Damage Management

This alternative precludes all activities by WS to protect human health and safety, protect agricultural resources, alleviate damage to property, and protect native wildlife species from impacts of mammals in Kentucky. WS would not provide operational or technical assistance. WS would not respond to requests for assistance and would direct all inquiries to appropriate federal, state, and/or local agencies or private business. This alternative would not deny other federal, state, and local agencies, including private entities from conducting management activities directed at alleviating damage and threats associated with those mammal species addressed in this EA. Many of the methods listed in Appendix B would be available for use by other agencies and private entities, unless otherwise noted in the Appendix, to manage damage and threats associated mammals in Kentucky.

3.2 METHODOLOGIES AVAILABLE TO WS IN KENTUCKY

The strategies and methodologies described below include those that could be used or recommended under Alternative 1 and Alternative 2 described above. Alternative 3 would terminate both WS' technical assistance and operational MDM activities. Appendix B provides a more thorough description of the methods that could be used or recommended by WS.

3.2.1 Integrated Wildlife Damage Management

For more than 70 years, WS has considered, developed, and used numerous methods of managing wildlife damage problems (USDA 1997). The efforts have involved research and development of new methods and the implementation of effective strategies to resolve wildlife damage.

The most effective approach to resolving wildlife damage is to integrate the use of several methods simultaneously or sequentially. IWDM is the implementation and application of safe and practical methods for the prevention and control of damage caused by wildlife based on local problem analyses, and the informed judgment of trained personnel. The WS' program applies IWDM (WS Directive 2.105) to reduce damage through WS' Decision Model (Slate et. al. 1992) described in the FEIS (USDA 1997).

The philosophy behind IWDM is to implement functional damage management techniques in an overall effective manner, while minimizing the potentially harmful effects on humans, target and non-target species, and the environment. IWDM draws from the largest possible array of options to create a combination of techniques appropriate for the specific circumstances. IWDM may incorporate cultural practices (i.e. animal husbandry), habitat modification (i.e., barriers, exclusionary methods), animal behavior modification (i.e. scaring), population management (i.e., local population reduction, redistribution of animal populations through live-capture and translocation), or any combination of those, depending on the characteristics of the specific damage problems and other criteria, such as management objectives of state wildlife agencies. In selecting management techniques for specific damage situations, consideration is given to the:

- Species responsible,
- Magnitude and geographic extent of damage,

- Duration and frequency of the damage,
- Prevention of future damage (lethal and non-lethal techniques), and
- Environmental concerns, such as T&E species in the same area.

The cost of IWDM may be secondary because of overriding environmental, legal, human health and safety, animal welfare, or other concerns.

WS employs different strategies to resolve wildlife damage problems. In certain situations, WS may provide cooperators with the information necessary to resolve the problem themselves (technical assistance). In other situations, WS may directly resolve the problem (direct assistance). However, the most common strategy to resolve wildlife damage is to use a combination of those approaches.

3.2.2 The IWDM Strategies Employed by WS

3.2.2.1 Technical Assistance Recommendations

Technical assistance as used herein is information, demonstrations, and advice on available and appropriate WDM methods. The implementation of damage management actions is the responsibility of the requester. In some cases, WS provides supplies or materials that are of limited availability for non-WS entities to use. Technical assistance may be provided through a personal or telephone consultation, or during an on-site visit with the requester. Generally, several management strategies are described to the requester for short and long-term solutions to damage problems. Those strategies are based on the level of risk, need, and the practicality of their application.

Under APHIS' NEPA implementing regulations and specific guidance for the WS' program, WS' technical assistance is categorically excluded from the need to prepare an EA or EIS. However, it is discussed in this EA because it is an important component of the IWDM approach to resolving mammal damage problems.

3.2.2.2 Operational Damage Management Assistance

Operational assistance is the conduct or supervision of damage management activities by WS' personnel. Operational damage management assistance may be initiated when the problem cannot effectively be resolved through technical assistance alone, and when *Agreements for Control* or other comparable instruments provide for direct damage management by WS. The initial investigation defines the nature, history, extent of the problem, species responsible for the damage, and methods that would be available to resolve the problem. Professional skills of WS' personnel are often required to effectively resolve problems, especially if restricted use pesticides are necessary, or if the problems are complex.

3.2.2.3 Education/Outreach Programs

Education/outreach is an important element of WS' program activities because WDM is about finding "balance" or co-existence between the needs of people and wildlife. 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 sustaining damage, lectures and demonstrations are provided to agricultural producers, homeowners, and other interested groups. WS frequently cooperates with other agencies in education and public information efforts. Additionally, technical papers are presented at professional meetings and conferences so that WS' personnel, other wildlife professionals, and the public are updated on recent developments in damage management technology, laws and regulations, and agency policies. WS provides informational leaflets about WDM, biology, and ecology. The WS' program in Kentucky annually provides hundreds of mammal leaflets and handouts to the public about MDM. This information is disseminated by means of school programs, exhibits, and calls from requesters.

3.2.2.4 Research and Development

The National Wildlife Research Center (NWRC) functions as the research unit of WS by providing scientific information and development of methods for WDM that is effective and environmentally responsible. NWRC scientists work closely with wildlife managers, researchers, field specialists and others to develop and evaluate WDM techniques. NWRC scientists have authored hundreds of scientific publications and reports and are respected worldwide for their expertise in WDM.

3.2.2.5 Examples of WS' Operational and Technical Assistance Activities in Kentucky

The following examples serve as illustrations of WS' operational and technical assistance MDM projects. They are intended to present realistic examples of on-going MDM projects only and are not a conclusive or all-encompassing list of all MDM projects conducted by WS in Kentucky.

Management of Wildlife Hazards to Aircraft and Air Passengers in Kentucky

WS participates with the FAA under a MOU to provide information or services, upon request, to airports in Kentucky. WS evaluates wildlife hazards at airports upon request, provides such airports with Wildlife Hazard Assessments which outline wildlife hazards found, and assists airports in developing Wildlife Hazard Management Plans to address wildlife threats. IWDM strategies are employed and recommended for those facilities.

WS' current program in Kentucky conducts IWDM programs and monitors wildlife hazards at airports to ensure the protection of human lives and aircraft. In addition to direct operational activities consisting of various harassment, live capture, and lethal removal techniques aimed at potentially injurious wildlife, WS personnel provide ongoing technical advice to airport managers regarding methodologies to reduce the presence of wildlife in airport environments. WS may also oversee various habitat management projects implemented by airport personnel in order to provide technical expertise about reducing wildlife attractants. In addition, WS promotes improved mammal strike record keeping and maintains a program of mammal identification and monitoring of mammal numbers at participating airports.

WS may receive requests in the future from airports previously discussed or any other airports in Kentucky for assistance in resolving wildlife hazards to aviation. WS may provide technical assistance and/or direct operational assistance using any combination of approved methods discussed in this EA which are appropriate for use in airport environments.

Management of Damage Caused by Beaver

WS conducts operational beaver damage management projects at the request of various federal and state agencies, organizations, and individuals to reduce beaver damage to bottomland hardwood timber, levees and dams, waterfowl refuges, agricultural crops, commercial timber, roads and bridges, natural areas, and other property.

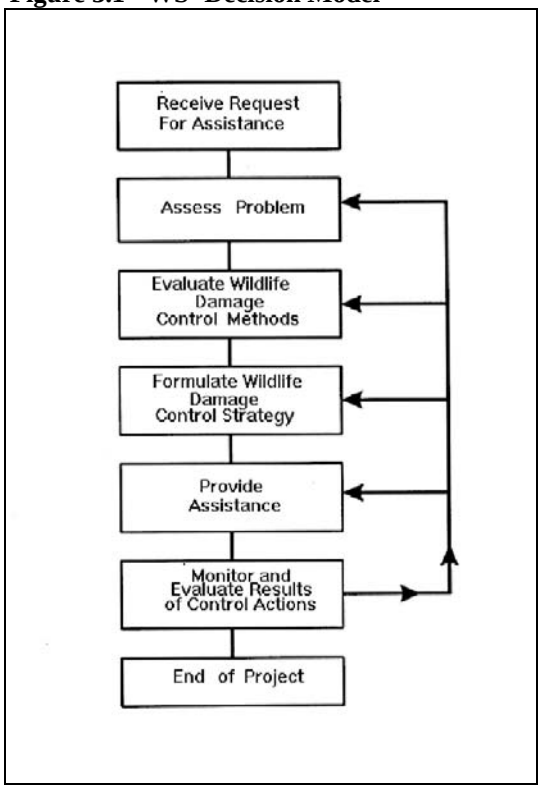
When conducting operational beaver damage management activities, WS utilizes a variety of lethal methods to remove beaver. Those methods include conibear and foothold traps, snares, and shooting. When warranted, beaver dams are breached by manual methods or through the use of binary explosives. WS often advises cooperators of drainage problems such as excessive siltation and drainage blockages other than beaver dams.

Often individuals experiencing damage caused by beaver will be referred to WS by other federal agencies as well as state agencies. When receiving such calls, WS provides the requester with the techniques, both lethal and non-lethal, that can be utilized to address damage caused by beaver. In some instances, individuals will request operational assistance from WS after techniques are discussed.

3.2.3 WS' Decision Making

WS' personnel use a thought process for evaluating and responding to damage complaints that are depicted by WS' Decision Model described by Slate et al., in 1992 (Figure 3.1). WS' personnel are frequently contacted after requesters have tried or considered non-lethal methods and found them to be impractical, too costly, or inadequate for acceptably reducing damage. WS' personnel assess the problem and evaluate the appropriateness and availability (legal and administrative) of strategies and methods based on biological, economic and social considerations. Following this evaluation, methods deemed to be practical for the situation are incorporated into a management strategy. After this strategy has been implemented, monitoring is conducted and evaluation continues to assess the effectiveness of the strategy. If the strategy is effective, the need for further management is ended. In terms of WS' Decision Model (Slate et al. 1992), most damage management efforts 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.

Figure 3.1 - WS' Decision Model



3.2.4 Mammal Damage Management Methods Available for Use (See Appendix B for detailed descriptions)

3.2.4.1 Nonchemical Methods

Resource owner practices consist primarily of non-lethal preventive methods, such as **cultural methods and habitat modification.**

Animal behavior modification refers to tactics that alter the behavior of mammals to reduce damages. Some but not all of those tactics include the following:

- Propane exploders
- Pyrotechnics
- Visual repellents and scaring tactics
- Electronic guards

Animal husbandry practices include modifications in the level of care or attention given to livestock (depending on the age and size of the livestock). Animal husbandry practices include, but are not limited to, the use of:

- guard animals
- herders
- carcass removal
- fencing
- pasture selection

Habitat modification is used whenever practical to attract or repel certain wildlife species or to separate livestock from predators. For example, WS may recommend that a producer clear brush from lambing or calving pastures to reduce available cover for predators. Habitat management also may involve manipulating beaver impoundment water levels to reduce damage or conflict caused by flooding and inundation. Water control devices and pond levelers are installed to regulate the volume of water and can

be effective in reducing flooding in certain situations. Water control devices and pond levelers also are utilized as a means of exclusion at road culverts.

Beaver Dam Breaching and Removal involves the removal of debris deposited by beaver that impedes water flow. Debris would be removed from beaver dams with binary explosives or hand tools.

Live capture and relocation can be conducted to reduce damage caused by certain mammals. Various capture devices such as box or cage traps and nets can be used to live capture mammals for relocation. In some instances, permits are required by the state wildlife agency to capture and relocate certain mammals.

Lure crops/alternate foods are crops planted or other food resources provided to mitigate the potential loss of higher value crops.

Sport hunting/trapping can be part of a MDM strategy to enhance the effectiveness of harassment techniques or can be used to reduce local populations of mammals. For example, WS sometimes directs sport hunters to contact KDFWR about areas where mammal damage is occurring, or informs individuals requesting assistance about the option of utilizing sport hunting as a management tool (USDA 2001a).

Shooting is selective for the target species and may involve the use of spotlights and rifles or shotguns. Calls and decoys may also be utilized with shooting. WS' personnel using firearms receive firearms safety training as specified by appropriate WS' directives.

Foothold Traps can be effectively used to capture a variety of mammals. Placement of traps is contingent upon habits of the respective target species, habitat conditions, and presence of non-target animals.

Snares are capture devices comprised of a cable formed in a loop with a locking device. Snares are usually placed in travel ways. Snares may be used as either a lethal or non-lethal method. Snares are generally easier to keep operational than foothold traps during inclement weather.

Cage traps are live capture traps used to trap a variety of small-to-medium-sized mammals. Cage traps are available in a variety of sizes. A cage trap is typically made of galvanized wire mesh, and consists of a treadle in the middle of the cage that triggers the door to close behind the animal being trapped.

Body grip (Conibear type) traps are designed to cause the quick death of the animal that activates the trap. Body grip traps usually range in size from #110 to #330. Safety hazards and risks to humans are usually related to setting, placing, checking, or removing traps.

Denning is the practice of finding coyote dens and eliminating the young, adults, or both to stop an ongoing predation problem or prevent future depredation on livestock.

Aerial Shooting or aerial hunting (shooting from an aircraft) is a commonly used coyote damage management method; it especially can be effective in removing offending coyotes that have become "bait-shy" to trap sets or are not susceptible to calling and shooting.

3.2.4.2 Chemical Methods

The chemical methods available to WS for use to manage damage caused by mammals in Kentucky are summarized below. A more detailed description of chemical methods can be found in Appendix B and the MSDS for many of the chemical methods can be found in Appendix C.

Repellents are designed to repel certain mammals. Most repellents are taste repellents used on trees, shrubs, garbage, fences and other objects. Some of the trade names for repellents include:

- Hinder®
- Ropel® Animal, Rodent, and Bird Repellent
- Ropel® Garbage Protector

As with most repellents, frequent reapplication is often necessary to obtain continued results.

Carbon dioxide (CO_2) gas is an AVMA approved euthanasia method which is sometimes used to euthanize mammals that are live captured and when relocation is not a feasible option (Beaver et al. 2001). Live animals are placed in a container or chamber into which CO_2 gas is released. The animal quickly expires after inhaling the gas.

Gas cartridges give off carbon monoxide and other gases when ignited. They are used to fumigate burrows of certain rodents and other mammals.

Toxicants are chemicals that kill instead of repel animals. The use of toxicants by WS' personnel in Kentucky is directed primarily at reducing damage caused by rodents. All toxicants used by WS' personnel are registered under FIFRA and administered by the EPA. WS' personnel who use toxicants are certified to use such products by the KDA according to established rules and regulations set forth by that agency. One toxicant utilized by WS in Kentucky is zinc phosphide (ZP). ZP is a heavy, finely ground black powder that is practically insoluble in water. When ZP comes in contact with moisture, it slowly decomposes and releases phosphine gas (PH_3). Another toxicant that may be used is aluminum phosphide (AP).

Warfarin and Diphacinone are anticoagulant rodenticides used to control rodents around buildings and other structures.

Ketamine (Ketamine HCl) is a dissociative anesthetic that is used to capture wildlife, primarily mammals, birds, and reptiles. It is used to eliminate pain, calms fear, and allays anxiety.

Telazol (tiletamine) is another anesthetic used in wildlife capture. It is 2.5 to 5 times more potent than ketamine; therefore, it generally works faster and lasts longer.

Xylazine is a sedative that calms nervousness, irritability, and excitement, usually by depressing the central nervous system. Xylazine is commonly used with ketamine to produce a relaxed anesthesia.

Sodium Pentobarbital is a barbiturate that rapidly depresses the central nervous system to the point of respiratory arrest. There are DEA restrictions on who can possess and administer this drug. Some states may have additional requirements for personnel training and particular sodium pentobarbital products available for use in wildlife. Certified WS' personnel are authorized to use sodium pentobarbital and dilutions for euthanasia in accordance with DEA and state regulations.

3.3 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

The following are several alternatives that were considered, but not analyzed in detail:

3.3.1 Lethal MDM Only by WS

Under this alternative, WS would not conduct any non-lethal control of mammals for MDM purposes in the State but would only conduct lethal MDM. This alternative was eliminated from further analysis because some mammal damage problems can be resolved effectively through non-lethal means. For example, a number of damage problems involving the encroachment of smaller mammals, such as squirrels, into buildings can be resolved by installing barriers or repairing structural damage to the buildings, thus excluding the animal. Further, damage situations such as immediately shooting a coyote on a runway might not be possible, whereas scaring them away through noise harassment might resolve the air passengers' threat at once. In addition, a lethal-only program does not satisfy wildlife management objectives of WS, KDFWR, and USFWS.

3.3.2 Compensation for Mammal Damage Losses

The compensation alternative would require the establishment of a system to reimburse persons impacted by mammal damage. This alternative was eliminated from further analysis because no federal or state laws currently exist to authorize such action. Under such an alternative, WS would not provide any direct management or technical assistance. Aside from lack of legal authority, analysis of this alternative in WS' programmatic FEIS indicated that the concept has many drawbacks (USDA 1997):

- It would require larger expenditures of money and labor to investigate and validate all damage claims, and to determine and administer appropriate compensation.
- Compensation would most likely be below full market value.
- It would be difficult, if not impossible, to assess and confirm losses in a timely manner for all requests, and, therefore, many losses could not be verified and would remain uncompensated.
- Compensation would give little incentive to resource owners to limit damage through improved cultural, husbandry, or other practices and management strategies.
- Not all resource owners would rely completely on a compensation program and unregulated lethal control would most likely continue as permitted by State law.
- Compensation would not be practical for reducing threats to human health and safety.

3.3.3 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 on private, state, local and federal government lands wherever a cooperative program was initiated in the State.

In Kentucky, eradication of native mammal species is not a desired population management goal of state agencies or WS, although most species which chronically cause damage may be taken liberally by the general public, either by authority of Kentucky's nuisance wildlife statutes (KRS 150.170), or with the appropriate permits, in areas where they are causing damage. Some landowners would prefer that some species such as voles and field mice be eradicated. However, eradication as a general strategy for managing mammal damage will not be considered in detail because:

- All state and federal agencies with interest in, or jurisdiction over, wildlife oppose eradication of any native wildlife species.
- 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 damage can be attributed to localized populations of mammals, WS can decide to implement local population suppression as a result of using the WS' Decision Model. Problems with the concept of suppression are similar to those described above for eradication.

It is not realistic or practical to consider large-scale population suppression as the basis of the WS' program. Typically, WS' activities in the State would be conducted on a very small portion of the sites or areas inhabited or frequented by problem species.

3.3.4 Bounties

Payment of funds (bounties) for killing mammals suspected of causing economic losses has not been supported by Kentucky state agencies such as KDFWR and KDA and most wildlife professionals, for many years (Latham 1960, Hoagland 1993). WS concurs with those agencies and wildlife professionals because of several inherent drawbacks and inadequacies in the payment of bounties, including:

- Bounties are generally ineffective at controlling damage, especially over a wide area such as Kentucky,
- Circumstances surrounding the take of animals are typically arbitrary and completely unregulated,
- It is difficult or impossible to assure animals claimed for bounty were not taken from outside the damage management area, and

- WS does not have the authority to establish a bounty program.

3.3.5 Reproduction Control

Reproductive control is often considered for use where wildlife populations are overabundant and where traditional hunting or lethal control programs are not publicly acceptable (Muller et al. 1997). Use and effectiveness of reproductive control as a wildlife population management tool is limited by population dynamic characteristics (longevity, age at onset of reproduction, population size, and biological/cultural carrying capacity), habitat and environmental factors (isolation of target population, cover types, and access to target individuals), socioeconomic and other factors. 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. Research into reproductive control technologies, however, has been ongoing, and the approach will probably be considered in an increasing variety of wildlife management situations.

Reproductive control for wildlife could be accomplished either through sterilization (permanent) or contraception (reversible, initial treatment usually followed by a booster and annual follow-up treatments).

Sterilization could be accomplished through:

- Surgical sterilization (vasectomy, castration, and tubal ligation)
- Chemosterilization
- Gene therapy

Contraception could be accomplished through:

- Hormone implantation (synthetic steroids such as progestins)
- Immunocontraception (contraceptive vaccines)
- Oral contraception (progestin administered daily)

Research into the use of those techniques would consist of laboratory/pen experimentation to determine and develop the sterilization or contraceptive material or procedure, field trials to develop the delivery system, and field experimentation to determine the effectiveness of the technique in achieving population reduction.

Concerns related to costs and logistics of widespread distribution of drugged baits, dosage control and ingestion of baits by children and non-target animals make oral contraception (by steroids) largely impractical (Lowery et al. 1993). More recently, immunocontraception has been studied in various situations and locations, but its potential use appears limited due to considerable constraints regarding treatment and follow-up treatment of a sufficiently large number of target animals, varying immunogenecity of vaccines, genetic backgrounds of individual animals, age, nutritional status, stress, and other factors (Becker and Katz 1997, Becker et al. 1999).

Immunocontraceptive vaccines prevent conception by stimulating the production of antibodies that bioneutralize proteins or hormones essential for reproduction (Miller et al. 2000). The use of porcine zona pellucida (PZP) as a contraceptive agent in wildlife management has been investigated recently (Kirkpatrick et al. 1990, Turner and Kirkpatrick 1991, Turner et al. 1992, Turner et al. 1996), but to date, there is no published documentation that immunocontraceptive vaccines have successfully reduced any free-ranging mammal population. Other components of the reproductive system have been studied for immunocontraception as well, such as Gonadotropin-Releasing Hormone (GnRH) (Becker and Katz 1997, Becker et al. 1999).

NWRC scientists have developed GonaCon™, a new single dose immunocontraceptive vaccine that shows great promise as a wildlife infertility agent. Recent studies have demonstrated the efficacy of this single-shot GnRH vaccine on California ground squirrels, Norway rats, feral cats, feral dogs, feral swine, wild horses and white-tailed deer. Infertility among treated female swine and white-tailed deer lasted up to 2 years without requiring a booster vaccination (Miller et al. 2000). This vaccine overcomes one of the major obstacles of

previous two dose vaccines, the need to only capture animals once to vaccinate them. A single-injection vaccine is much more practical as a field delivery system for use on free-ranging animals.

No fertility control agents have been approved by FDA for non-investigational use on wildlife populations in the U.S. Several materials, however, including GnRH and PZP vaccines, have been classified as investigational drugs that may be used only in rigidly controlled research studies. NWRC studies that are underway at several locations are being conducted as pivotal studies that are required as part of FDAs approval process for a new animal drug.

One possible approach is gene therapy, which could accomplish reproductive control via sterilization through producing death of the anterior pituitary cells that synthesize luteinizing hormone, which triggers ovulation in females and spermatogenesis in males. Efficacy testing and development of a delivery system will be investigated over the next few years.

The use of reproductive control is subject to federal and state regulation. Additionally:

- No chemical or biological agent to accomplish reproductive control for free-ranging mammals has been approved by federal and Kentucky authorities,
- If an effective tool was legally available, and if the project area was fenced., it would take many years for some mammal populations to stabilize at a lower level, and ongoing damage would continue to occur at unacceptably high levels, and
- There are considerable logistic, economic, and socio-cultural limitations to trapping, capturing and chemically treating the hundreds or thousands of mammals that would be necessary to cause an eventual decline in the population. Because there is no tool currently available for field application, and due to considerable logistic, economic, and socio-cultural limitations to the use of fertility control on free-ranging mammals, this approach is not considered for further analysis in this EA.

3.3.6 Non-lethal Methods Required Before Lethal Methods

This alternative would require that all non-lethal methods or techniques described in Appendix B be applied to all requests for assistance to reduce damage and threats to safety from mammals in Kentucky. If the use of all non-lethal methods fails to resolve the damage situation or reduce threats to human safety at each damage situation, lethal methods would be employed to resolve the request. Non-lethal methods would be applied to every request for assistance regardless of severity or intensity of the damage or threat until deemed inadequate to resolve the request. 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, only the presence or absence of non-lethal methods can be evaluated. WS' proposed action described in section 3.1.1 is similar to a non-lethal before lethal alternative because WS considers the use of non-lethal methods before lethal methods (WS Directive 2.101). Adding a non-lethal before lethal alternative and the associated analysis would not add additional information to the analyses in the EA.

3.4 STANDARD OPERATING PROCEDURES FOR MAMMAL DAMAGE MANAGEMENT TECHNIQUES

3.4.1 Standard Operating Procedures

The current WS' program, nationwide and in Kentucky, uses many SOPs. Some key SOPs pertinent to the proposed action and alternatives include:

- The WS' Decision Model thought process, which is used to identify effective WDM strategies and their effects.
- RPMs or reasonable and prudent alternatives (RPA) are identified through consultation with the USFWS and are implemented to avoid effects to T&E species.

- EPA-approved label directions are followed for all pesticide use. The registration process for chemical pesticides is intended to assure minimal adverse effects to the environment when chemicals are used in accordance with label directions.
- Drugs are used according to the DEA, FDA, and WS' program policies and directives with procedures followed to minimize pain.
- All controlled substances are registered with DEA or FDA.
- WS' employees would follow approved procedures outlined in the WS Field Manual for the Operational Use of Immobilizing and Euthanizing Drugs (USDA 2001c).
- WS' employees that use controlled substances are trained to use each material and are certified to use controlled substances under Agency certification program.
- WS' employees who use pesticides and controlled substances participate in State-approved continuing education to keep abreast of developments and maintain their certifications.
- Pesticide and controlled substance use, storage, and disposal conform to label instruction and other applicable laws and regulations and Executive Order 12898.
- Material Safety Data Sheets (MSDS) for pesticides and controlled substances are provided to all WS personnel involved with specific WDM activities.
- All WS' personnel in the State who use restricted chemicals are trained and certified by, or else operate under the direct supervision of, program personnel or others who are experts in the safe and effective use of chemical MDM materials.
- Research is being conducted to improve MDM methods and strategies so as to increase selectivity for target species, to develop effective non-lethal control methods, and to evaluate non-target hazards and environmental effects.

Some additional factors specific to the current program include:

- Management actions would be directed toward localized populations or groups of target species and/or individual offending members of those species. Generalized population suppression across the State, or even across major portions of the State, would not be conducted.
- WS uses MDM devices and conducts activities for which the risk of hazards to public safety and hazard to the environment have been determined to be low according to a formal risk assessment (USDA 1997, Appendix P). Where such activities are conducted on private lands or other lands of restricted public access, the risk of hazards to the public is even further reduced.

3.4.2 Additional SOPs Specific to the Issues

The following is a summary of additional SOPs that are specific to the issues listed in Chapter 2 of this document.

3.4.2.1 Effects on Target Species Populations

- MDM activities are directed to resolving mammal damage problems by taking action against individual problem mammals, or local populations or groups, not by attempting to eradicate populations in the entire area or region.
- WS' take is monitored by comparing numbers of mammals killed by species or species group (e.g., carnivore) with overall populations or trends in populations to assure the magnitude of take is maintained below the level that would cause significant adverse effects to the viability of native species populations (See Chapter 4).

3.4.2.2 Effects on Non-target Species Populations Including T&E Species

- WS' personnel are trained and experienced to select the most appropriate method for taking problem animals and excluding non-targets. For example, WS' personnel utilize pan tension devices or alter trap triggers in order to exclude or reduce the capture of non-target species.
- WS has consulted with the USFWS regarding potential effects of control methods on T&E species, and abides by RPAs and/or RPMs established as a result of that consultation. For the full context of the

Biological Opinion, refer to the WS' FEIS, Appendix F (USDA 1997). Further consultation on species not covered by or included in that formal consultation process will be initiated with the USFWS, and WS will abide by any RPAs, RPMs, and terms and conditions that result from that process to avoid jeopardizing any listed species.

- WS uses chemical methods for MDM that have undergone rigorous research to prove their safety and lack of serious effects on non-target animals and the environment.

3.4.2.3 Effects on Human Health and Safety

- WS' personnel are trained and supervised in the use of MDM methods, including firearms, watercraft, explosives, traps, immobilization drugs, and vertebrate pesticides, to ensure that they are used properly and according to policy. Furthermore, WS' personnel using restricted-use vertebrate pesticides will be certified according to EPA and Kentucky State laws. WS' personnel using binary explosives in MDM will be certified to use them according to WS' policy and directives, and WS' personnel using firearms will routinely receive firearms safety training according to WS' policy.

3.4.2.4 Effects on Socio-cultural Elements and Economics of the Human Environment

- Whenever practicable, WS' personnel perform components of mammal removal activities, such as shooting and euthanizing, away from public view.
- In addition, animals which are transported after being killed are concealed from public view when they must be transported in areas of human habitation, in an effort to reduce adverse effects on the aesthetic quality of the environment.

3.4.2.5 Effects of Beaver Dam Removal on Wetland Wildlife Habitat

- WS' personnel remove beaver dams in accordance with federal and state laws and regulations for environmental protection. Beaver dam removal would be conducted to restore drainage or the stream channel for an area, or if an area has an established silvicultural or other agricultural, commercial/industrial activity, and where such an area has not become an established wetland.

- Property owners will be required to obtain a Section 404 permit from the USACE for areas determined to be wetlands, for dams that have more than 10 cubic yards of fill associated with them, or if the project would alter the waters into a use it was previously not subject, where the flow or circulation of waters would be impaired or the reach of the waters reduced.

More detail pertaining to beaver dam removal is found in the discussion of methods used by WS in Appendix B.

3.4.2.6 Humaneness of Methods Used by WS

- WS' personnel kill captured target animals that are slated for lethal removal as quickly and humanely as possible. In most field situations, a shot to the brain with a small caliber firearm is performed, which causes rapid unconsciousness followed by cessation of heart function and respiration. This is in concert with the AVMA definition of euthanasia (Beaver et al. 2001).
- Research continues with the goal of improving the selectivity and humaneness of management devices.
- WS' personnel recommend the use of various non-lethal methods such as exclusion, habitat and animal behavior modification, where applicable.
- WS' personnel use trap lures and set traps in locations that are conducive to capturing the target animal, but minimize potential effect on non-target species. Further, all damage management methods would be used in a manner that minimizes pain and suffering of individual animals, to the extent that the method is effective and its use is practical.

4.0 CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions in selecting the appropriate alternative for meeting the purpose of the proposed action. This chapter analyzes the environmental consequences of each alternative in relation to the issues identified for detailed analysis in Chapter 2. This section analyzes the environmental consequences of each alternative in comparison with the No Action Alternative to compare the real or potential effects. Therefore, the proposed action or current program alternative serves as the baseline for the analysis and the comparison of expected effects among the alternatives. The background and baseline information presented in the analysis of the current program alternative thus also applies to the analysis of each of the other alternatives.

The following resource values within the State are not expected to be significantly impacted by any of the alternatives analyzed: soils, geology, minerals, water quality/quantity, floodplains, visual resources, air quality, prime and unique farmlands, aquatic resources, timber, and range. Those resources will not be analyzed further.

Cumulative Effects: Discussed in relationship to each of the alternatives analyzed, with emphasis on potential cumulative effects from methods employed, including summary analyses of potential cumulative impacts to target and non-target species, including T&E species.

Irreversible and Irretrievable Commitments of Resources: Other than minor uses of fuels for motor vehicles and other materials, there are no irreversible or irretrievable commitments of resources.

Effects on sites or resources protected under the NHPA: WS' MDM actions are not undertakings that could adversely affect historic resources (See Section 1.8.2.4).

4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

As described in section 2.1.1, in those situations where a non-federal cooperator has obtained the appropriate KDFWR permit or authority, and has already made the decision to remove or otherwise manage a mammal species to stop damage with or without WS' assistance, WS' participation in carrying out the action will not affect the environmental status quo. In some situations, however, certain aspects of the human environment may actually benefit more from WS' involvement than from a decision not to assist. For example, if a cooperator believes WS has greater expertise to selectively remove a target species than a non-WS entity; WS' management activities may have less of an impact on target and non-target species than if the non-federal entity conducted the action alone. Thus, in those situations, WS' involvement may actually have a beneficial effect on the human environment when compared to the environmental status quo in the absence of such involvement.

The following analyses evaluate the environmental consequences of each alternative in relation to the issues identified for detailed analysis in Chapter 2:

4.1.1 Alternative 1 – Adaptive Integrated Mammal Damage Management Program (Proposed Action/No Action)

4.1.1.1 Effects on Wildlife

4.1.1.1.1 Effects on Target Mammal Populations

The authority for management of resident wildlife species has traditionally been a responsibility left to the states. The KDFWR is the state agency with management responsibility over animals classified by state law as protected. KDFWR provided information where available regarding population estimates for certain species, but was unable to provide any definitive estimates of population sizes for some species. KDFWR commented on the validity of WS' determinations of actions affecting populations. In those situations where a non-federal cooperator has obtained the appropriate KDFWR permit or authority, and has already made the decision to remove or otherwise manage a mammal species to stop damage with or without WS' assistance, WS' participation in carrying out the action will not affect the environmental status quo.

The analysis for magnitude of impact generally follows the process described in Chapter 4 of WS' FEIS (USDA 1997). Magnitude is described in USDA (1997) as ". . . *a measure of the number of animals killed in relation to their abundance*." Magnitude may be determined either quantitatively or qualitatively. Quantitative determinations are based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations are based on population trends and harvest data when available. Generally, WS only conducts damage management on species whose population densities are high and usually only after they have caused damage. Table 4.1 shows numbers of individual mammals killed according to species by method as a result of WS' MDM activities in Kentucky from FY 1998 through FY 2006.

NEPA requires federal agencies to determine whether their actions have a "significant impact on the quality of the human environment." A declining population of a resident wildlife species does not necessarily equate to a "significant impact" as defined by NEPA if the decline is collectively condoned or desired by the people that live in the affected human population. It is reasonable and proper to rely on the representative form of government within a state as the established mechanism for determining the "collective" desires or endorsements of the people of a state. WS abides by this philosophy and defers to the collective desires of the people of the State of Kentucky by complying with State laws and regulations that govern the take or removal of resident wildlife. Although the analysis herein indicates mammal populations are not being affected to the point of causing a decline, if at some point in the future they are, then such a decline would not constitute a "significant" impact as defined by NEPA so long as the actions that cause the decline are in accordance with state law, and concomitantly, with the collective desires of the people of the State.

Table 4.1 - Number of Mammals Killed by WS in Kentucky during MDM activities from FY 1998 – 2006.

SPECIES	METHOD								TOTALS		
	TRAPS						CHEMICAL				
	Cage	Body-Gripping	Foot-hold	Snare	Shooting	Other	Zinc Phosphide	Other	Target/UT	NT	Total
Beaver	0	731	79	58	49	0	0	0	917	0	917
Cat, Feral	92	19	5	1	15	4	0	0	136	0	136
Coyote	1	0	11	84	25	10	0	0	131	0	131
Dog, Feral	1	0	1	1	0	1	0	0	3	1	4
Fox, Gray	2	1	1	3	0	0	0	0	7	0	7
Fox, Red	3	4	5	6	1	0	0	0	19	0	19
Groundhog	16	80	0	3	14	0	0	12	124	1	125
Swine, Feral	51	0	0	0	70	6	0	0	127	0	127
Mink	0	1	0	0	0	0	0	0	0	1	1
Muskrat	1	43	1	0	19	0	0	0	54	10	64
Opossum	35	57	8	7	8	4	0	0	118	1	119
Otter, River	0	19	3	4	1	0	0	0	17	10	27
Rabbit, Cottontail	42	0	3	7	8	0	0	0	58	2	60
Raccoon	156	74	27	25	35	14	0	0	315	16	331
Skunk, Striped	32	5	0	0	21	0	0	0	49	9	58
Squirrel, Fox	0	10	0	0	1	0	0	0	11	0	11
Squirrel, Gray	4	1	0	0	4	0	0	0	9	0	9
Vole	0	0	0	0	0	0	943	0	943	0	943

4.1.1.1.1.1 Bat Populations Information and Effects Analysis

Bats are the only mammals that can truly fly. They are exceeded only by rodents as the most numerous mammals, both in number of species and number of individuals (Greenhall and

Frantz 1994, National Audubon Society 2000). The bodies of bats are generally well-furred and forelimbs are enlarged and developed as wings with membranes attached to 4 greatly elongated fingers, which spread when in flight and draw together when at rest. The "thumb" projects from the end of the "forearm" as a small but sharp claw that is used as the animal crawls about. Wing membranes are often naked and translucent (National Audubon Society 2000). The motion of bats in the air appears to be a swimming motion, in which they rotate their wings to catch air with the membrane, as opposed to birds, which flap their wings (National Audubon Society 2000). Although most North American bats have small eyes, their visual acuity is good (Humphrey 1982). However, insectivorous bats locate food and avoid objects by means of echolocation, which is similar to radar or sonar (Humphrey 1982). While flying, the bat emits through its nose or mouth a continuous series of supersonic sounds. Those sounds bounce off objects and are picked up by the bats' complex ears (National Audubon Society 2000).

Bats are nocturnal, leaving the roosts around dusk, and usually flying to a stream, pond, or lake, where they obtain water by skimming the surface and dipping their lower jaw into the water. Bats in North America are virtually all insectivorous, feeding on a variety of flying insects, many of which are harmful to humans (Greenhall and Frantz 1994). Insectivorous bats obtain food by various means of capturing their prey, mostly while in flight. During those feeding flights, they often fly close to animals, including humans, and sometimes cause alarm (National Audubon Society 2000).

Among the 40 species of bats found north of Mexico, only a few species cause problems for humans. Bats congregating in groups are called colonial bats; those that live a lone existence are known as solitary bats. The colonial species most often encountered in and around human buildings in the U.S. are the little brown bat (*Myotis lucifugus*), the Mexican free-tailed bat (*Tadarida brasiliensis*), the pallid bat (*Antrozous pallidus*), the Yuma myotis (*Myotis yumanensis*), and the evening bat (*Nycticeius humeralis*). Solitary bats typically roost in tree foliage or under bark, but occasionally are found associated with buildings, some only as transients during migration (Greenhall and Frantz 1994).

Sixteen species of bats are known to occur in Kentucky. Some of those are federally-listed as threatened, endangered, or as species of management concern. Additionally, some bats are state listed as endangered, threatened, or as species of special concern by the KSNPC, a non-regulatory agency concerned with conservation of wildlife resources in the State. Any species of bats listed as State T&E in this document have been so defined by the KSNPC. Table 4.2 identifies bat species found in Kentucky, and the status of each species (KDFWR 2003, KSNPC 2005). Further, information related to occurrence and roosting/nesting/hibernating information is given.

Several bat species in Kentucky 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.

KDFWR handles at least 60 bat complaints from Kentucky residents each year (T. Wethington, KDFWR, pers. comm. 2003). The KDFWR does not issue permits to kill bats, but only to manipulate habitat or live-capture and release them.

During FY 1998-2006, WS provided assistance to 179 complaints (annual average = 19.8/year) from the public regarding damage or threats of damage by bats. Species of bats were not identified. Resources protected included human health and safety, buildings, and general property. Damage included perceived rabies threats, other disease threats, droppings and nuisance. The public reported $91,100 in damages associated with those complaints. Almost all complaints were handled through technical assistance and public education regarding bats. More than 90% of all complaints involved bats which had wandered into living or working spaces of buildings or were roosting in various structures (USDA 2007).

Most situations were resolved through providing an escape route for the intruding bat, by capturing and releasing it, or by exclusion of roosting animals. WS routinely makes recommendations that bats be excluded from buildings by various proven techniques.

Table 4.2 – Bats Commonly Found in Kentucky

Common Name	Scientific Name	Occurrence	Habitat	KY and U.S. Status*
Big Brown Bat	*Eptesicus fuscus*	year-round, nearly statewide	human structures during spring, summer, fall	PN
Brazilian free-tailed bat	*Tadarida brasiliensis*	occasional vagrant	under bridges, in buildings and caves	PN
Eastern pipistrelle	*Pipistrellus subflavus*	common during summer and migration, but present year round	caves	PN
Evening Bat	*Nycticeius humeralis*	common in western one-third of state, scattered records, summer resident	caves, hollow trees, buildings, barns, under bridges	PN, SC
Gray Myotis	*Myotis grisescens*	year round, probably most of state; recorded in 46 counties	caves; migrate between summer, winter caves	PN, FLE, ST
Hoary bat	*Lasiurus cinereus*	year round, common, most of state	trees, clusters of leaves; winter in hollow trees, abandoned buildings	PN
Indiana Bat	*Myotis sodalist*	year round; probably most of state; recorded in more than 50 counties	limestone caves; riparian forests, other habitats	PN, FLE, SE, CHD
Little Brown Bat	*Myotis lucifugus*	year round, throughout state; restricted to locales with caves in winter	caves, mines in winter; barns, buildings (attics) in summer	PN
Northern myotis	*Myotis septentrionalis*	year round, statewide	caves, under loose tree bark, rock shelters, mines, bridges and abandoned buildings	PN
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	year round, locally across state	caves, mines, protected rock shelters, abandoned buildings, bridges, hollow trees	PN, FM, SC
Red bat	*Lasiurus borealis*	year round (primarily summer), statewide	forests, clusters of leaves, hollow trees, fallen logs, leaf litter in winter	PN
Seminole Bat	*Lasiurus seminolus*	summer, Edmonson Co. and Land-Between the Lakes	trees (beneath clusters of leaves), clumps of Spanish moss	PN
Silver-haired bat	*Lasionycteris noctivagans*	primarily transient, locally across state, some overwinter	hollow trees, tree cavities, tree crevices in summer, rock fissures and cave entrances in winter	PN
Eastern Small-footed myotis	*Myotis leibii*	year round (mostly in winter), locally across eastern two-thirds of state	caves, rock shelters, cliff fissures, mines, quarries, abandoned buildings, bridges	PN, FM, ST
Southeastern myotis	*Myotis austroriparius*	year round, very locally distributed western half of state	caves, hollow trees, abandoned buildings	PN, FM, SE
Virginia Big-eared Bat	*Corynorhinus townsendii virginianus*	year round, eastern KY	caves	PN, FLE, SE

***Status Codes:** F = federal listing, S = state listing, LE = Listed Endangered (Federal Code), E = Endangered, T = Threatened, M = Species of Management Concern, C = Species of Special Concern (normally coded as "S" by KSNPC), PN = Protected non-game, CHD = Critical Habitat Determined
Sources: Kentucky Department of Fish and Wildlife Resources and Kentucky State Nature Preserves Commission (KDFWR 2003, KSNPC 2005)

In future program activities, bat damage will continue to be handled by WS primarily through various technical assistance projects. Program activities would continue to feature such non-

lethal control methods as exclusion, live capture/release and habitat manipulation. To reduce the possibility of adversely affecting a bat maternity colony, WS would implement and recommended to persons receiving technical assistance that all exclusion and habitat manipulation be conducted from September 1 to early November, when practicable. Many bat species, except big brown bats, would have migrated at that time, and the rearing of young would have been completed. MDM activities conducted after this date would therefore be highly unlikely to disturb maternity colonies of any species during critical young-rearing periods. Conducting exclusionary and other projects at this time would also give big brown bats, or other species which overwinter in Kentucky, an opportunity to find alternate roost sites before the onset of extremely cold weather.

Most requests for WS' assistance would likely occur in relation to bats inhabiting human-occupied buildings. Only one listed bat species found in Kentucky, the evening bat, is likely to be found in such locations. This species is listed as a Species of Special Concern on the KSNPC T&E list in Kentucky (Table 4.2), but is not protected by regulation. Federally-listed T&E bat species in Kentucky are not generally associated with man-made structures and so it is highly unlikely that any federally listed T&E bats would be found occupying such habitats (T. Wethington, KDFWR, pers. comm. 2003). For that reason, it is highly unlikely that programs to address bat damage in such sites would affect any federally- listed T&E bat species.

Based upon the above information, WS would have no adverse impacts on bat populations in the state.

4.1.1.1.1.2 Beaver Population Information and Effects Analysis

Beaver are large, bulky rodents whose most prominent features include a large scaly, paddle-shaped tail and orange-colored incisors (Hill 1982). Most adults weigh from 15.8-38.3 kg (35-50 lbs) with some occasionally reaching more than 45 kg (100 lbs) and are the largest North American rodents (Miller and Yarrow 1994). They range in most of Canada and the U.S., with the exception of portions of Florida and the desert southwest. Beaver are active throughout most of the year and are primarily nocturnal, but it is not uncommon to see them during the daylight hours. Beaver living along a river or large stream generally make bank burrows with multiple underwater entrances. Those in smaller streams, lakes, and ponds usually build dams and a lodge (National Audubon Society 2000). Sign of beaver in an area include gnawing around the base of trees and fallen trees as a result of gnawing. Trees are stripped of bark, which is a primary food source for beaver.

Beaver were trapped extensively during the 19th and part of the 20th century and as a result, disappeared from much of their range (Novak 1987). Now reestablished over most of the North American continent and protected from overexploitation, the beaver population has exceeded the societal 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 the dams may create a favorable habitat for many forms of life (Hill 1982).

Beaver family groups are typically comprised of 2 adult parents with 2-6 offspring from the current or previous breeding season. Average family group size has been documented as ranging from 3.0-9.2 (Novak 1987). Beaver abundance has been reported in terms of families per kilometer of stream or per square kilometer of habitat. Novak (1987) summarized beaver family abundance, with reported estimates ranging from 0.31-1.5 families/kilometer of stream (0.5-2.4 families per mile of stream), equating to 0.15-3.9 families/square kilometer (0.24-6.3 families/square mile).

According to biologists with the KDFWR, beaver populations are increasing in Kentucky (D. McChesney, KDFWR, pers. comm. 2002, J. Lane, KDFWR, pers. comm. 2005). Beaver are

present in all 120 counties in Kentucky. No exact population estimates were available for beaver in Kentucky. Therefore, the best available information was used to estimate statewide populations. There are over 637,000 acres of wetlands in Kentucky (U.S. Geological Survey (USGS) 1997, Kentucky Department for Environmental Protection (KDEP) 2003), including an estimated minimum of 89,431 miles of streams (KDEP 2003). Using the conservative estimate of 3 beaver per family group and an abundance of 0.5 families per stream mile provided by Novak (1987), the minimum statewide beaver population estimate for Kentucky could be estimated at more than 134,000 beaver.

Beaver are a protected furbearer species in Kentucky. A season for take of beaver is set by the KDFWR with no take limits (KDFWR 2005a). During FY 1998-2006, WS responded to 231 (average = 25.6/year) requests for assistance with beaver damage, in which complainants reported $1,305,870 in damages. Beaver damaged natural resources such as timber and reclamation sites, natural streams, agricultural crops, commercial timber, roadways, drainage and irrigation structures, and other property through flooding, damming, and feeding (USDA 2007). During FY 1998-2006, WS killed 917 beaver (average of 101.8/yr) in Kentucky in all damage management projects (USDA 2007). The number of beaver taken by entities other than WS, such as Nuisance Wildlife Control Officers (NWCO) and fur trappers, is unknown for the same time period.

Based on population trends and WS' limited lethal take, WS' MDM programs to address beaver damage had no consequential effect on the overall population of this species (J. Lane, KDFWR, pers. comm. 2005). In future programs, WS may be requested to address damage being caused by beaver anywhere in Kentucky to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill up to 600 beaver per year in all MDM programs in Kentucky in future years. Beaver damage management activities would target single beaver or local populations at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property after a request for assistance is received.

Based upon the above information, WS' limited lethal take of beaver would have no adverse impacts on overall beaver populations in the state. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the beaver populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.3 Black Bear Population Information and Effects Analysis

The American black bear is the smallest and most widely distributed of the three North American bear species (Pelton 1982). This species is a compact, heavily structured mammal with relatively massive legs and feet. Adult male black bears weigh from 120-280 kg (265-617 lbs) and measure from 130-190 cm (51-61.7 inches) in length from the tip of the nose to the tip of the tail. Adult females weigh from 45-182 kg (100-400 lbs) and measure from 110-170 cm (45-67 inches) in total length. The normal color is black with a brownish muzzle and frequently, a white V-shape across the throat or chest (Novak et al. 1987). Black bears mate in June and July.

Female bears produce litters that average 1-5 young, though two cubs is typical. Although black bears are primarily nocturnal, they may be seen at any time. They occupy ranges of 20-25 km^2 (8-10 mi^2), and sometimes up to 40 km^2 (15mi^2). The home range of the male black bear is about double that of the female. Black bears are powerful swimmers and climb trees for protection or food. Although they are in the order Carnivora, their diet includes all types of vegetation including twigs, buds, leaves, nuts, roots, fruit, corn, berries, and newly sprouted plants. Black bears will rip open bee trees to feed on honey, honeycomb, bees, and larvae. They will also tear apart rotting logs for grubs, beetles, crickets, and ants. The black bear wades in streams or lakes, snagging fish with its jaws or pinning them with a paw. The black

bear's diet also includes small to medium-sized mammals or other vertebrates, and even livestock such as cattle, sheep, and goats. Bears are often a problem around open dumps, becoming dangerous as they lose their fear of humans. Occasionally, people have been killed by black bears (National Audubon Society 2000). Habituated, food-conditioned bears pose the greatest threat to humans and such bears are usually found in association with campgrounds and sites where people regularly feed them (Herrero 1982, Herrero 1985, Kolenosky and Strathearn 1987).

In North America, black bear densities range from 0.1-1.3 bears/km^2, depending on region and habitat. Densities are greatest in highly diverse forests at a relatively early stage of development. In non-hunted and lightly hunted populations, the annual survival rate of adult female black bears is about 80-90%, while adult male survival is slightly less. As hunting pressure increases, the number of males decreases more rapidly than that of females because of their greater vulnerability to hunting (Fraser et al. 1982).

Black bear populations in Kentucky are increasing slowly, with populations appearing only in the eastern part of the state (S. Dobey, KDFWR, pers. comm. 2006). However, there is no justifiable population estimate available for black bears in Kentucky (S. Dobey, KDFWR, pers. comm. 2006). Black bears are a protected non-game species in Kentucky and are listed as a species of special concern by the KSNPC. KDFWR is currently managing black bears with the objective of allowing the natural recolonization of bears into suitable habitats to build self-sustaining populations. On-going research conducted by KDFWR should help provide population estimates within 2 years (S. Dobey, KDFWR, pers. comm. 2006).

No black bears have been killed by WS during MDM programs in Kentucky. Annually, WS responds to at least 2 requests for assistance to manage damage caused by black bears each year. WS has responded to request for bear damage management by providing technical assistance in the past. All complainants were referred to KDFWR for further action. Any direct damage management actions by WS to address black bear damage in Kentucky in future programs, including any lethal take of bears, would be conducted as part of coordinated activities with KDFWR for the purpose of meeting state wildlife resource management objectives. WS would obtain permits from KDFWR for such activities, if required. Such projects would usually involve live-capture and translocation of bears causing damage. Some bears could be killed in actions to protect human safety or livestock. However, lethal removal of less than 4 bears per year by WS is likely based upon an anticipated increase for requests for WS' assistance.

Based upon the above information, WS' limited lethal take of black bears would have no adverse impacts on overall black bear populations in the state. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from damage management activities, including removal of bears by WS, will be detrimental to the survival of the black bear population in the state of Kentucky (J. Day, KDFWR, pers. comm. 2003).

4.1.1.1.4 Bobcat Population Information and Effects Analysis

The bobcat, also called "wildcat," is a medium-sized member of the North American cat family, and may be mistaken for a large bob-tailed domestic cat by some people. This species is actually 2-3 times larger than most domestic cats and appears 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, woodrats, porcupines, pocket gophers, and ground hogs comprise most of their diet. Opossums, raccoon, grouse, wild turkey, and other ground nesting birds are also eaten. Occasionally, insects and reptiles can be part of a bobcat's diet. They also resort to scavenging. They 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). McCord

and Cordoza (1982) reported the cottontail rabbit to be the principal prey of bobcats throughout their range.

On some islands in the Gulf Coast of the southeastern U.S., bobcats reach densities of about 1 per 0.7 km^2 (1 per ¼ mi^2). Densities vary from about 1 per 1.3 km^2 (1 per 0.5 mi^2) in coastal plains to about 1 per 107 km^2 (1 per 66 mi^2) in portions of the Appalachian foothills. Mid-Atlantic and Midwestern states usually have scarce populations of bobcats (Virchow and Hogeland 1994). Bobcat densities in Virginia range from 1 per 0.09-0.18 km^2 and from 1 per 0.77-1.16 km^2 in Alabama (McCord and Cardoza 1982). Populations are stable in many northern states and reviving in other states where intensive trapping historically decimated the species (National Audubon Society 2000). 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 Bailey's (1972) study of bobcats 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).

No population estimates were available for bobcats in Kentucky, though populations have been increasing and expanding statewide based on road-kill surveys conducted from 1996-2004 (L. Patton, KDFWR, pers. comm. 2006). The best available information was used to estimate statewide populations. There are almost 26 million acres of rural land in Kentucky, including 13.8 million acres of farmland (NASS 2005) and 11.9 million acres of forested land (Kentucky Department of Forestry (KDF) 2005). Approximately 8.4 million acres of the farmland is considered cropland (NASS 2005). Using the assumption that 75% of the rural lands throughout the state have sufficient habitat to support bobcats and bobcat densities average 1 per 5 mi^2, a conservative statewide bobcat population could be estimated at over 10,800 bobcats.

Bobcats are regulated furbearers in Kentucky and KRS 150.025 authorizes KDFWR to open, close, make seasons conditional, apply seasons to portions of the state, and establish harvest quotas and tagging requirement for bobcat for the purpose of managing their populations in the state. In the past, KDFWR defined two zones for bobcat take; the eastern zone allowed the take of 400 bobcats per year and the western zone allowed 300 individuals to be taken (2002-2003 limits). Bobcats had to be tagged within 48 hours of take. Hunters or trappers had to make arrangements for tagging bobcats by contacting a department wildlife biologist or wildlife and boating law enforcement officer within the bobcat harvest zones. During past seasons, when it was determined that the bobcat quotas of 400 in Eastern Kentucky and/or 300 in Western Kentucky would be filled prior to January 31, the bobcat hunting and trapping season was closed early in that zone. Notice of early closure of the season was provided a minimum of 24 hours in advance of the time and date of closing. A total of 283 bobcats were reported harvested in Kentucky during the 1999-2000 seasons (D. McChesney, KDFWR, pers. comm. 2001). Hunters were required to report the take of bobcats within 24 hours and KDFWR tabulated the total take from this record.

Beginning in 2003, KDFWR discontinued zone management of bobcats and the hunting and trapping seasons were expanded. Rules for taking bobcats are currently the same throughout the state. Under the new management scheme, there are no quotas on take of this species, licensed hunters/trappers are allowed to kill 3 animals each, and hunters/trappers are required to tag each animal and report such take within 48 hours. A total of 1,726 bobcats were reported harvested in Kentucky during the 2005-06 seasons (KDFWR 2006a). WS maintains permits for take of mammals with bobcats included on the permit. WS would follow reporting guidelines for take of bobcats in MDM actions implemented.

No bobcats have been killed in WS' MDM programs in Kentucky. WS responds to at least 2 requests regarding bobcats each year, but WS has provided only technical assistance for those complaints in the past, and always refers complainants to KDFWR for further action. Any

direct damage management actions by WS to address bobcat damage in Kentucky in future programs would be conducted as part of a wildlife management activity coordinated with KDFWR for the purpose of meeting state wildlife resource management objectives. Such projects might involve live-capture and translocation of bobcats where such actions would align with KDFWR wildlife management objectives for this species. Some bobcats could be killed in actions to protect human safety or livestock. However, lethal removal of less than 5 bobcats per year is likely based upon an anticipated increase for requests for WS' assistance. Although bobcat population densities in Kentucky are unknown, KDFWR suggested that bobcat populations are increasing and expanding; thus such actions are not expected to have any adverse effect on bobcat populations in the State (J. Lane, KDFWR, pers. comm. 2005, L. Patton, KDFWR, pers. comm. 2006).

Based upon the above information, WS' limited lethal take of bobcats would have no adverse impacts on overall bobcat populations in the state. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the bobcat populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005, L. Patton, KDFWR, pers. comm. 2006).

4.1.1.1.1.5 Coyote Population Information and Effects Analysis

Coyotes are a familiar 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 (National Audubon Society 2000). Color varies greatly, however, 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). Coyotes are known to breed with domestic dogs on occasion, producing hybrids called "coydogs" (National Audubon Society 2000). The size of coyotes varies from about 9-18 kg (20-40 lbs) (Novak et al. 1987).

Coyotes range throughout the U.S. east to New Brunswick and Nova Scotia. The populations with the highest densities occur on the Plains and in the south-central U.S., including Texas. The distribution of coyotes in eastern North America has expanded during this century from 1900-1920. Now, all eastern states and provinces have at least a small population of coyotes (Voigt and Berg 1987).

Coyotes breed between January and March and are able to breed before they reach one year of age (Kennely and Johns 1976), but the percentage of yearlings having litters varies from 0-80% in different populations (Gier 1968). This variation is influenced by a number of factors, but causes large annual variation in total number of coyotes breeding. In a study in Texas, the percentage of females having litters varied from 48-81% (Knowlton 1972). Pups are born after a gestation period of 60-63 days, with litter sizes varying primarily with prey availability. Gier (1968) reported average litter sizes of 4.8-5.1 in years with low rodent numbers, but litters of 5.8-6.2 during years with high rodent numbers. Litter sizes of 1-19 pups have been reported (National Audubon Society 2000).

The coyote is probably the most extensively-studied carnivore (Bekoff 1982), and considerable research has been conducted on population dynamics. Data from scent-station indices suggest that density increases from north to south. Coyote densities as high as 2/km^2 (5/mi^2) have been reported in the southwestern and west-central U.S., but are lower in other portions of the country including eastern North America. However, few studies have accurately determined densities (Voigt and Berg 1987). Home range size varies from 13-36 km^2 (5-13 mi^2) (Servello et al. 1999).

Many references indicate that coyotes were originally found in relatively open habitats of the western U.S., particularly grasslands and sparsely wooded areas. 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 and Gipson 1994).

Coyotes often include many items in their diet. Rabbits are one of the most common prey items. Other items in the coyote's diet include carrion, rodents, ungulates (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 dump sites and take small domestic pets, such as cats and dogs (Voigt and Berg 1987).

Coyote populations are increasing in Kentucky where the species is considered a nongame species and unprotected (J. Lane, KDFWR, pers. comm. 2005). Coyotes may be hunted year-round in Kentucky, but trapped only during the furbearer season: appropriate licenses apply for each and there is no take limit. No harvest data was available for this species in Kentucky.

No population estimates were available for coyotes in Kentucky. Therefore, the best available information was used to estimate statewide populations. There are almost 26 million acres of rural land in Kentucky, including 13.8 million acres of farmland (NASS 2005) and 11.9 million acres of forested land (KDF 2005). Approximately 8.4 million acres of the farmland is considered cropland (NASS 2005). Using the assumption that 75% of the rural lands throughout the state have sufficient habitat to support coyotes, coyotes are only found in rural habitat, coyote home ranges average 1 per 8 mi^2, and home ranges of coyotes do not overlap, a conservative statewide coyote population could be estimated at over 3,800 coyotes.

During FY 1998-2006, WS responded to 125 (average = 13.8/year) requests for assistance with coyote damage in which complainants reported $272,030 in damages. Most coyote complaints are referred to KDFWR or NWCOs and no record is made by WS regarding the outcome. Some of the assistance requests were related to damage resulting from coyotes colliding with aircraft, or from coyotes presenting threats to aircraft and passenger safety, and loss values were difficult to estimate. Coyote damage reported to WS was related to threats to human health or safety, predation on other animals, and nuisance (USDA 2007). Complainants are rarely able to provide loss values for human health and safety threats.

WS killed 131 coyotes (average = 14.5/ year) in all MDM programs in Kentucky during FY 1998-2006. Almost all of those were killed in programs to protect aircraft and air passengers at airports (USDA 2007). This number is insignificant compared to the total population of this species in the state. In future programs, WS may be requested to address damage being caused by coyotes anywhere in Kentucky to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill as many as 400 coyotes each year in MDM programs in the State. Many of those would be removed in projects aimed at protecting air passenger safety and aircraft, while a substantial number might be killed to reduce human safety threats in residential areas and to protect livestock, agriculture, and pets. Coyote damage management activities would target single coyotes or local populations at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property. Few, if any coyotes in residential areas and airports are hunted and few are trapped by fur trappers. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site. Population models developed by Connolly and Longhurst (1975) and revisited by Connolly (1995), suggest that coyotes can withstand an annual removal of 70% of their population and still maintain a viable population.

Based upon the above information, WS' limited lethal take of coyotes would have no adverse impacts on overall coyote populations in the state. The KDFWR has determined that there is no evidence to suggest that human mediated-mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the coyote population in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.6 Eastern Cottontail Rabbit Population Information and Effects Analysis

There are 9 species of cottontail rabbits in North America, north of Mexico. The eastern cottontail (*Sylvilagus floridanus*) is the most abundant and widespread of those species. Although in Kentucky there are swamp rabbits (*Sylvilagus aquaticus*) and eastern cottontails, damage associated with rabbits is primarily caused by the eastern cottontail (Craven 1994).

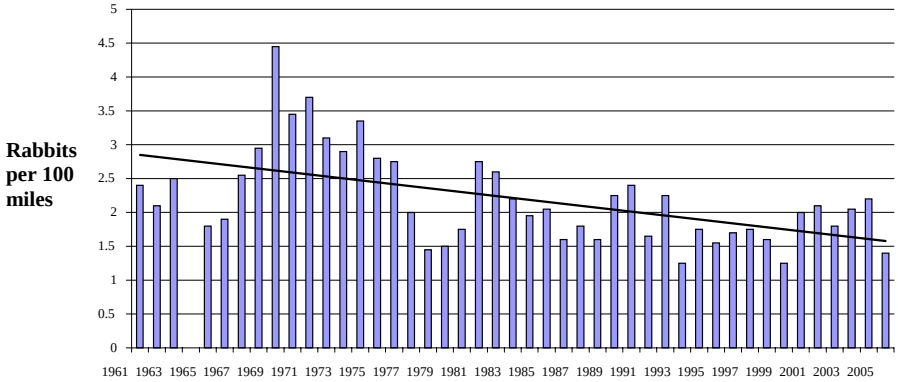
The eastern cottontail is approximately 37-48 cm (15-19 inches) in length and weighs 0.9-1.8 kg (2-4 lbs). Males and females are basically the same size and color. Rabbits do not distribute themselves evenly across the landscape, but tend to concentrate in favorable habitats such as brushy fence rows or field edges, gullies filled with debris, brush piles, areas of dense briars, or landscaped backyards where food and cover are suitable. They are rarely found in dense forest or open grasslands, but fallow crop fields, such as those in the Conservation Reserve Program, may provide suitable habitat. Within those habitats they spend their entire lives in an area of 10 acres or less. Occasionally, they may move a mile or so from 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 1 rabbit per 0.4 hectares (1 acre) is a reasonable average (Craven 1994). The average lifespan of rabbits is 12-15 months. Rabbits can raise as many as 6 litters per year of 1-9 young (usually 4-6), having a gestation period of 28-32 days. If no young were lost, a single pair together with their offspring could produce 350,000 rabbits in 5 years (National Audubon Society 2000).

Rabbit populations in Kentucky generally have been declining over the last 45 years (KDFWR 2005b). However, trends evaluated through surveys conducted by mail carriers throughout the state as part of a volunteer activity solicited by KDFWR indicate that rabbit populations have been relatively stable over the last 20 years. In those surveys, mail carriers record the number of rabbits observed and numbers of miles they drive, in the course of mail delivery duties. The observations are tabulated by KDFWR and are reported as the number of rabbits observed/100 miles driven.

During Calendar Year (CY) 2000, statewide populations experienced an increase of 48.4% compared to CY 1999 observations. In CY 1999, rabbit numbers observed were at an all time low since 1961. The extended drought in 1999 may have been a primary factor in the low numbers for that year. This trend continued through CY 2001, with a slight downturn in CY 2002 (Figure 4-1; KDFWR 2002b). Observed population numbers increased in 2003 and 2004, but in CY 2005, statewide populations experienced a decline of 37.5% from 2004 (KDFWR 2005b). Loss of habitat has been implicated as the most important factor in the decline of rabbit populations in the State and the population trend corresponds to a 1% annual decline since 1961 (KDFWR 2005b).

No population estimates were available for cottontail rabbits in Kentucky. Therefore, the best available information was used to estimate statewide populations. There are almost 26 million acres of rural land in Kentucky, including 13.8 million acres of farmland (NASS 2005) and 11.9 million acres of forested land (KDF 2005). Approximately 8.4 million acres of the farmland is considered cropland (NASS 2005). Using the assumption that 50% of the rural lands throughout the state have sufficient habitat to support rabbits, rabbits are only found in rural habitat, and rabbit densities average 1 per acre, a conservative statewide rabbit population could be estimated at almost 13 million rabbits.

Figure 4.1 - Rabbit Trends in Kentucky: 1961-2005 (missing 1964 data)



(Adapted from 2004-05 Rabbit Hunting Cooperator Survey Report, KDFWR 2005b)

Cottontail rabbits are a regulated game species in Kentucky and are harvested recreationally for food. KDFWR sets seasons and limits on this species annually (KDFWR 2005a). Although complete hunter harvest data is unavailable for numbers of rabbits taken in the state, in the 2004-05 season, 104 hunters who participated in a survey conducted by KDFWR averaged 15 hunting trips each for the season and killed 3,951 cottontail rabbits. Those hunts occurred in 96 counties (KDFWR 2005b).

During FY 1998-2006, WS conducted MDM programs in Kentucky to address eastern cottontail rabbit damage at only a few sites. The majority of damage reported involved gardens. Other damage reported was to landscaping, turf and flowers, trees and shrubs, and general property. A total of $32,450 damage to all resources was reported for cottontail rabbits in Kentucky during FY 1998-2006 ($3,605.55 annually). Most complaints were handled by providing resource owners with technical assistance advice. A total of 58 (annual average = 6.4) rabbits were killed in all WS' MDM programs at all sites during the 9-year period (USDA 2007).

Requests for assistance from WS may be made by those experiencing damage from rabbits anywhere in the state to protect any resource being damaged. Based upon an anticipated increase for requests for WS' assistance in such programs, WS could kill as many as 200 rabbits per year in Kentucky. Almost all take of rabbits would be removed from urban, commercial, or industrial habitat and airports. However, this level of take is inconsequential to the numbers of animals taken by hunters each year and is not expected to affect populations of the species in the state. Cottontail rabbit damage management activities would target single rabbits 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.

Based upon the above information, WS' limited lethal take of cottontail rabbits would have no adverse impacts on overall rabbit populations in the state. The KDFWR has determined that there is no evidence to suggest that human mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the cottontail rabbit populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.7 Feral Cat Population Information and Effects Analysis

Feral cats weigh from 3-8 lbs (1.4-3.6 kg), standing 8-12 inches (20-30.5 cm) high at the shoulder, and 14-24 inches (35.5-61 cm) long. The tail adds another 20-30.5 cm (8-12 inches)

to their length. Colors range from black to white to orange with numerous color combinations of those colors. Other hair characteristics also vary greatly (Fitzwater 1994).

Cats are found in commensal relationships wherever people are found. In some urban and suburban areas, cat populations equal human populations. In many suburban and eastern rural areas, feral house cats are 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 produce 2-10 kittens during any month of the year. An adult female may produce 3 litters per year where food and habitat are sufficient. Cats may be active during the day but typically are more active during twilight or night. House cats have been reported to live up to 27 years, but feral cats probably average only 3-5 years. They are territorial and move within a home range of roughly 4 km^2 (1.5 mi^2). After several generations, feral cats can be considered totally wild in habits and temperament (Fitzwater 1994).

Where it has been documented, the impact of feral cats on wildlife populations in suburban and rural areas, directly by predation, and indirectly by competition for food, has been substantial (Coleman and Temple 1989). In the United Kingdom, one study determined that house cats may take an annual toll of approximately 70 million animals and birds (Churcher and Lawton 1987). In addition, feral cats serve as a reservoir for human and wildlife diseases, including cat scratch fever, distemper, histoplasmosis, leptospirosis, mumps, plague, rabies, ringworm, salmonellosis, toxoplasmosis, tularemia, and various parasites (Fitzwater 1994).

WS responded to 31 requests (average = 3.4/year) for assistance with feral cat damage in Kentucky MDM programs during FY 1998-2006. Requesters reported $12,085 (average = $1,342.77/year) in damages resulting from feral cats during the period. Feral cat damage reported to WS was related to threats to human health or safety, predation of captive birds, collisions with aircraft, nuisances around residential buildings, and damage threats to domestic or captive animals (USDA 2007). No damage figures were provided for threats to human health and safety, nor strikes with aircraft. Complainants are rarely able to provide loss values for human health and safety.

WS killed 136 feral cats (average = 15.1/year) in all MDM programs in Kentucky during FY 1998-2006 (USDA 2007). This number is insignificant to the total population of this species in the state. The lowest estimate of the U.S. feral cat population is 20 million, which gives Kentucky some 400,000 feral cats if feral cats were distributed evenly in the U.S. (Alley Cat Allies 2003). In future programs, WS may be requested to address damage being caused by feral cats anywhere in Kentucky to protect any resource being damaged or threatened. Feral cats are identified by WS' personnel as those cats which are free roaming and do not possess a collar. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill as many as 400 feral cats each year in MDM programs in the State. Many of those would be removed in projects aimed at protecting human health and safety, valuable wildlife, or captive birds and other animals. Feral cats are not viewed as furbearers in Kentucky. However, thousands of feral cats are captured and euthanized by city and county animal control officers each year in Kentucky (E. Blow, Jefferson County Animal Control, pers. comm. 1999).

Based upon the above information, WS' limited lethal removal of feral cats should have no adverse effects on overall populations of the species in Kentucky. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site. In those cases where feral cats are causing damage or are a nuisance and complete removal of the local population could be achieved, this would be considered a beneficial impact on the human environment since those species are not considered part of the native ecosystem.

4.1.1.1.1.8 Feral Dog Population Information and Effects Analysis

Like domestic dogs, feral dogs (sometimes referred to as wild or free-ranging dogs) 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 humans, 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 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 domestic and feral dogs by observing the behavior of dogs while confined in cage traps. Domestic dogs usually wagged their tails or exhibited a calm disposition when a human approached, whereas most feral dogs showed highly aggressive behavior, growling, barking, and attempting to bite. Some dogs were intermediate in their behavior and couldn't be classified as either feral or domestic based solely on their reaction to humans. Since many feral dogs have been pursued, shot at, or trapped by people, their aggressive behavior toward humans is not surprising. Gipson (1983) described the numerous lead pellets imbedded under the skin of a feral dog caught in Arkansas as a testament to its relationship with people (Green and Gipson 1994).

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 the gathering or den sites may be well defined. Food scraps and other evidence of concentrated activity may be observed at gathering sites.

The appearance of tracks left by feral 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 those 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 be correspondingly varied, unlike the tracks of a group of coyotes (Green and Gipson 1994).

Feral dogs may occur wherever people are present and permit dogs to roam free, or where people abandon unwanted dogs. Feral 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 dogs vary considerably in size and are probably 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 km^2 (50 mi^2) or more (Green and Gipson 1994).

Feral dogs are often found in forested areas or shrublands in the vicinity of human habitation. 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 be found 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 dogs are best described as 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 dogs are highly adaptable, social carnivores. Gipson (1983) suggested that family groups of feral dogs are more highly organized than previously believed. Pup-rearing may be shared by several members of a pack. Survival of pups born during autumn and winter has been documented, even in areas with harsh winter weather. Gipson 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. It is noteworthy 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 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. He 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). In some areas of the U.S., including Kentucky, feral dogs pose threats to air traffic by invading airport environments to forage (K. Stucker, WS, pers. comm. 2007).

WS provided technical assistance for six feral dog complaints related to human health and safety during FY 1998-2006. Most complaints regarding dogs are referred to local animal control agencies since requesters are usually unable to determine whether the dog is feral or a pet. A record is only generated when some kind of technical assistance is provided by WS as a result of the contact.

WS killed three feral dogs in all MDM programs in Kentucky during FY 1998-2006 (USDA 2007). This number is insignificant to the total population of this species in the state. In future programs, WS may be requested to address damage being caused by feral dogs anywhere in Kentucky to protect any resource being damaged or threatened. It is possible that WS could kill as many as 200 feral dogs each year in MDM programs in the State. Many of those would be removed in projects aimed at protecting human health and safety, valuable wildlife or other natural resources, livestock, or other agriculture. Feral dogs are not viewed as furbearers in Kentucky. However, thousands are captured and euthanized by city and county animal control officers each year in Kentucky (E. Blow, Jefferson County Animal Control, pers. comm. 1999).

Based upon the above information, WS' limited lethal removal of feral dogs should have no adverse effects on overall populations of the species in Kentucky. Any MDM involving lethal control actions by WS would be restricted to isolated individual sites. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site. In those cases where feral dogs are causing damage or are a nuisance and complete

removal of the local population could be achieved, this would be considered a beneficial impact on the human environment since those species are not considered part of the native ecosystem.

4.1.1.1.1.9 Feral Swine Population Information and Effects Analysis

Feral swine, also known as “wild pigs,” “wild boars,” and “feral hogs,” are medium-size hoofed mammals that look like domestic pigs. They usually have coarser and denser coats than their domestic counterparts and exhibit modified canine teeth called “tusks”, which are usually 7.5-12.5 cm (3-5 inches) long, but may up to 23 cm (9 inches) long. The tusks curl out and up along the sides of the mouth. Lower canines are also prominent but smaller. Young feral swine have pale longitudinal stripes on the body until they are 6 weeks of age. Adults of the species average 90 cm (3 ft) in height and 1.32-1.82 m (4.5-6 ft). Males may attain a weight of 75-200 kg (165-440 lbs) while females may weigh 35-150 kg (77-330 lbs). Those animals mate any time of year, but peak breeding times usually occur in January-February and early summer. Litters sizes are usually 3-12 (National Audubon Society 2000). Given adequate nutrition, a wild pig population can double in just 4 months. Feral swine may begin to breed before 6 months of age and sows can produce 2 litters per year (Barrett and Birmingham 1994).

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 in wild habitat. This species is found in variable habitat in much of the southern U.S., including Kentucky. Populations are usually clustered and not widespread. Feral swine are game animals in Texas, Tennessee, North Carolina, Puerto Rico, Hawaii, and Florida (Wood and Barrett 1979, Mayer and Brisbin 1991).

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 and destruction of tree seedlings, and erosion of soils (Barrett and Birmingham 1994). Food sources for feral swine include acorns, hickory nuts, pecans, beech nuts, and a wide variety of vegetation, including roots, tubers, grasses, fruit, and berries. 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 have been known to kill and eat deer fawns (National Audubon Society 2000). They have also been reported to kill considerable numbers of domestic livestock, especially young animals, in some areas (Barrett and Birmingham 1994). Several diseases are associated with feral swine populations (Table 1.1).

Current population estimates for feral swine in Kentucky were unavailable. In Kentucky, legal hunters (those possessing valid hunting licenses) may take feral swine year-round, statewide. Feral swine may also be removed by permit from the KDFWR. In addition to a valid hunting license, hunters must possess a valid deer permit if hunting swine when a firearms deer season is open. Some other restrictions apply on Wildlife Management and some other public use areas. There is no take limit on this species and hunters need not check feral swine with KDFWR (301 KAR 3:030). No harvest data was available for this species.

Feral swine damage may be addressed by WS’ MDM programs in response to requests at any location in Kentucky. 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 controlling feral swine populations where disease threats to humans may be present (Table 1.1). WS may use any legal methods among those outlined by Barrett and Birmingham (1994) as suitable for feral swine damage management in MDM programs.

One hundred twenty-one feral swine (annual average = 13.4/year) were killed by WS in all Kentucky MDM programs during FY 1998-2006 (USDA 2007). Because feral swine populations are not large in Kentucky and damage caused by them has not been widespread, or of great magnitude, large-scale damage management activities by WS are not expected to occur. Removal of a small herd or a few individuals 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 this species has ample resources and opportunity to expand. WS may receive requests for MDM programs to address damage in such locations in the future. It is possible that WS could kill up to 100 individuals of this species in Kentucky each year in those programs. However, such population reduction is not expected to affect overall statewide populations of the species because of high reproductive rates exhibited by those animals (Barrett and Birmingham 1994). Feral swine damage management activities 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.

Based upon the above information, WS' limited lethal take of feral swine would have no adverse impacts on overall feral swine populations in the state. Any MDM involving lethal control actions by WS would be restricted to isolated individual sites. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site. In those cases where feral swine are causing damage or are a nuisance and complete removal of the local population could be achieved, this would be considered a beneficial impact on the human environment since those species are not considered part of the native ecosystem.

4.1.1.1.1.10 Fox Population Information and Effects Analysis

4.1.1.1.1.10.1 Gray Fox Population Information and Effects Analysis

The gray fox is common in many parts of the U.S. where deciduous woodlands provide habitat. However, this secretive carnivore is seldom seen. The gray fox is somewhat smaller in stature then 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 underparts are buff. White shows on the ears, throat, chest, belly, and hindlegs, and the black, white, and reddish facial markings provide distinctive accents (Fritzell 1987).

Gray fox adults weigh about 3-7 kg (6.5-15 lbs) with males slightly larger than females. Generally, adult gray fox measure 80-113 cm (31.5-44 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 U.S., the Great Plains, and eastern Central America. Gray fox occur over most of North America, north and east from southern California, Arizona, and central Texas (Fritzell 1987).

Gray fox prefer habitat with dense cover such as thickets, riparian areas, swamp land, or rocky pinyon-cedar ridges. In eastern North America, this species is closely associated with edges of deciduous forest. They can also be found in urban areas where suitable habitat exists (Phillips and Schmidt 1994).

Gray fox mate from January-March and produce litters of 1-7 kits after a gestation period of 53 days (National Audubon Society 2000). They rear young in a maternity den, commonly in wood piles, rocky outcrops, hollow trees, or brush piles (Phillips and

Schmidt 1994). The male parent gray fox helps tend the young but does not den with them. The young are weaned at 3 months and hunt for themselves at 4 months, when they weigh about 3.2 kg (7 lbs). Rabies and distemper are associated with this species (National Audubon Society 2000).

Accurate estimates of carnivore populations are rare, and those for gray fox populations are no exception. Estimates based on knowledge of the species, experience, and intuition may be as accurate as those based on recognized methods such as mark-recapture studies. Published estimates of gray fox density vary from 1.2-2.1/km^2 (3.1-5.4/mi^2) depending on location, season, and method of estimation (Errington 1933, Gier 1948, Lord 1961, Trapp 1978). Over areas larger than 5,000 km^2 (1,930 mi^2) in which habitat quality varies, densities are likely lower. Exceptionally high fox densities have been recorded in some situations, however (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 the 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 1 month in Alabama (Nicholson 1982) and Missouri (Haroldson and Fritzell 1984), and it was determined that they all had home ranges larger than 200 ha (500 acres), and many exceeded 500 ha (1,235 acres).

Gray fox feed on a wide variety of plant and animal matter and are considered to be more omnivorous than other North American canids (Fritzell 1987). 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, it occasionally forages 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, insect, and much 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 (National Audubon Society 2000).

No population estimates were available for gray fox in Kentucky. Therefore the best available information was used to estimate statewide populations. There are almost 26 million acres of rural land in Kentucky, including 13.8 million acres of farmland (NASS 2005) and 11.9 million acres of forested land (KDF 2005). Approximately 8.4 million acres of the farmland is considered cropland (NASS 2005). Using the assumption that 50% of the rural lands throughout the state have sufficient habitat to support gray fox, fox are only found in rural habitat, and gray fox densities average 3.1/ mi^2, a conservative statewide gray fox population could be estimated at over 62,968 fox.

Gray fox are classified as protected furbearers in Kentucky, and seasons and limits on take are set by KDFWR. There are no bag limits for gray fox (KDFWR 2005a). No harvest data was available for this species. Gray fox populations in Kentucky are stable to decreasing (D. McChesney, KDFWR, pers. comm. 2002).

WS provided technical assistance for 3 gray fox damage complaint in Kentucky MDM programs during FY 1998-2006. In one instance, the complainant reported damages of $1,000 to captive animals. Most gray fox complaints are referred to KDFWR or NWCOs, and no record is made by WS regarding the outcome.

WS killed 7 gray fox (average = 0.8/year) in all MDM programs in Kentucky during FY 1998-2006 (USDA 2007). In future programs, WS may be requested to address damage

being caused by gray fox anywhere in Kentucky to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill as many as 10 gray fox each year in MDM programs in the state. Most of those would be removed in projects aimed at protecting resources in urban or industrial habitats. Few gray fox are trapped for fur or hunted in those locales.

Based upon the above information, WS' limited lethal take of gray fox would have no adverse impacts on overall populations of the species in Kentucky. The KDFWR has determined that there is no evidence to suggest that human mediated-mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the gray fox populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.10.2 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 (Honacki et al. 1982). Typically, black-tipped ears, black cheek patches, white throat parts, a lighter underside, and black "leg stockings" are found 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).

In North America, the red fox weighs about 3.5-7 kg (7.7-15.4 lbs), with males averaging about 1 kg (2.2 lbs) heavier than females. Generally, adult fox measure 100-110 cm (39-43 inches) from the tip of the nose to the tip of the tail. Juveniles are as large as adults by their first autumn (Voigt 1987). They occur over most of North America, north and east from southern California, Arizona, and central Texas. They are found throughout most of the U.S., with the exception of a few isolated areas. Prehistoric fossil records suggest that the red fox historically may not have inhabited much of the U.S., but were plentiful in many parts of Canada. However, it has been suggested that climatic factors, interbreeding with the introduced European red fox, extirpation of the gray and red wolf, and clearing of land for agriculture have possibly contributed to the present-day expansion and range of this species in North America (Voigt 1987).

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 U.S., where woodlands are interspersed with farmlands. The range of the species has expanded in recent years to fill habitats formerly occupied by coyotes. The reduction of coyotes in many sagebrush/grassland areas of Montana and Wyoming has resulted in increased fox numbers. Red fox have also demonstrated their adaptability by establishing breeding populations in many urban areas of the U.S., 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 January-March and produce litters of 1-10 kits after a gestation period of 51-53 days. They rear young in a maternity den, commonly an enlarged groundhog or badger den, usually in sparse ground cover on a slight rise, with a good view of all approaches (National Audubon Society 2000). 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 (Harris 1979, Voigt and MacDonald 1984, Voigt 1987). Pups are born after a gestation period of 60-63 days, with litter sizes varying primarily with prey availability. Gier (1968) reported average litter sizes of 4.8-5.1 in years with low rodent numbers, but litters of 5.8-6.2 during years with high rodent numbers. Litter sizes of 1-19 pups have been reported (National Audubon Society 2000). 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.

The density of red fox populations is difficult to determine because of the animals secretive and elusive nature. Estimates are prone to error even in open prairie 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). In Great Britain where food is overabundant in many urban areas, densities as high as 30 fox/km^2 (78/mi^2) have been reported (Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986). In southern Ontario, densities of about 1 fox/km^2 (2.6/mi^2) occurred during spring. Those estimates include both pups and adults. In small areas of the best habitat, 3 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 the presence of competition from species such as coyotes (Voigt and Earle 1983).

Cyclical changes in fox numbers occur routinely and complicate density estimates and species 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 U.S. are usually from 500-2,000 ha. (1,235-4,940 acres) in rural settings such as farmland (Voigt and Tinline 1980), but such sizes may not apply among fox populations in urban settings.

The red fox is a skilled nonspecific predator, foraging on a variety of prey. It is also an efficient scavenger, and in parts of the world garbage and carrion are extremely important to its diet (Voigt 1987). Red fox 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 taken (Phillips and Schmidt 1994). They also feed on squirrels, groundhogs, crayfish, and even grasses (National Audubon Society 2000).

Red fox populations in Kentucky are stable (J. Lane, KDFWR, pers. comm. 2005). No population estimates were available for red fox in Kentucky. Therefore, the best available information was used to estimate statewide populations. There are almost 26 million acres of rural land in Kentucky, including 13.8 million acres of farmland (NASS 2005) and 11.9 million acres of forested land (KDF 2005). Approximately 8.4 million acres of the farmland is considered cropland (NASS 2005). Using the assumption that 50% of the rural lands throughout the state have sufficient habitat to support red fox, fox are only found in rural habitat, red fox home ranges average 2.6/mi^2, and home ranges of fox do not overlap, a conservative statewide red fox population could be estimated at over 52,812 fox.

This species is a regulated furbearer, and seasons for take are set by KDFWR. There are no bag limits for red fox (KDFWR 2005a). No hunter/trapper harvest data is available for this species.

WS provided technical or operational assistance for 31 requests (average = 3.4/year) associated with red fox damage in Kentucky during FY 1998-2006. This tally represents

only those red fox complaints for which WS' employees initiated some type of assistance activity. Most red fox complaints were referred to KDFWR or NWCOs, and no record is made by WS regarding the outcome. Complainants reported $37,870 (average = $4,207.77/year) in damages resulting from red foxes during that period. Red fox damage reported to WS was related to threats to human health or safety, vehicle damage, and predation on captive animals. Estimated damage costs for 1 incident involving vehicle damage was $35,000. No damage figures were provided for threats to human health and safety, because complainants are rarely able to provide loss values for this resource (USDA 2007).

WS killed 19 red foxes (average = 2.1/yr) in all MDM programs in Kentucky during FY 1998-2006 (USDA 2007). In future programs, WS may be requested to address damage being caused by red fox anywhere in Kentucky to protect any resource being damaged or threatened. It is possible that WS could kill as many as 20 red fox each year in MDM programs in the state. Many of those would be removed in projects aimed at protecting human health and safety. Almost all of those animals would be killed in urban or industrial habitats. Few red fox are trapped for fur or hunted in those locales. Red fox damage management activities 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. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site.

Based upon the above information, WS' limited lethal take of red fox would have no adverse impacts on overall populations of the species in Kentucky. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the red fox populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.11 Groundhog Population Information and Effects Analysis

The groundhog, also known as the "woodchuck," is a large rodent, often seen in pastures, meadows, and fields in Kentucky. They dig large burrows, generally 8-12 inches at the opening, sometimes 5 feet deep and 30 feet long with more than 1 entrance to a spacious grass-filled chamber. Green vegetation such as grasses, clover, and alfalfa forms its diet; at times it will feed heavily on corn and can cause extensive damage in a garden to other crops (National Audubon Society 2000). Groundhogs may also jeopardize the integrity of earthen dams, present hazards to livestock and farm equipment as a result of burrowing; gnaw electrical cables, and damage hoses and other accessories on automobiles by gnawing (Bollengier 1994, USDA 2007).

The breeding season for groundhogs is usually from March through April (Bollengier 1994). Female groundhogs usually produce from 4-6 young (Chapman and Feldhamer 1982). The offspring breed at age 1 and live 4-5 years. Mammal species with high mortality rates, such as rodents (i.e. woodchucks) and lagomorphs (i.e. rabbits), typically possess high reproductive rates and produce large and frequent litters of young (Smith 1996). For example, if a pair of groundhogs and their offspring all survived to breed as soon as possible, with an average litter size of 4 with a 1:1 sex ratio; they could produce over 645 groundhogs through their life time. Groundhog ranges in the U.S. extend throughout the East, northern Idaho, northeastern North Dakota, southeastern Nebraska, eastern Kansas, northeastern Oklahoma, and south to Virginia and Alabama.

Groundhog populations in Kentucky are not monitored by KDFWR or WS. This species is classified as an unprotected nongame species in the state. No limits or seasons are set for the take of this species. Field observations related to the presence of groundhogs in urban

environments in Kentucky suggest that they are locally abundant in many such areas of the state (K. Stucker, WS, pers. comm. 2007). No harvest data was available for this species. During FY 1998-2006, WS responded to 117 requests for assistance with groundhog damage in Kentucky, and complainants reported $155,170 (annual average=$17,241.11/year), in damages to a variety of resources including gardens, buildings, lawns, vehicles and electrical equipment (USDA 2007). A number of damage reports by Kentucky citizens involving groundhogs are received by KDFWR. For instance, in CY 1998, KDFWR received 8 requests for assistance related to damage by this species (KDFWR 1998).

A total of 125 (annual average of 13.8/year) groundhogs were killed in all MDM activities conducted by WS in Kentucky during FY 1998-2006. However, most complaints received by WS in Kentucky were addressed through technical assistance advice or loan of equipment to complainants (USDA 2007). The Kentucky program received an increased number of requests for assistance in managing damage related to groundhogs burrowing in earthen dams during FY 2001 (R. Myers, WS, pers. comm. 2002), and this may mean an increased number of animals will be killed in future years to protect human health and safety and property related to those structures. It is possible that WS could be requested to provide MDM to address groundhog damage at any location in the State. Based upon current and an anticipated increase in groundhog damage management activities in the future, it is possible that WS could kill 200 groundhogs per year in all MDM programs in Kentucky. Groundhog damage management activities 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. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site.

Based upon the above information, WS' limited lethal take of groundhogs would have no adverse impacts on overall groundhog populations in the State. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the groundhogs population in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.12 Mink Population Information and Effects Analysis

The mink is member of the weasel family and is about 46-61cm (18-24 inches) in length, including the somewhat bushy tail. These animals weigh about 0.7-1.4 kg (1.5-3 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 underfur 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 1994a). They also mark their hunting territory with musk, which is as malodorous as a skunk's musk, although it does not carry as far (National Audubon Society 2000).

Mink are found throughout North America, with the exception of the desert southwest and tundra areas (Eagle and Whitman 1987). 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. They make their dens in muskrat houses, ban burrows, holes, crevices, logjams, or abandoned beaver lodges. They are active mainly at night and are active year-round except for brief intervals during periods of low temperature or heavy snow (Boggess 1994a). They may, however, adjust hunting times to prey availability (National Audubon Society 2000).

Population densities for mink vary spatially according to habitat and may be influenced temporally by weather, trapping, and intraspecific aggression. Generally, populations are most dense in those states and provinces with abundant, stable aquatic habitat. In general,

population densities typically range from 0.025-0.247 mink per acre (McVey et al. 1993). According to harvest statistics, Louisiana populations are most dense in swamps, followed by marshes and drained bottomlands (Linscombe et al. 1982). In Montana, Mitchell (1961) estimated that 280 mink inhabited a 33-km^2 (12.8 mi^2) area, resulting in a density of 1 mink/11.8 ha (29.2 acres). However, the following year, he estimated that there were only 109 mink in the area, a density of 1 mink/30.3 ha (74.7 acres). Fur harvest returns of 115 and 40 mink during the 2 years were comparable with returns from drained bottomland habitat in Louisiana. Marshall (1936) estimated densities from mink tracks in snow in Michigan, reporting 0.6 females in 1 km^2 (1.5/mi^2) of riverbank and a 1:1 sex ratio following heavy trapping. Errington (1943) counted 1-5 mink families occupying a 180-ha (450 acres) marsh in Iowa from 1933 to 1938. In 1939 no families were located. Errington (1943) suggested that over-trapping was responsible for the low numbers, which continued after 1938. Errington also suggested that intraspecific aggression was responsible for the upper limit of mink inhabiting the marsh.

McCabe (1949) estimated that there were 24 mink on a 445-ha (1,100 acres) refuge in Wisconsin during 1944, a density of 1 mink/18.8 ha (46.3 acres). He estimated that during the next 4 years (1945-48) the population ranged from 7 to 10 individuals. His estimates were inversely related to duration and depth of snow cover, but were poorly related to food supply (rabbits [*Sylvilagus* spp.] and mice [*Peromyscus* spp.]). McCabe (1949) suggested that excessive poaching and heavy trapping on the borders of the refuge caused lower mink numbers following 1944. Gerell (1971) worked in 2 study areas in Sweden. In a 10,000-ha (25,000 acres) area he estimated that there were 11 and 16 summer residents during 2 years, 1 mink/909 ha (2,245 acres) in year 1 and 1 mink/625 ha (1,545 acres) in year 2. In Gerell's (1971) other area, which included 10 km (6 miles) of riverbank, he estimated 3 and 6 summer residents in 2 years. In interior British Columbia, Ritcey and Edwards (1956) caught 11, 6, and 5 mink on 1.9 km (1.2 miles) of stream during 3 years. Their densities were similar to the estimate of 1.5-3 mink/km (2.5-5 mink/mile) of shoreline reported by Hatler (1976) for a coastal area of Vancouver Island. Mitchell (1961) reported that a turnover of the population occurred during a 3-year period, and Gerell (1971) concurred (Novak et al. 1987).

No population estimates were available for mink in Kentucky. Therefore, the best available information was used to estimate statewide populations. There are over 637,000 acres of wetlands in Kentucky (USGS 1997, KDEP 2003), including an estimated minimum of 89,431 miles of streams (KDEP 2003). Using the assumption that 50% of the wetlands support a mink population, and an average density of 0.1 mink per acre, a conservative statewide mink population could be estimated at over 31,800 mink.

Mink are classified as regulated furbearers in Kentucky and seasons and limits on take are set by KDFWR. There are no bag limits on mink (KDFWR 2005a). No harvest data was available for this species. Road-kill surveys conducted by KDFWR suggested that average mink abundance is increasing statewide and increases may be notable for the Western and Bluegrass regions (KDFWR 1998).

WS provided technical assistance for 6 mink damage complaints during FY 1998-2006. In all circumstances domestic or captive birds were killed. Total damage losses reported were $6,200 (average = $775/occurrence). These loss values included value of livestock and costs in efforts and methods to alleviate the problem (USDA 2007).

No targeted mink were taken by WS while conducting MDM in Kentucky during FY 1998-2006. Most complaints regarding this furbearer species are referred to KDFWR. In future programs, WS may be requested to address damage being caused by mink anywhere in Kentucky to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, as many as 10 mink each year could be killed by WS in MDM programs to address such damage. Mink damage management activities 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. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site.

Based upon the above information, WS' limited lethal take of mink would have no adverse impacts on overall populations of the species in Kentucky. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the mink populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.13 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 which are nearly naked and laterally flattened, tapering to a point but not paddle-shaped as the beaver. They build houses, or lodges of aquatic plants, especially cattails, up to 2.4 m (8 feet) in diameter and 1.5 m (5 feet) high. Those structures are usually built atop piles of roots, mud, or similar support in marshy areas, streams, lakes, or along water banks. Muskrats also burrow in stream or pond banks with entrances often above the water line. Other signs of the presence of muskrats include: feeding platforms built of cut vegetation in water or on ice, marked by discarded or uneaten grasses or reed cuttings, and floating blades of cattails, sedges, and similar vegetation near banks. This species is most active during crepuscular periods 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 of marshes, ponds, lakes, rivers, and canals in most of Canada and the U.S., except for Arctic regions, much of California, the southwestern U.S., Texas, and Florida (National Audubon Society 2000). They can be found in marshes, ponds, sloughs, lakes, ditches, streams, and rivers (Boutin and Birkenholz 1987).

Muskrats are highly prolific and produce 3-4 litters per year that average 5-8 young per litter (Wade and Ramsey 1986), which makes them relatively immune to overharvest (Boutin and Birkenholz 1987). Harvest rates from 3-8/acre have been reported to be sustainable in muskrat populations (Boutin and Birkenholz 1987). Muskrat home ranges vary from 529 ft^2 to 11,970 ft^2 (0.1-0.25 acres), with the size of muskrat home ranges depending on habitat quality and population density (Boutin and Birkenholz 1987).

No population estimates were available for muskrat in Kentucky. Therefore, the best available information was used to estimate statewide populations. There are over 637,000 acres of wetlands in Kentucky (KDEP 2003), including an estimated minimum of 89,431 miles of streams (KDEP 2003). Using the assumption that 50% of the wetlands support a muskrat population, an average home range of 0.25 acres per muskrat, only 1 muskrat occupies a home range, and no home ranges overlap, a conservative statewide muskrat population could be estimated at over 1.2 million muskrats.

Muskrats are classified as regulated furbearers in Kentucky, and seasons and limits for take are set by KDFWR. There are no bag limits on muskrats (KDFWR 2005a). No harvest data was available for this species. They are considered abundant in most areas of Kentucky and scattered in suitable habitat over the remainder of the State.

WS provided technical or operational assistance for 36 (annual average = 4/year) muskrat damage complaints during FY 1998-2006. Total damage losses reported were $29,550. Those loss values included damage to earthen dams, gardens, stream banks general property, turf, landscaping, and lawns (USDA 2007).

Muskrats usually cause damage to small areas in Kentucky and WS killed 54 to alleviate or resolve damage in FY 1998-2006 (annual average = 6). They sometimes threaten the integrity of earthen dams and therefore pose a threat to human safety and property at those sites. Muskrats may also cause damage to hobby and vegetable gardens and are implicated in erosion to yards, where they burrow in drainage ditches in urban environments. In addition to intentional take of muskrats in Kentucky MDM programs, 8 were taken unintentionally during beaver damage management operations (USDA 2007). In future programs, WS may be requested to address damage being caused by muskrats anywhere in Kentucky to protect any resource being damaged or threatened.

Based upon an anticipated increase for requests for WS' assistance, it is highly unlikely that the program would kill more than 200 muskrats in the entire state in any year under the proposed action. Most of those animals would probably be taken in urban and industrial habitats where little or no trapping by fur harvesters is done. Muskrat damage management activities 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.

Based upon the above information, WS' limited lethal take of muskrat would have no adverse impacts on overall populations of the species in Kentucky. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the muskrat populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.14 Opossum Population Information and Effects Analysis

Opossums are cat-sized mammals and are the only marsupials (possess a pouch in which young are reared) found north of Mexico (Seidensticker et al. 1987). They frequent most of the eastern and central U.S., except Minnesota, northern Michigan and New England, extending west to Wyoming, Colorado, and central New Mexico (National Audubon Society 2000). They are also found in parts of the southwestern U.S., California, Oregon, and Washington (Jackson 1994a). Adults range in size from less than 1 kg (2.2 lbs) to about 6 kg (13 lbs), depending on sex and time of year. They grow throughout life (Seidensticker et al. 1987). They have a fairly broad range of pelage colors, but are usually considered as "gray" or "black" phase. Their fur is grizzled white above, and 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, those animals eat insects, frogs, birds, snakes, small mammals, earthworms, and berries and other fruits; persimmons, apples, and corn are favorite foods (National Audubon Society 2000). They use a home range of 4-20 ha (10-50 acres), foraging throughout this area frequently (Jackson 1994a), but concentrating on a few sites where fruits abound, when they are in season (Seidensticker et al. 1987).

The reproductive season of the Virginia opossum typically occurs from December to February, depending on latitude, and extends into November (Gardner 1982). Gestation is short (average of 12.8 days) and 1-14 (National Audubon Society 2000) or 1-17 (Gardner 1982). Young are born in an embryonic state, climb up the mother's belly to the marsupium (pouch, attach to teats, and begin to suckle. The young remain in the pouch for about 2 months, at which time they will begin to explore and may be found traveling on their mother's back with their tails grasping hers (Whitaker, Jr. and Hamilton, Jr. 1998). Opossums live for only 1-2 years. Seidensticker et al. (1987) found that as few as 8% of a population of opossums survived into the second year in a study in Virginia. During the 5-year study, there was a wide variation in opossum numbers seasonally and during different years, in what was considered excellent habitat for the species (Seidensticker et al. 1987). However, the mean density during the study was 3.9/km^2 (10.1/mi^2), an estimate that was comparable to other opossum population densities in similar habitats in Virginia.

No population estimates were available for opossums in Kentucky. Therefore, the best available information was used to estimate statewide populations. There are almost 26 million acres of rural land in Kentucky, including 13.8 million acres of farmland (NASS 2005) and 11.9 million acres of forested land (KDF 2005). Approximately 8.4 million acres of the farmland is considered cropland (NASS 2005). Using the assumption that 75% of the rural lands throughout the state have sufficient habitat to support opossums, opossums are only found in rural habitat, opossum densities average 10/mi^2, a conservative statewide opossums population could be estimated at almost 305,000 opossums.

Many people in urban environments fear opossums, ostensibly because of their appearance and posturing, and report that those animals look dangerous or gruesome, hiss, and exhibit their teeth in a threatening manner (B. Dunlap, WS, pers. comm. 2007). WS received 270 (annual average = 30) complaints from individuals during FY 1998-2006 about opossum damage in Kentucky. Damage associated with opossums in Kentucky included fear for human safety, threats and predation to small pets, fouling of residential and non-residential buildings, nuisance, and other property damage. Kentucky residents reported $26,435 in damages to WS associated with opossums during FY 1998-2006 ($2,937/year; USDA 2007). Few damage figures were provided for threats to human health and safety, because complainants are rarely able to provide loss values for this resource (USDA 2007).

Opossums are classified as a regulated furbearer in Kentucky and seasons for take are set by KDFWR (KDFWR 2005a). There is no bag limit during opossum hunting or trapping seasons. Opossum populations in Kentucky are probably increasing, at least in urban environments of larger cities in the State (D. McChesney, KDFWR, pers. comm. 2006). No population data related to statewide population size is kept for opossums by KDFWR. No hunter/trapper harvest data was available for this species.

WS killed 118 opossums (annual average = 13.1/year) in all MDM programs in Kentucky during FY 1998-2006 (USDA 2007). In future programs, WS may be requested to address damage being caused by opossums anywhere in Kentucky to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill as many as 200 opossums each year in MDM programs in Kentucky. These animals would be removed primarily from urban and suburban populations, which are not hunted. Few of those animals are trapped by fur trappers. Opossum damage management activities 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 this number of opossums will have no adverse affect on overall populations of the species in Kentucky. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site.

Based upon the above information, WS' limited lethal take of opossums would have no adverse impacts on overall populations of the species in Kentucky. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the opossum populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.15 Other Rodent and Burrowing Mammal Population Information and Effects Analysis

4.1.1.1.1.15.1 Rats, Mice and Voles

Rats and mice belong to the rodent family Muridae and form the largest, most successful, and most adaptable group of mammals in the world. No other family contains more species and more individuals, or occupies a greater geographic range. The family

currently includes 281 genera and 1,326 species worldwide, with 20 genera and 78 species in North America north of Mexico. These animals are found in every available habitat, and vary greatly in habits and form. The animals in Family Muridae range in size from the 8-g (¼ oz) Northern pygmy mouse to the 1.8-kg (4 lb) common muskrat. In the U.S., this family includes 3 subfamilies: New World rats and mice, voles and lemmings, and the 3 introduced Old World species of house rats and mice (National Audubon Society 2000).

For the purpose of this analysis, population information and effects of proposed MDM actions will be considered for only 3 species of New World mice, 3 species of voles, and 2 species of Old World rats. The species include: deer mice (*Peromyscus maniculatus*), white-footed mice (*Peromyscus leucopus*), and eastern harvest mice (*Reithrodontomys humulis*) among New World rats and mice; meadow voles (*Microtus pennsylvanicus*), pine voles (*Microtus pinetorum*), and prairie voles (*Microtus ochrogaster*) among voles; and Norway rats (*Rattus norvegicus*) and Roof rats (*Rattus rattus*) among Old World rats. Those species are common in Kentucky and may cause damage to resources, including human health and safety, agriculture, property, and natural resources.

4.1.1.1.1.15.1.1 White-footed and Deer Mice

Fifteen species of native mice of the genus *Peromyscus* may be found in the U.S. The 2 most common and widely distributed species are the deer mouse and the white-footed mouse. Collectively, all species of *Peromyscus* are often referred to as “white-footed mice” or “deer mice.” All of the *Peromyscus* species have white feet, usually white undersides, and brownish upper surfaces. Their tails are relatively long, sometimes as long as the head and body. The deer mouse and some other species have a distinct separation between the brownish back and white belly. Their tails are also sharply bicolored. It is difficult even for an expert to tell all of the species apart (Timm and Howard 1994).

The deer mouse is found throughout most of North America, while the white-footed mouse is found throughout the U.S. east of the Rocky Mountains except in parts of the Southeast. Both species use a variety of habitats including wooded and brushy areas, cultivated and open habitats, and human structures such as homes and outbuildings (National Audubon Society 2000). Both species are prolific breeders and may raise several litters of 1-8 young (average 3-5) after a gestation period of 21-23 days. The young are weaned at 2 to 3 weeks of age and become sexually mature at about 7-8 weeks. Those born in spring and summer may breed the same year (Timm and Howard 1994).

Deer and white-footed mice principally cause problems by entering homes, cabins, and other structures that are not rodent-proof. They build nests, store food, and cause considerable damage to upholstered furniture, mattresses, clothing, paper, or other materials that they find suitable for nest-building. They can also cause extensive damage in reseeding programs, causing failure of such operations by feeding on planted seeds (Timm and Howard 1994).

In addition to damage to planting efforts and human property, deer mice have been associated with 2 serious diseases in recent years: Lyme disease, a bacterial infection, and Hanta virus, a respiratory illness. Lyme disease is carried by deer ticks, tiny arthropods that reside on deer mice at the immature stage. Hanta virus appeared in New Mexico in the early 1990s and caused a number of deaths; it is carried by the deer mouse and has also been found in many regions in other *Peromyscus* species, as well as in *Microtus* species (Timm and Howard 1994, National Audubon Society 2000).

Other identified damage occurs at airports within the range of deer and white-footed mice, where those species act as attractant prey for various mammal and avian predators, especially coyotes, fox, various hawks, and owls. Those predators often forage on airports where large populations of mice occur, and thereby present special hazards to operating aircraft, air passengers and crews (S. Stopak, WS, pers. comm. 2007).

White-footed and deer mice are classified as unprotected nongame in Kentucky. No limits are set on the take of those species.

WS has provided technical assistance in the past in Kentucky to airports regarding methods to control numbers of mice in airport environs to reduce the attraction of predators to such properties. The aim of such reductions in numbers is to reduce the risk of air strikes involving predator species which use the airport for hunting.

WS killed 22 deer mice and no white-footed mice in MDM programs in Kentucky during FY 1998-2006 (USDA 2007). In future programs, WS may be requested to address damage being caused by deer mice and white-footed mice anywhere in Kentucky to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill as many as 50 deer mice and 50 white-footed mice each year in MDM programs in the State. Some local populations of those species might be reduced as a result of MDM activities in a specific locale.

Based upon the above information, WS' limited lethal take of white-footed and deer mice would have no adverse impacts on overall populations of the species in Kentucky. Impacts to such rodents would be minimal because any rodent control would be localized, and is supported by the high reproductive rate of those rodents. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from damage management, including removal by WS, will be detrimental to the survival of the white-footed and deer mouse populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.15.1.2 Norway Rats and Roof Rats

The Norway rat is a stocky burrowing rodent, unintentionally introduced into North America by settlers who arrived on ships from Europe. Also called the brown rat, house rat, barn rat, sewer rat, gray rat, or wharf rat, it is a slightly larger animal than the roof rat. Adult Norway rats weigh an average of 454 g (1 lb). Their fur is coarse and usually brownish or reddish gray above and whitish gray on the belly. Blackish individuals occur in some locations. They make a network of interconnecting tunnels for nesting and they are a colonial species. They may burrow to make nests under buildings and other structures, beneath concrete slabs, along stream banks, around ponds, in garbage dumps, and at other locations where suitable food, water, and shelter are present (Timm 1994).

They live in close association with people (Burt and Grossenheider 1976, Timm 1994, National Audubon Society 2000), and in urban areas they live in and around residences, in cellars, warehouses, stores, slaughterhouses, docks, and sewers. On farms they may inhabit barns, granaries, livestock buildings, silos, and kennels (Timm 1994). In summer they may inhabit cultivated fields (National Audubon Society 2000), potentially developing extensive colonies of several hundred individuals at such sites (B. Dunlap, USDA, pers. comm. 2007). Norway rats are found throughout the U.S. and southern Canada and on the Pacific coast north to Alaska. They may be found in this range wherever humans live (Timm 1994, National Audubon Society 2000). They are primarily nocturnal and usually become

active about dusk, when they begin to forage for food and water. Some individuals may be active during daylight hours when rat populations are high. They have poor eyesight, relying more on hearing and the senses of smell, taste and touch. They are considered color blind (Timm 1994).

Norway rats will eat nearly any type of food. When given a choice they will select a nutritionally balanced diet, choosing fresh, wholesome items over stale or contaminated food. They prefer cereal grains, meats and fish, nuts, and some types of fruit. Food items in household garbage offer a fairly balanced diet and also satisfy their water requirements (Timm 1994). Rats often contaminate food they do not eat with droppings. They will also kill chickens and eat their eggs. They eat wild plants, insects, and seeds (National Audubon Society 2000).

Norway rats breed year-round (National Audubon Society 2000) but peaks occur in spring and fall. Reproductive activity typically declines during the heat of summer and often stops completely in winter, depending on habitat. The average female rat has 4-6 litters per year with 2-22 young per litter (Timm 1994, National Audubon Society 2000). Twelve litters per year are possible (Burt and Grossenheider 1976, National Audubon Society 2000). Gestation is 21-26 days. Female rats may breed again within 1-2 days after a litter is born (Timm 1994).

WS handled 31 requests (average = 3.4/year) for assistance with Norway rat and mixed species of rat damage in Kentucky during FY 1998-2006 through various technical assistance actions. Complainants reported $1,653 (average = $183.66/year) in damages resulting from Norway rats during the period. Loss values were not obtained for all reports. Complainants are rarely able to provide loss values for human health and safety threats. Resources affected included human health and safety, and dikes and impoundments. Damage reported included gnawing, nuisance, other damage, and other threats (USDA 2007). Normally, complaints regarding damage by Norway rats are often handled by local health departments and the KDA.

WS did not kill any Norway rats in MDM programs in Kentucky during FY 1998-2006. In future programs, WS may be requested to address damage being caused by Norway rats anywhere in Kentucky to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill as many as 5,000 Norway rats each year in MDM programs in the State. In those cases where Norway rats are causing damage or are a nuisance, complete removal of the local population could be achieved. This would be considered to be beneficial to the human environment since such actions would be requested by the affected property owner or administrator. Although regional population effects would be minor, even if large regional or nationwide reductions could be achieved, this would not be considered an adverse impact on the human environment because the species is not part of native ecosystems.

However, any local reductions or complete removal of local populations of Norway rats will have no adverse effect on regional or national populations of the species. Some local populations may be temporarily reduced as a result of MDM projects.

Based upon the above information, WS' limited lethal take of Norway rats would have no adverse impacts on overall populations of the species in Kentucky. Impacts to such rodents would be minimal because any rodent control would be localized, and is supported by the high reproductive rate of this species.

The Roof rat or Black rat (*Rattus rattus*) is a species of Old World rat that was introduced into the U.S. in the late 1500's to early 1600's (National Audubon

Society 2000). The roof rat is similar in appearance to the Norway rat, but has a longer tail and a shorter nose (Whitaker, Jr. and Hamilton, Jr. 1998).

The roof rat is most abundant in the South (National Audubon Society 2000). While most abundant in coastal areas, in the eastern U.S. it can be found inland to east Arkansas, west Kentucky, north Alabama and 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 will generally be found 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 at 2-3 months of age. A female roof rat will typically have 4-6 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 is done by roof rats (National Audubon Society 2000). Because of their ability to climb, they often do damage to nuts and fruits while still on the tree (Whitaker, Jr. and Hamilton, Jr. 1998).

There were no requests for assistance with roof rat damage in Kentucky during FY 1998-2006. Normally, complaints regarding damage by roof rats are often handled by local health departments and the KDA.

WS killed no roof rats in MDM programs in Kentucky during FY 1998-2006. In future programs, WS may be requested to address damage being caused by roof rats anywhere in Kentucky to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill as many as 10,000 roof rats each year in MDM programs in the State. In those cases where roof rats are causing damage or are a nuisance, complete removal of the local population could be achieved. This would be considered beneficial to the human environment since such actions would be requested by the affected property owner or administrator. Although regional population effects would be minor, even if large regional or nationwide reductions could be achieved, this would not be considered an adverse impact on the human environment because the species is not part of native ecosystems. However, any local reductions or complete removal of local populations of roof rats will have no adverse effect on regional or national populations of the species. Some local populations may be temporarily reduced as a result of MDM projects.

Based upon the above information, WS' limited lethal take of roof rats would have no adverse impacts on overall populations of the species in Kentucky. Impacts to such rodents would be minimal because any rodent control would be localized, and is supported by the high reproductive rate of those rodents.

4.1.1.1.1.15.1.3 Voles

Voles, also called meadow mice or field mice, are compact rodents with stocky bodies, short legs, and short tails. Their eyes are small and their ears are partially hidden. Their underfur is generally dense and covered with thicker, longer guard hairs. They usually are brown or gray, though many color variations exist (O'Brien 1994, National Audubon Society 2000).

There are 23 species of voles in the U.S. (O'Brien 1994), and the genus *Microtus* to which meadow, pine, and prairie voles belong, contains 15 (National Audubon Society 2000) or 17 (Jones et al. 1992) species. Of those species, meadow and

prairie voles are relatively abundant in the U.S., with meadow voles being the most widely distributed *Microtus* species. Prairie voles measure 13-18 cm (5-7 in), and have gray to dark brown fur mixed with gray, yellow or hazel-tipped hairs, giving a "peppery" appearance. Underparts are gray to yellow-gray. Prairie voles are the most common voles in prairie habitats. Meadow voles measure 14-19 cm (5½-1½ in) and their fur is gray to yellow-brown, obscured by black-tipped hairs. Northern subspecies may also have some red in their fur. The underparts are gray, at times washed with silver or buff (O'Brien 1994). Pine voles measure 10.5-14.5 cm (4-5¾ in), and have reddish-brown short soft fur above with grayish, washed with buff coloration below (National Audubon Society 2000). The pine vole utilizes tunnel systems that are usually one to several inches below ground.

Prairie voles range from southeastern Alberta, southern Saskatchewan and southern Manitoba south to northwestern New Mexico, northern Oklahoma, northern Arkansas, Tennessee, and western West Virginia. There have been isolated populations in southeastern Texas and southwestern Louisiana. Meadow voles range from Alaska and Canada south and east to northern Washington, Idaho, Utah, New Mexico, Wyoming, Nebraska, northern Missouri, northern Illinois, Kentucky, Tennessee, northeastern Georgia, and South Carolina. Both species are found together in some habitats, since meadow voles live chiefly in lush, grassy fields, marshes, swamps, woodland glades, and mountaintops, while prairie voles live principally in dry grass prairie or mixed grassy-weedy situations. As a rule, when those 2 species occur together, meadow voles inhabit the moist areas, while prairie voles inhabit the drier areas (National Audubon Society 2000). Meadow and prairie voles are active day and night, constructing many tunnels and surface runways with numerous burrow entrances. A single burrow system may contain several adults and young (O'Brien 1994).

The pine vole is found in the eastern U.S. ranging from New England to central Iowa, north to central Wisconsin, and in the southern states except for most coastal areas. Habitat for the pine vole is deciduous woodlands with thick leaf mold or thick herbaceous ground cover and sometimes park-like grassy areas (National Audubon Society 2000).

Voles feed on a variety of green vegetation, including grasses, forbs, and tubers, and in late summer they store seeds, tubers, bulbs, and rhizomes (O'Brien 1994, National Audubon Society 2000). They eat bark at times, primarily in fall and winter, and will eat crops, especially when their populations are high. Occasional food items include snails, insects, and animal remains. Voles may cause extensive damage to orchards, ornamentals, and tree plantings due to their girdling of seedlings and mature trees while feeding on bark. This usually occurs in fall and winter. Field crops such as alfalfa, clover, grain, potatoes, and sugar beets may be damaged or completely destroyed by voles. Their activities on such crops may interfere with crop irrigation by displacing water and causing levees and checks to wash out. They can also ruin lawns, golf courses, and ground covers.

Voles may breed throughout the year, but most commonly in spring and summer (O'Brien 1994), and may do so all year long in the south (National Audubon Society 2000). In the field, they have 1-5 litters/yr, and meadow voles have produced up to 17 litters/yr in a laboratory (O'Brien 1994). Litter sizes range from 1-11, but usually average 3-6. The gestation period is about 21 days, and young are weaned by the time they are 21 days old. Females mature in 35-40 days and life spans of voles are short; probably ranging from 2-16 months. In one population, there was 88% mortality during the first month of life (O'Brien 1994).

Large population fluctuations are characteristic of voles and generally peak every 2-5 years, but cycles are not predictable. Population densities are variable. Cole and Batzli (1979) found that prairie vole populations averaged 38/ha (15/acre) in prairie, 38/ha (15/acre) in bluegrass, and 244/ha (99/acre) in alfalfa. Among meadow voles, an Ontario, Canada population ranged from 80-400 ha (32-162/acre) over one year, while an Illinois population ranged from 5-15 ha (2-6/acre), also over one year. Much higher densities may be reached during population irruptions.

A wide variety of predators feed on voles. Voles are relatively easy for most predators to catch and are active, and therefore available, day and night, year-round. Despite their vulnerability and availability, voles are not usually "controlled" by predators, because they have a high reproductive potential. Postpartum breeding is common and females may breed as early as one week of age. Synchronous breeding also occurs. These factors enable voles to increase at a faster rate than predators are able to reduce them (Pearson 1985).

WS responded to 17 requests (average = 1.8/yr) for assistance with vole damage during FY 1998-2006. Most complaints were handled by providing technical assistance advice on methods for addressing damage. Complainants reported $43,000 (average = $4,777.77/year) in damages resulting from voles during the period. Resources affected included landscaping, turf and flowers, trees and shrubs, and soybeans. Damage included feeding, burrowing and digging, gnawing, and girdling (USDA 2007).

Determination of numbers of voles killed by MDM actions is difficult when lethal chemical methods such as zinc phosphide treatments are employed. This is because most animals killed by those methods die underground. Most vole damage management actions by WS in Kentucky in the past have been addressed using zinc phosphide injected into vole burrows. These activities have been associated with damage to earthen dams with resultant threats to human safety, because the integrity of the dams is threatened by vole burrowing activities. In addition, WS has conducted some MDM programs to reduce vole numbers at airports to reduce attractiveness of properties to predators and to reduce damage to landscape plants, seedlings, trees, shrubs, and other ground cover. Based on area sizes treated and number of treatments, it is estimated that WS killed 943 voles (average = 104.77/year) in all MDM programs in the state during FY 1998-2006.

In future programs, WS could receive requests for assistance in reducing damage caused by voles to any resource anywhere in Kentucky. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill 2,000 voles each year in such programs, statewide.

Based upon the above information, WS' limited lethal take of voles would have no adverse impacts on overall populations of vole species in Kentucky. Impacts to such rodents would be minimal because any rodent control would be localized, and is compensated by the high reproductive rate of those rodents.

The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from damage management, including removal by WS, will be detrimental to the survival of the vole populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.15.2 Chipmunks

Chipmunks belong to the family Sciuridae, which has 66 species in the U.S. and Canada, including tree and ground squirrels, marmots, prairie dogs, and a few lesser known

genera. Chipmunks consist of 1 genus, *Tamiass*, which is represented by 2 groups: the western and eastern chipmunk. There are 22 species of chipmunks in North America, 21 of which are considered western species. The single eastern species, *Tamiass striatus*, is larger than its western relatives and is also distinguished by different dentition. Analysis in this Subsection will be related to the eastern species.

The eastern chipmunk's range includes most of the eastern U.S., except the extreme south and along the southeastern seaboard (Williams and Corrigan 1994, National Audubon Society 2000). The eastern chipmunk is a brownish, ground-dwelling squirrel, typically 13-15 cm (5-6 in) long and weighing 90 g (3 oz). The tail is 8-10 cm (3-4 in) long and hairy, but it is not bushy (Williams and Corrigan 1994).

Chipmunks, generally forest creatures, have large, fur-lined internal cheek pouches for carrying nuts and seeds. They have black and white facial stripes, and 5 dark stripes separated by 4 pale ones, on the back and sides of their bodies. They 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 2 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 either an underground burrow, or a hollow tree limb (National Audubon Society 2000). These burrows may often be well hidden near objects, such as stumps, wood piles, brush piles, basements, and garages or other buildings. The burrow entrance is usually about 5 cm (2 in) in diameter with no obvious mounds of soil around them (Williams and Corrigan 1994, National Audubon Society 2000).

Eastern chipmunks have two mating periods, during early spring and again during the summer or early fall. There is a 31-day gestation period, producing 2-5 young (Williams and Corrigan 1994). First-year females that do not breed 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 5-10 animals/ha (2-4 animals/acre) (Burt and Grossenheider 1976), and may be as high as 24/ha (10 animals/acre) where sufficient food and cover are available. Home ranges often overlap among individuals and are usually less than 92 m (100 yd) across (Williams and Corrigan 1994).

No population estimates were available for chipmunks in Kentucky. Therefore, the best available information was used to estimate statewide populations. There are almost 26 million acres of rural land in Kentucky, including 13.8 million acres of farmland (NASS 2005) and 11.9 million acres of forested land (KDF 2005). Approximately 8.4 million acres of the farmland is considered cropland (NASS 2005). Using the assumption that 25% of the forested areas throughout the state have sufficient habitat to support chipmunks, chipmunks are only found in rural habitat, and chipmunk densities average 1 chipmunk per acre, a conservative statewide chipmunk population could be estimated at almost 3 million chipmunks.

Throughout their North American range, chipmunks are considered 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 seedling, as well as bird seed, grass seed, and pet food that is not stored in rodent-proof storage containers. In New England, chipmunks and tree squirrels cause considerable damage to maple sugar tubing systems by gnawing tubes. Chipmunks are classified as protected non-game in Kentucky.

WS responded to 60 requests (average = 6.6/year) for assistance with chipmunk damage during FY 1998-2006. Most complaints were handled by providing technical assistance advice on methods for addressing damage. Complainants reported $12,650 (average = $1,581.25/year) in damages resulting from chipmunks during the period. Loss values were not obtained for all reports. Resources affected included landscaping, residential buildings, grasses, gardens, and general property. Damage included feeding, burrowing and digging, nuisance, and other damage (USDA 2007).

No chipmunks were killed by WS in any MDM programs in Kentucky during FY 1998-2006. In future programs, WS may be requested to address damage being caused by chipmunks anywhere in Kentucky to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill as many as 200 chipmunks each year in MDM programs in the state. Chipmunks would almost always be removed from urban, suburban, industrial or commercial habitats. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local project site.

Based upon the above information, WS' limited lethal take of chipmunks would have no adverse impacts on overall populations of the species in Kentucky. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from damage management, including removal by WS, will be detrimental to the survival of the chipmunk populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.15.3 Moles

Moles are often confused with voles and shrews, but can be distinguished by their hairless pointed snout extending nearly 1.3 cm (½ in) in front of their mouth opening. The small eyes and the opening of the ear canal are concealed in the fur; there are no external ears. The forefeet are very large and broad, with the palms wider than they are long (Henderson 1994). The enlarged forefeet allow moles to tunnel through soil by executing a kind of breast stroke, enabling them to virtually swim through porous soil at a rate of about one foot per minute (National Audubon Society 2000). The toes are webbed to the base of the claws, which are broad and depressed. The hind feet are small and narrow with slender, sharp claws (Henderson 1994).

Two mole species are found in Kentucky. The eastern or common mole (*Scalopus aquaticus*) is found throughout all of Kentucky and inhabits open fields, waste areas, lawns, gardens and sometimes woods in well-drained loose soils. This species has short, velvety fur; it is gray in its northern range, brownish or tan in southern and western parts. The tail is short and nearly naked. Eastern moles measure 82-223 mm (3¼-8¾ in) in total length (National Audubon Society 2000). They range throughout most of the eastern U.S. from southern Minnesota and extreme southeastern Wyoming, Kansas, and central Texas east to the Atlantic and Gulf coasts (National Audubon Society 2000).

The hairy-tailed mole (*Parascalops breweri*) is found in mountainous and foothill habitat in extreme eastern Kentucky and inhabits well-drained, light soil, brushy areas, and occasionally lawns or golf courses adjacent to woods. The fur of this species is dense and silky, dark gray to nearly black. Hairy-tailed moles typically measure from 139-170 mm (5½-6¾ in) in length (National Audubon Society 2000). The tail is short and hairy. They range throughout extreme southeastern Canada and New England southwest through the mountains of North Carolina and Tennessee, and west through eastern Ohio.

Moles eat several kinds of invertebrates including earthworms, grubs, beetles, beetle larvae, centipedes, ants, wasps, spiders, and flies, among others. They also eat seeds and some other plant materials. Typical mole damage occurs as tunnels in gardens, lawns,

golf courses and other grassy areas, results from their incessant search for food. They eat between 70% and 100% of their body weight each day and store food (Godfrey and Crowcroft 1960, Holbrook and Timm 1986, Henderson 1994).

Eastern moles live in the seclusion of underground burrows, coming to the surface rarely, and then often by accident. Hairy-tailed moles stay in burrows by day but may emerge at night to feed (National Audubon Society 2000). Researchers believe moles are solitary. On several occasions two or even three moles have been trapped at the same spot, but that does not necessarily mean they had been living together in a particular burrow. Networks of runways made independently occasionally join otherwise separate burrows (Godfrey and Crowcroft 1960, Henderson 1994).

During the mating season, male moles will seek out a female in her burrow to mate (National Audubon Society 2000). Moles have few natural enemies, which allows them to maintain populations by producing only one annual litter of 2-6 (National Audubon Society 2000) or 3-5 offspring (Henderson 1994) each year. Gestation period of moles is approximately 42 days. Young are born primarily in March and early April (Henderson 1994). Home range estimates for moles range form 1,385 to 114,486 square feet (Yates and Pedersen 1982). Both species of moles found in Kentucky are classified as unprotected non-game. No seasons or limits are set on the take of those species in the state.

No population estimates were available for moles in Kentucky. Therefore, the best available information was used to estimate statewide populations. There are almost 26 million acres of rural land in Kentucky, including 13.8 million acres of farmland (NASS 2005) and 11.9 million acres of forested land (KDF 2005). Approximately 8.4 million acres of the farmland is considered cropland (NASS 2005). Using the assumption that 25% of the non-forested areas throughout the state have sufficient habitat to support moles, moles are only found in rural habitat, mole home ranges average 1 mole per 2.6 acre, and no home ranges overlap, a conservative statewide mole population could be estimated at over 1.35 million moles.

WS responded to 53 requests (average = 5.8/year) for assistance with mole damage during FY 1998-2006. Most complaints were handled by providing technical assistance advice on methods for addressing damage. Complainants reported $8,850 (average = $983.33/year) in damages resulting from moles during the period. Loss values were not obtained for all reports. Resources affected included landscaping, grasses, gardens, turf, and flowers. Damage included burrowing, digging, and other damage (USDA 2007).

WS killed no moles in MDM programs in Kentucky during FY 1998-2006. In future programs, WS may be requested to address damage being caused by moles anywhere in Kentucky to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill as many as 200 moles each year in MDM programs in the state. These moles would almost always be removed from urban, suburban, industrial or commercial habitats. Removing this number of moles will have no adverse effect on overall populations of the species in Kentucky. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local project site.

Based upon the above information, WS' limited lethal take of moles would have no adverse impacts on overall populations of the species in Kentucky. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from damage management, including removal by WS, will be detrimental to the survival of the mole populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.16 Raccoon Population Information and Effects Analysis

The raccoon, also called "coon," is a stocky mammal about 61-91 cm (2-3 ft) long, weighing 4.5-13.5 kg (10-30 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 1994b).

The raccoon is one of the most omnivorous of animals. They will eat carrion, garbage, birds, mammals, insects, crayfish, mussels, other invertebrates, and a wide variety of grains, various fruits, other plant materials and most or all foods prepared for human or animal consumption (Sanderson 1987). Raccoons occasionally kill poultry (Boggess 1994b), and come into conflict with man frequently in urban and suburban environments by raiding garbage cans and pet food sources (S. Stopak, WS, Pers. Comm., 2007).

The raccoon is found throughout most of the U.S., with the exception of the higher elevations of mountainous regions and some areas of the arid southwest (Boggess 1994b, National Audubon Society 2000). Raccoons are more common in the wooded eastern portions of the U.S. than in the more arid western plains (Boggess 1994b), and are frequently found in cities or suburbs as well as rural areas (National Audubon Society 2000). 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 range diameters of raccoons have been reported as being 1-3 km (0.6-2.9 mi) maximum, with some home range diameters of dense suburban populations reported as 0.3-0.7 km (0.2-0.4 mi).

Absolute raccoon population densities are difficult or impossible to establish because of the difficulty in determining what percentage of the population has been counted or estimated and the additional difficulty of knowing how large an area the raccoons are using (Sanderson 1987). Due to their adaptability, raccoon densities reach higher levels in urban areas than in rural areas. Relative raccoon population densities have been inferred by estimating take of animals per unit area. For instance, Twichell and Dill (1949) reported removing 100 raccoons from tree dens in a 41-ha (101-ac) waterfowl refuge area, while Yeager and Rennels (1943) studied raccoons on 881 ha (2,177 ac) in Illinois and reported trapping 35-40 raccoons in 1938-39, 170 in 1939-40, and 60 in 1940-41. Slate (1980) estimated one raccoon occurs per 7.8 ha (19.3 ac) in New Jersey, in predominantly agricultural land on the inner coastal plain. Raccoon densities of 100 per square mile (1 raccoon/6.4 ac) can be attained around abundant food sources (Kern 2002). Kennedy et al. (1991) estimated 13 raccoons per 100 ha (1 raccoon/19 ac) of lowland forest in Tennessee.

No population estimates were available for raccoons in Kentucky. Therefore, the best available information was used to estimate statewide populations. There are almost 26 million acres of rural land in Kentucky, including 13.8 million acres of farmland (NASS 2005) and 11.9 million acres of forested land (KDF 2005). Approximately 8.4 million acres of the farmland is considered cropland (NASS 2005). Using the assumption that 75% of the rural lands throughout the state have sufficient habitat to support raccoons, raccoons are only found in rural habitat, and raccoon densities average 1 raccoon per 19 acres, a conservative statewide raccoon population could be estimated at over 1 million raccoons.

In Kentucky, raccoons cause damage to gardens, crops, residential and non-residential buildings, fish, domestic fowl and pets, as well as cause general property damage. For example, 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 1994b).

Kentuckians are also concerned about health and safety issues associated with raccoons. 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 the roundworm. Ingestion of those eggs can result in serious or fatal infections in other animal and in humans (Davidson and Nettles 1997, Table 1.1).

Raccoons are regulated furbearers in Kentucky. They are harvested for fur value and hunting and trapping seasons are determined for the species by KDFWR (KDFWR 2005a). There are no bag limits on raccoons. Information regarding the total number of raccoons killed in Kentucky annually is not available. Raccoon densities are lowest in the southeastern portions of the state (L. Patton, KDFWR, pers. comm. 2006). Based on road-kill surveys conducted by KDFWR, populations fluctuate annually, possibly influenced by distemper outbreaks (L. Patton, KDFWR, pers. comm. 2006). From 1996-2004, the number of raccoon killed on roads ranged from 25-34 individuals per 10,000 miles statewide (L. Patton, KDFWR, pers. comm. 2006).

WS handled 365 requests (average = 40.5/year) for assistance with raccoon damage in Kentucky MDM programs during FY 1998-2006 through various technical assistance and direct damage management actions. Complainants reported $758,873 (average = $84,319.22/year) in damages resulting from raccoons during the period. Loss values were not obtained for all reports. Complainants are rarely able to provide loss values for human health and safety threats. Complaints included human health and safety threats, damage to other animals, including pets, and damage to grasses, sod, gardens, general property, aircraft, electrical utilities, and residential and non-residential buildings (USDA 2007).

WS conducts sampling activities involving live-capture and data collection for raccoons in Kentucky before they are released. During FY 2002-2006, WS live-captured, sampled, and released 15 raccoons in eastern Kentucky to gather information about the status of rabies in the state (USDA 2007). Those activities are part of the national rabies barrier program covered under separate environmental analyses (USDA 2005b). No raccoons have been captured for rabies studies since 2003 in the state, but other rabies monitoring or control activities may occur as part of this program.

WS killed 315 raccoons (average = 35/year) in all MDM programs in Kentucky during FY 1998-2006 (USDA 2007). In future programs, WS may be requested to address damage being caused by raccoons anywhere in Kentucky to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill as many as 400 raccoons each year in MDM programs in the State. Those raccoons would almost always be removed from urban and suburban populations of the species. Urban and suburban populations are not hunted and few are trapped by fur trappers. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local project site.

Based upon the above information, WS' limited lethal take of raccoon would have no adverse impacts on overall populations of the species in Kentucky. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the raccoon populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.17 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 (Hall and Kelson 1959). 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. Otters are found 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, present distribution spans the North American continent from east to west and extends from southern Florida to northern Alaska (Melquist and Dronkert 1987). River otters were extirpated from Kentucky until reintroductions began in 1972. River otters are known to occur primarily in western Kentucky, where population densities appear greatest. In that area of the state, lowland marshes and swamps interconnect with meandering streams and small lakes, and provide more suitable habitat. KDFWR suggests that the range is expanding as otter populations increase. Reports of otters have been reported throughout the state (D. McChesney, KDFWR, pers. comm. 2001).

River otters are a state-regulated furbearer, considered by KDFWR and the public to be a valuable fur-producing species. A new river otter season was established during 2004-2005 for the following counties: Ballard, Caldwell, Calloway, Carlisle, Crittenden, Fulton, Graves, Hickman, Livingston, Lyon, Marshall, McCracken and Trigg. Season limit is 5 otters per person. A total of 374 otters were taken (138 hunted and 236 trapped) during the 2005-06 season (KDFWR 2006b).

KDFWR does not estimate river otter populations. The best information available for otter population trends is based on the professional opinion of biologists at KDFWR, who believe the otter population is increasing (D. McChesney, KDFWR, pers. comm. 2002). Melquist and Dronkert (1987) summarized studies estimating river otter densities, which showed that densities were about 1 per 175-262 acres in Texas coastal marshes, and ranged from 1 per 1.8 miles to 1 per 3.6 miles of waterway (stream or river). There are over 637,000 acres of wetlands in Kentucky (KDEP 2003), including an estimated minimum of 89,431 miles of streams (KDEP 2003). Using the conservative estimate of one otter per 2.4 stream miles provided by Novak (1987), and assuming river otters occur in one-half of the stream habitat in Kentucky, the minimum statewide river otter population estimate for Kentucky could be estimated at 18,630 river otters.

WS killed 17 river otters (average = 1.8/yr) in Kentucky MDM programs during FY 1998-2006 (USDA 2007). Those animals were taken as unintentional non-targets during beaver damage management activities. A few river otters will probably continue to be taken as non-targets in WS' MDM programs to address beaver or muskrat damage in the State in future years. It is probable that less than 15 river otters per year would be unintentionally taken in all such programs during a given year by WS.

Some aquaculture producers or fish hatchery managers could request assistance from WS to address the loss of fish taken by river otters. A few river otters may be killed in some of those instances. It is possible that as many as 15 river otters per year could be intentionally killed in WS conducted damage management programs to protect fish production in Kentucky.

Based upon the above information, WS' limited lethal take of river otter would have no adverse impacts on overall populations of the species in Kentucky. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the river otter population in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.18 Skunk Population Information and Effects Analysis

4.1.1.1.1.18.1 Spotted Skunk Population Information and Effects Analysis

Spotted skunks are one of the smallest skunks, (approximately half the size of a house cat). The legs are short, and the tail is long and bushy with a white tip. The spotted skunk has a black pelage with broken white stripes, and a white patch on the nose, and front of the ears. The average total length is 403-610 mm and tail length is 193-280 mm. The adult male weighs from 444-999 g (1-2.5 lbs), and the female weighs from 363-567 g (0.8-1.25 lbs) (Whitaker, Jr. and Hamilton, Jr. 1998).

The eastern spotted skunk ranges from Costa Rica and northeastern Mexico through the Great Plains of the central U.S. to the Canadian border. It is also found throughout the southeastern U.S. The eastern spotted skunk has been found in open lowlands, mountainous country, and at altitudes of 2,400 m (7,875 ft) (Baker and Baker 1975). Few studies have been published on the home range, population density, and mortality of spotted skunks. Crabb (1948) found that the western spotted skunk in Iowa maintained a home range of 64.8 ha (160 ac) at densities of 2.2/km^2 (5.7/mi^2). Crabb (1948) also noted movements of 4.8 km (3 mi)/night. However, spotted skunks are nomadic, do not occupy a territory, and do not defend a home range (Crabb 1948).

This species mates in April, the gestation period is 50-70 days, and average litter size is 2-6 young. Offspring are blind and average 1/3 ounce each. Some males are sexually mature and can breed by 5 months. The male gives no care to the young. The eyes of the young open at around 1 month and they can emit musk at about 46 days. The young develop teeth by 40 days and are weaned by 55 days, after which they forage with the mother until late fall when they disperse (National Audubon Society 2000, KDFWR 2002a).

This species is nocturnal, and they climb trees more than other skunks. They are also quicker and more alert. There is no true hibernation, but short, inactive periods occur in the winter to conserve body fat. Several individuals may den together in the winter. Populations up to 13 or more per square mile can be found. Males may wander farther, and dens distributed over the area seem to belong to the whole population, except during breeding season. Spotted skunks have a characteristic handstand defense mechanism that makes them appear larger. The home range is generally from 1-1.3 miles in diameter, with female home ranges approximately one-third as large as male home ranges (KDFWR 2002a). Skunk densities vary widely according to season, food sources and geographic area. Densities have been reported to range from 1 skunk per 77 acres to 1 per 10 acres (Rosatte 1987).

Spotted skunks feed on a variety of items including beetles, grubs, bees and honey, mice, moles, rats, chipmunks, bird eggs and fresh carrion (KDFWR 2002a). They are more predaceous than other skunk species, and mammals appear to be a more important food source than arthropods (Howard and Marsh 1982). For example, in Iowa, mammals were identified in 90% of scats collected during winter (Crabb 1941). Eastern cottontails appeared to be a major food item, along with meadow and prairie voles.

Adult spotted skunks can stay in burrows for several weeks during cold spells, losing up to 30% of their body weight with no ill effects. Underground dens are either excavated or abandoned by other animals. Dens have 2-5 entrances with 1-3 nest chambers, and can have up to 60 feet of tunnels. Sections below the frost line are used in the winter when all except one entrance may be sealed. Deserted woodchuck and other small animal's burrows are frequently used as dens. Occasionally, owls prey upon spotted skunks. This species can carry and transmit rabies (KDFWR 2002a).

No population estimates were available for spotted skunks in Kentucky. The presence of spotted skunks has been confirmed in 8 counties in Kentucky, and they may also occur in approximately 40 other counties in the eastern and southeastern portions of the state (AWAKE 2003). The best available information was used to estimate statewide populations. There are almost 26 million acres of rural land in Kentucky, including 13.8 million acres of farmland (NASS 2005) and 11.9 million acres of forested land (KDF 2005). Approximately 8.4 million acres of the farmland is considered cropland (NASS 2005). Using the assumption that 25% of the rural lands throughout the state have sufficient habitat to support spotted skunks, skunks are only found in rural habitat, and skunks densities average 1 skunk per 77 acre, a conservative statewide spotted skunk population could be estimated at over 84,000 skunks.

Spotted skunks are protected furbearers in Kentucky and are listed as a species of State special concern by the KSNPC. This classification is a category of wildlife which should be continually monitored, according to KSNPC. KDFWR forbids the take of spotted skunks by regulation (KDFWR 2005a).

No spotted skunks were killed either as targets or non-targets in any WS' MDM programs in Kentucky from FY 1998-2006 (USDA 2007). Because most WS' MDM actions which target skunks in Kentucky allow identification of offending species, killing of spotted skunks as non-targets is highly unlikely and lethal take is not anticipated. WS would consult with KDFWR to determine their wildlife management objectives for this species, and would modify damage management methods or strategies to assist KDFWR in meeting those objectives. This might mean using only live capture and translocation methods for capturing individual spotted skunks in areas where they are causing damage. Because of such mitigation measures, no adverse effects on this species are expected to occur from WS' MDM actions in Kentucky.

Based upon the above information, WS' management activities involving spotted skunks would have no adverse impacts on overall populations of the species in Kentucky. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from damage management, including MDM actions by WS, will be detrimental to the survival of spotted skunk populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.18.2 Striped Skunk Population Information and Effects Analysis

Although easily recognized by their black and white fur, the striped skunk may be most readily recognized by the odiferous musk smell. Striped skunks are common throughout the U.S. and Canada (Rosatte 1987). They are primarily nocturnal and do not have a true hibernation period, although during extremely cold weather they may become temporarily dormant. The striped skunk is an omnivore, feeding heavily on insects such as grasshoppers and crickets, beetles, and bees and wasps (Chapman and Feldhamer 1982). The striped skunk's diet also includes small mammals, the eggs of ground-nesting birds and amphibians. Striped Skunks are typically non-aggressive, and will attempt to flee when approached by humans (Rosatte 1987). However, when provoked, skunks will give a warning and assume a defensive posture prior to discharging their foul-smelling musk. This musk contains sulfur-alcohol compounds known as butylmercaptan (Chapman and Feldhamer 1982).

The striped skunk may use abandoned burrows of other animals as a home. They may also dig their own burrow, or use a protected place, such as a hollow log, crevice, or space beneath a building. This species is currently one of the chief carriers of rabies in the U.S. (National Audubon Society 2000).

Adult skunks begin breeding in late February. Yearling females (born in the preceding year) mate in late March. Gestation usually lasts about 7-10 weeks, and there is usually only 1 litter annually. Litters commonly consist of 4-6 young. The home range of striped skunks is usually not consistent. It appears to be in relation to life history requirements such as winter denning, feeding activities, dispersal and parturition (Rosatte 1987). Home ranges of striped skunks have been reported to average between 2.2 and 4.9 km^2 (0.85-1.9 mi^2) in rural areas of Minnesota and Illinois (Rosatte 1987). 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 have been reported to range from 1 skunk per 10 acres to 1 per 77 acres (Rosatte 1987).

No population estimates were available for spotted skunks in Kentucky. Therefore, the best available information was used to estimate statewide populations. There are almost 26 million acres of rural land in Kentucky, including 13.8 million acres of farmland (NASS 2005) and 11.9 million acres of forested land (KDF 2005). Approximately 8.4 million acres of the farmland is considered cropland (NASS 2005). Using the assumption that 50% of the rural lands throughout the state have sufficient habitat to support stripped skunks, skunks are only found in rural habitat, and skunk densities average 1 skunk per 77 acre, a conservative statewide stripped skunk population could be estimated at almost 169,000 striped skunks.

Striped skunk populations are increasing in Kentucky (J. Lane, KDFWR, pers. comm. 2005). This species is classified as a regulated furbearer in Kentucky and KDFWR sets limits and seasons for take of those animals (KDFWR 2005a). No harvest data was available for this species.

Striped skunks have also been associated with rabies in urban environments in areas of the State where populations are fairly large (D. McChesney, KDFWR, pers. comm. 2002). Skunks totaled 6 out of 17 confirmed cases of rabies in Kentucky in 2005, but represented only 2.2% of the total number of animals tested for that year (22 out of 995 total samples) (Kentucky Cabinet for Health and Family Services 2006a, Kentucky Cabinet for Health and Family Services 2006b). Skunks totaled 14/23, 20/39, 17/28, and 15/30 confirmed cases in 2004, 2003, 2002, and 2001, respectively (Kentucky Cabinet for Health and Family Services 2006a).

WS responded to 172 requests (average = 19.1/year) for assistance with striped skunk damage during FY 1998-2006. Most complaints were handled by providing technical assistance advice on methods for addressing damage. Complainants reported $30,370 (average = $3,374.44/year) in damages resulting from striped skunks during the period. Loss values were not obtained for all reports, especially human health and safety. Complainants are rarely able to provide loss values for human health and safety threats. Resources affected included human health and safety, general property, residential and non-residential buildings, pets, and turf or flowers. Damage included burrowing/digging, odor, nuisance, rabies threats, and other threats (USDA 2007).

WS killed 49 striped skunks (average = 5.4/year) in all MDM programs in Kentucky during FY 1998-2006. In future programs, WS may be requested to address damage being caused by striped skunks anywhere in Kentucky to protect any resource being damaged or threatened. Based upon current and an anticipated increase in striped skunk damage management activities in the future, it is possible that WS could kill 200 striped skunks per year in all MDM programs in Kentucky. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local project site.

Based upon the above information, WS' limited lethal take of striped skunks would have no adverse impacts on overall populations of the species in Kentucky. The KDFWR has

determined that there is no evidence to suggest that human mediated-mortality resulting from regulated fur trapping and damage management, including removal by WS, will be detrimental to the survival of striped skunk populations in the state of Kentucky (J. Lane, KDFWR, pers. comm. 2005).

4.1.1.1.1.19 Tree Squirrel Population Information and Effects Analysis

Tree squirrels are divided into three groups: large tree squirrels; red or pine squirrels; and flying squirrels. Large tree squirrels include fox *(Sciurus niger*), eastern gray *(Sciurus carolinensis*), western gray *(Sciurus griseus*), and tassel-eared *(Sciurus aberti*) squirrels. Only fox squirrels and eastern gray squirrels have been associated with notable levels of damage in the State (USDA 2007). Thus, only those 2 species will be treated in this Subsection. Further reference to "squirrels" as a group in this Subsection will include only fox squirrels and eastern gray squirrels.

Fox squirrels measure 46-69 cm (18 – 27 in) from nose to tip of tail. They weigh 787-1,012 g (1¾-2½ lbs). Color varies greatly, from all black in Florida to silver gray with a white belly in Maryland. Georgia fox squirrels usually have a black face. Ohio and Michigan fox squirrels are grizzled gray-brown above with an orange underside. Sometimes several color variations occur in a single population. Eastern gray squirrels measure 41-51 cm (16-20 in). They weigh 567-794 g (1¼-1¾ lbs) (National Audubon Society 2000). Eastern gray squirrels are also variable in color. Some have a distinct reddish cast to their gray coat. The black color phase is common in some northern parts of their range.

Gray and fox squirrels are found throughout most of the eastern U.S., including Kentucky. They inhabit mixed hardwood forests, especially those containing nut trees such as oak/hickory mix. Fox squirrels are also found in cypress and mangrove swamps and piney woods in the south. While those species are aptly named tree squirrels, they spend quite a bit of time on the ground foraging. However, gray squirrels rarely venture far from trees, while fox squirrels may wander into areas of weeds and fields in search of food (Burt and Grossenheider 1976, National Audubon Society 2000). 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. Nuts are often cached for later use. In late winter and early spring, squirrels prefer tree buds. In summer they eat fruits, berries, and succulent plant materials. Fungi, corn, and cultivated fruits are taken when available. They may also chew bark during high population peaks, when food is scarce, and they may eat insects and other animal matter (Jackson 1994b).

Gray squirrels produce young during early spring, while fox squirrels have litters around February to early March, though they may produce young at any time until early September (National Audubon Society 2000). Older adults of both species may produce 2 litters per year (Burt and Grossenheider 1976, Jackson 1994b). The gestation period is 42-45 days, and about 3 young comprise a litter. Young begin to explore outside the nest at about 10-12 weeks of age (Jackson 1994b). Home ranges of squirrels range from 1.2 to over 40 acres in size (Flyger and Gates 1982).

Squirrel populations periodically rise and fall, and during periods of high population densities, squirrels may go on mass emigrations, during which time many animals die. Squirrel species are vulnerable to numerous parasites and diseases such as ticks, mange mites, fleas, and internal parasites. Squirrel hunters often notice bot fly larvae, called "wolves" or "warbles," protruding from the skin of animals killed. These larvae do not impair the quality of the meat for eating. In addition to being a food source for some people, squirrels are also prey for hawks, owls, snakes, and several mammalian predators. Predation seems to have little effect on squirrel populations. Typically, about half the squirrels in a population die each year and

wild squirrels over 4 years old are rare, while captive individuals may live 10 years or more (Jackson 1994b).

No population estimates were available for squirrels in Kentucky. Therefore, the best available information was used to estimate statewide populations. There are almost 26 million acres of rural land in Kentucky, including 13.8 million acres of farmland (NASS 2005) and 11.9 million acres of forested land (KDF 2005). Approximately 8.4 million acres of the farmland is considered cropland (NASS 2005). Using the assumption that 75% of the forested areas throughout the state have sufficient habitat to support squirrels, squirrels are only found in rural habitat, squirrel home ranges average 1 squirrel per 40 acres of forested habitat, and that home ranges do not overlap, a conservative statewide squirrel population could be estimated at over 297,500 squirrels.

Gray and fox squirrels are considered regulated consumptive recreational game in Kentucky and appropriate seasons and bag limits are set by the KDFWR (2005a). Information regarding the total number of squirrels killed in Kentucky annually is not available. Although squirrel population densities are not determined in Kentucky, evaluation of volunteer squirrel hunters' surveys submitted to KDFWR and evaluation of mast crop production indicated that gray squirrel populations are rising, and fox squirrel populations are either stable or slightly declining in all regions within the state (KDFWR 2005c). Mast production in 2004-2005 had the lowest rating in more than 20 years (KDFWR 2005c).

WS responded to 222 (annual average = 24.6/year) requests for assistance with squirrel damage during FY 1998-2006. Most complaints were handled by providing technical assistance advice on methods for addressing damage. Complainants reported $51,495 (average = $5,721.66/) in damages resulting from squirrels during the period. Loss values were not obtained for all reports. Complainants are rarely able to provide loss values for human health and safety threats. Resources affected included human health and safety, general property, residential and non-residential buildings, and truck gardens. Damage included feeding, gnawing, nuisance, and other damage (USDA 2007).

WS killed 20 squirrels (annual average = 2.2/year) in all MDM programs in Kentucky during FY 1998-2006. In future programs, WS may be requested to address damage being caused by squirrels anywhere in Kentucky to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill as many as 300 squirrels (combination of gray and fox squirrels) each year in MDM programs in the state. These squirrels would almost always be removed from urban and suburban populations of the species, which are not hunted populations. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local project site.

Based upon the above information, WS' limited lethal take of gray and fox squirrels would have no adverse impacts on overall populations of those species in Kentucky. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the gray and fox squirrel populations in the state of Kentucky (C. Garland, KDFWR, pers. comm. 2003).

4.1.1.1.2 Effects on Non-target Species Populations, Including T&E Species

Direct impacts on non-target species occur if WS' program personnel were to inadvertently kill, injure, or harass animals that are not target species. In general, those impacts result from the use of methods that are not completely selective for target species. WS' take of non-target species during WDM activities is expected to be extremely low to non-existent. While every precaution is taken to safeguard against taking non-target species, at times changes in local animal movement patterns and other unanticipated events could result in the incidental take of unintended species. Those occurrences are rare and should not affect

the overall populations of any species under the current program. SOPs designed and implemented to avoid adverse effects on non-target species are described in Chapter 4.

WS' personnel are experienced and trained in wildlife identification, and to select the most appropriate methods for taking targeted animals and excluding non-target species. Non-target species are usually not affected by WS' non-lethal management methods, except for the occasional scaring from harassment devices. In those cases, affected non-target wildlife may temporarily leave the immediate vicinity of scaring, but would most likely return after conclusion of the action. Shooting is virtually 100% selective for the target species; therefore no adverse impacts are anticipated from use of this method. WS' personnel use animal lures and set traps and snares in locations that are conducive to capturing target animals while minimizing potential impacts to non-target species. Any non-target species captured unharmed in a live trap would be subsequently released on site.

Any operational uses of MDM chemicals would be in accordance with labeling requirements under FIFRA and state pesticide laws and regulations that are established to avoid unreasonable adverse effects on the environment. Following labeling requirements and use restrictions are a built-in mitigation measure that would assure that use of registered chemical products would avoid significant adverse effects on non-target species populations. No adverse impacts from the use of chemical methods are anticipated. Based on a thorough Risk Assessment, APHIS concluded that, when the WS' program uses chemical methods in accordance with label directions, they are highly selective to target individuals or populations, and such use has negligible effects on the environment (USDA 1997).

Non-target species taken in Kentucky are recorded as Target-Unintentional (i.e., they were listed on the agreement as target species but were taken unintentionally during efforts to take other target species) or Non-target (i.e., they were not listed as target species on the agreement and were taken unintentionally during efforts to take target species). With this type of data recording, some species were targets in some situations and non-targets in others. Non-target mammals killed by WS during MDM activities in Kentucky during FY 1998-2006 included: feral dog (1), muskrats (10), raccoons (16), groundhogs (1), striped skunk (9), white-tailed deer (1), mink (1), cottontail rabbit (2), opossum (1), and river otters (10) (USDA 2007). The level of non-target take for each of those species is insignificant and had no effect on their populations in the State. WS does not anticipate the level of non-target take to increase substantially above current levels of take. Any other non-targets that may incidentally be taken by WS is expected to be minimal and should have no adverse effect on statewide populations. The KDFWR concurs that Kentucky WS' management of mammal damage will have no adverse effects on native wildlife populations in Kentucky, including state listed T&E species, and species of concern (J. Lane, KDFWR, pers. comm. 2005). Analysis of impacts on feral cats, feral dogs, gray fox, red fox, groundhog, muskrat, opossum, river otter, cottontail rabbit, mink, and raccoon are provided in Section 4.1.1.1. Analysis of turtle population impacts are provided in the following subsection.

4.1.1.1.2.1 Turtle Populations Information and Effects Analyses

Turtles in Kentucky are classified as a nongame species, regulated under 310 KAR 2:508. Sport fishermen can take the common snapping turtle (not alligator snapping turtles, which are a State-listed threatened species) and softshell turtles year-round by the same methods legal for taking rough fish species. A hunting license is required when taking turtles by gun or by use of archery equipment. Otherwise, a fishing license is required to take turtles. Turtle harvesters may also use traps of a specific design to capture turtles (KDFWR 2001). Table 4.3 lists turtles found in Kentucky. Box turtles were excluded from this table. There are no bag limits on turtles and KDFWR does not keep harvest data on turtle species.

Turtles comprise the highest non-target take by WS in MDM activities. In Kentucky, WS killed 70 (annual average = 7.8) turtles and released 88 turtles statewide during FY 1998-2006 (USDA 2007). This is very low in comparison to the number taken by commercial fishermen and trappers in the state each year. The most frequently taken species by WS were common snapping turtles, followed by sliders (D. Lingo, WS, pers. comm. 2007, K. Stucker, WS, pers. comm. 2007). It is unknown how many of each of those species WS takes because records are not kept for turtles by species. However,

the alligator snapping turtle, which is a State-listed threatened species in Kentucky, has a sedentary hunting behavior and is found in deeper waters, and, therefore, WS will probably take them infrequently. The southern painted turtle is also a State-listed species of concern, but none have been observed to have been taken by WS' MDM programs, and it is probable that take of this species will be extremely infrequent.

Table 4.3 Turtles (Except Box Turtles) Found in Kentucky

SCIENTIFIC NAME	COMMON NAME	STATUS*
Chelydra serpentina	Snapping Turtle	PN
Chelydra serpentina serpentina	Common Snapping Turtle	PN
Macrochelys temminckii	Alligator Snapping Turtle	PN,ST
Kinosternon subrubrum	Eastern Mud Turtle	PN
Sternotherus odoratus	Common Musk Turtle	PN
Chrysemys picta dorsalis	Southern Painted Turtle	PN,ST
Graptemys geographica	Common Map Turtle	PN
Graptemys pseudogeographica kohnii	Mississippi Map Turtle	PN
Graptemys ouachitensis	Ouachita Map Turtle	PN
Graptemys pseudogeographica pseudogeographica	False Map Turtle	PN
Pseudemys concinna concinna	Eastern River Cooter	PN
Pseudemys concinna	River Cooter	PN
Pseudemys concinna hieroglyphica	Hieroglyphic River Cooter	PN
Trachemys scripta	Slider	PN,FPS
Trachemys scripta elegans	Red-eared Slider	PN
Apalone mutica mutica	Midland Smooth Softshell	PN,SC
Apalone spinifera spinifera	Eastern Spiny Softshell	PN
Apalone spinifera	Spiny Softshell	PN

Sources: Kentucky Department of Fish and Wildlife Resources and Kentucky State Nature Preserves Commission (KDFWR 2003, KSNPC 2005)
***Status Codes:** F = Federal listing, S = State listing, LE = Listed Endangered (Federal Code), E = Endangered, T = Threatened, M = Species of Management Concern, C = Species of Special Concern (normally coded as "S" by KSNPC), PN = Protected non-game, CHD = Critical Habitat Determined, PS = Partial Status (status applies only to a portion of the species' range)

The level of take of all turtles in MDM programs by WS in Kentucky is insignificant in terms of the overall populations of any species, or of all species combined in Kentucky. Therefore, WS' effects on turtle populations are considered insignificant in terms of the overall population, or in relation to any individual species population in the State.

Based upon the above information, WS' limited lethal take of turtles would have no adverse impacts on overall populations of any turtle species in Kentucky. The KDFWR has determined that there is no evidence to suggest that human-mediated mortality resulting from regulated harvest, including removal by WS, will be detrimental to the survival of any turtle populations in the state of Kentucky (T. Slone, KDFWR, pers. comm. 2002).

4.1.1.1.2.2 Threatened and Endangered Species

The list of federal and state T&E species for Kentucky was reviewed by WS to determine whether any T&E species might be affected by the proposed action.

Beaver dams can adversely impact stream ecosystems by impounding water which floods habitat and increases sedimentation in streams affecting wildlife that depend on clear water, such as certain T&E species of fish and mussels. WS' MDM actions related to beaver damage management projects which might affect T&E mussel populations in Kentucky are discussed in subsections 4.1.1.2.3.1 and 4.1.1.2.3.2. Other T&E species in the state have been evaluated in relation to all WS' MDM program actions to determine whether any other such species might be affected by those activities. SOPs designed and implemented to avoid adverse effects on T&E species were described in Chapter 3

(subsection 3.4.2.2). Those measures should assure that the proposed action would not likely adversely affect any T&E species.

Federally-listed species

Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or mitigation measures. WS has consulted with the USFWS under Section 7 of the ESA concerning potential impacts of WS' MDM methods on T&E species, and has obtained a Biological Opinion (BO). For the full context of the BO, see Appendix F of the WS' FEIS (USDA 1997). WS is also in the process of reinitiating Section 7 consultation at the national level to assure that potential effects on T&E species have been adequately addressed.

WS has reviewed the USFWS list of T&E species for the state of Kentucky and has determined the proposed MDM program will not adversely affect those T&E species included in the USFWS 1992 BO. This determination is based on an evaluation of MDM methods used by the WS' program, including those used in Kentucky. In addition, WS has determined that the proposed MDM program will not likely adversely affect any T&E species federally listed in Kentucky since the completion of USFWS 1992 BO. In addition to the 1992 BO issued by the USFWS for WS' programmatic activities, WS in Kentucky initiated consultation with the USFWS for MDM activities proposed under this EA. The USFWS has issued a letter of concurrence that WS' activities will not likely adversely affect T&E species listed in Kentucky (V. Andrews, USFWS, letter to B. Dunlap, WS, February 7, 2007).

State-listed species

The KDFWR concurs that the WS' MDM program in Kentucky will not adversely affect any State listed T&E species.

4.1.1.1.2.3 Mussel Populations Information and Effects Analyses

Several mussel species in Kentucky are federally listed as T&E (Appendix D). For many of those species, habitat factors which may affect their recovery, continued existence, or health are of special concern to the public and wildlife management agencies and entities. It is of considerable importance therefore, that analysis be conducted relative to the potential effects of WS' actions at sites which might host such T&E populations, or locations that might have the potential to provide suitable habitat for them. This subsection provides that analysis.

Fresh water mussels belong to the phylum Mollusca which are characterized by two shells which attach by a hinge, are soft bodied, and feed through a process of filtering food items from flowing water. Mussels are mobile and free swimming before reaching adulthood, but are sedentary as adults, moving only short distances using a "foot" to drag themselves across the bottom of a water body or stream. During development before adulthood, many mussel species attach to the gills of fish and travel there as parasites for 20-70 days before sinking to the bottom to begin life as a sedentary adult (Hickman et al. 1978).

Kentucky hosts a number of mussel species, of which 19 are federally listed as T&E. Of those, some are represented in Kentucky by more than one population (see Appendix E). Additional populations are categorized by USFWS as "Experimental Non-essential." For additional information on such populations, refer to USFWS T&E classifications (USFWS 2003). Appendix E provides an overview of mussel species and habitat types in which they are found in Kentucky.

Evaluation of MDM actions by species of mammal addressed and methods used indicate that only beaver damage management presents scenarios which might have the potential to affect T&E mussel species in Kentucky. For that reason, only beaver damage management actions will be evaluated relative to T&E mussel species. That analysis is presented in the two following subsections.

4.1.1.1.2.3.1 Beaver Removal Methods and SOP Effects Analysis

In almost all beaver damage management projects WS' employees use or recommend integrated methods. Those methods may include lethal removal of problem beaver from selected sites. SOPs for such activities include assessment of the magnitude of damage, evaluation of natural water flow patterns and drainage characteristics, and decisions about techniques to remove beaver with minimal disturbance of sites. Beaver are captured using a variety of trap types, or by snares, as discussed in Appendix B. Activities conducted in water by WS in setting traps or snares to capture beaver are always performed in areas of relatively high beaver activity where individuals have created dams, lodges, or runways used to travel to and from feeding areas. These areas are almost always sites where beaver have greatly disturbed the soil, drainage substrate, and vegetation. The bottoms of streams, pools, ponds, and other water bodies in the vicinity of those beaver activities are often disturbed by digging, dredging, and dragging of materials as beaver build, travel, and feed (Novak 1987). Sites such as those adjacent to dams and lodges are almost always heavily silted and strewn with sticks, leaves, and other debris. Locations of frequent and heavy beaver activity are probably substandard sites for mussel populations of any T&E species in Kentucky, based on habitat and water quality characteristics needed (Appendix E). Very minimal activity, such as digging or walking on the bottom of streams and ponds is conducted by WS' employees beyond those areas disturbed by vigorous beaver activity. Shooting of beaver is performed from the bank or from a boat and no contact with the bottom by WS' personnel is made. This reduces the likelihood that any WS' MDM activities related to beaver removal would disturb sites where T&E mussel populations exist. Therefore, WS' MDM trapping and shooting activities related to the removal of beaver from those locations is not likely to adversely affect T&E mussel species in the State.

4.1.1.1.2.3.2 Beaver Dam Removal Methods and SOP Effects Analysis

Removal of beaver dams during beaver damage management activities is discussed in subsections 2.2.4, 3.4.2.5, 4.1.1.5, and Appendix B. SOPs are outlined for making determinations about the appropriateness of dam removal and for complying with water quality standards and permitting. The Kentucky Division of Water has determined that removal of most beaver dams during WS' MDM programs would not require permitting in Kentucky, based on federal and state permitting requirements (T. VanArsdall, Kentucky Division of Water, pers. comm. 2002). Situations which might require permitting are discussed in Appendix B.

WS either manually removes small beaver dams, or employs certified WS' explosive specialists who use binary explosives for larger or more substantial dams. Manual removal of dams requires access to the most disturbed sites in beaver habitat. Almost all activity related to manual removal of such dams occurs within 10 feet of the center of the dam. This area is always dredged, dug, and littered by the beaver's dam building activity and it is unlikely that any mussels would be found in such close proximity to a dam. Material removed from those dams is either tossed on the bank of the water body or stream, or escapes to flow downstream. Mud and small materials such as bark and other plant debris also escapes downstream and tends to settle out within 40-60 feet. Small to medium limbs may drift further distances. Few large limbs are used in such dams.

Removal of beaver dams through the use of explosives is complex and requires careful analysis of several factors. This method requires consultation with local landowners, often with local and state agencies, and sometimes with federal agencies. Quantity of explosives to be used must be calculated and charges appropriately set. WS implements explosive projects using optimal explosive charges in order to adequately remove a beaver dam while at the same time minimizing effects on the environment. Considerations for appropriateness of the method and possible effects on adjacent habitat, channel substrate, and water release are contemplated. Typically, removal of a beaver dam using explosives, while producing some immediate water surge downstream, does not release large amounts of sediment for great distances downstream.

The effects of appropriately calculated and placed charges tend to disperse material around the blast site or simply loosen the dam and allows upstream water pressure to erode the dam and carry and deposit it downstream. Both components of the binary explosive charge utilized by WS are completely expended in the combustion of the material and residues are practically nonexistent. As with manually-removed beaver dams, most activities in the water are limited to within 10 feet of the dam site where some of the most disturbed portions of beaver habitat exist.

When removal of a beaver dam is conducted using explosives, it lifts and loosens the material and allows some of it to be dispersed downstream, heavier clays and waterlogged debris settle out within 20-40 feet of the dam site, and most sedimentary material will settle out within 150-200 feet. The more swiftly flowing water created by removing the obstruction represented by the dam dilutes debris and disperses it thinly along the channel bed downstream. Waters normally clear below such sites within 30 minutes because adequate flow is usually returned to the channel. Disturbance by those activities is limited and almost always assists in restoring smoother and more rapid flow to natural drainages, which may improve water quality in most instances.

WS will evaluate sites proposed for beaver dam removal for potential presence of T&E mussel species based upon site specific maps provided by the USFWS. In those locations identified within the state where T&E mussels have been recorded as present, WS will consult with USFWS and KDFWR and make determinations about the presence of such species populations and the appropriateness of dam removal activity as it relates to their protection. When T&E mussels are determined to be in close proximity to a proposed beaver dam removal site, WS will seek guidance and recommendations from USFWS about the feasibility of removal of such dams by explosives or other means. If USFWS determines that mussel beds or individuals may be jeopardized as a result of the use of explosives, WS may propose to manually remove those dams and will consult with USFWS regarding the procedures to be used in such actions. Manual removal may proceed through one of the following processes or a combination thereof:

- WS could employ backhoes or trackhoes, in areas where their use was feasible, to rake beaver dams from drainages. This action would release water more slowly than explosives removal of those structures and would thus result in less water surge and large amounts of sediment affecting downstream habitat. Properly executed, this technique can often remove a large amount of sediment producing mud of which the beaver dam is constituted, which can be deposited on the bank and will not be discharged downstream. This protocol might work well where such heavy equipment could be operated from public, farm, logging, or other access roads in close proximity to the affected area.
- WS could use hand implements to remove all or most of the dam in one action occurring during one day to bring water behind the dam to a natural level. The rationale of this action would be to release impounded water in a relatively short time, but minimize the deposition of sediments downstream and around the dam site when compared with removal by explosives. Manual removal of 1 cubic yard of beaver dam manually usually takes at least one hour, and water is released gradually during this time. This protocol would work well with small dams which have resulted in moderate impoundment of a drainage, and could work as well with larger dams which possess a shallow profile and where impounded water averages less than two feet deep within 90 feet of the dam.
- WS could use hand implements to partially breach the dam and then follow this treatment with consecutive deepening of those breaches after downstream waters had returned to pre-breached flow, continuing this until waters above the dam returned to normal levels. The rationale of this action would be to release impounded waters gradually over a longer period of time in such a way that hydraulic pressure and velocity did not result in the transfer of large amounts of sediment downstream. This protocol would work well with large dams where water is deeply impounded and may average more than two feet in depth within 90 feet of the dam. Additionally, dam removal using this method might work well with large dams which restrict water in large deep reservoirs where the dam is placed in a relatively shallow drainage waterway and the average water depth in the waterway is two feet or less.

- WS could breach a dam partially, removing just enough depth necessary to reduce flooding damage yet maintain proper habitat conditions for T&E mussel species. This will elicit dam repairing activities by beaver for the purpose of enhancing population management activities. In those cases, dams would not be totally removed and no significant water flow or sediment disturbance would occur. Only a few sticks and a small amount of soil, detritus, and leafy debris would be expected to be discharged downstream. This action would have little effect on the turbidity of the water and stream flow would quickly disperse the small amount of debris.

Of the four possible scenarios discussed above, specific protocols to be used at a proposed project site will be mutually agreed upon among USFWS, KDFWR, and WS.

If the USFWS determines that mussel populations in a potentially affected site would be jeopardized by any action to remove a target beaver dam, WS would accept this conclusion and not attempt to remove the dam. Beaver may, however, be removed from the site and future population management activities proceed to ensure that no beaver use the area in subsequent seasons and years, if requested by a cooperator. Such population management activities would be conducted as outlined in Subsection 4.1.1.2.3.1 and might allow natural degradation and disappearance of the beaver dam in a few to several years.

4.1.1.3 Effects on Human Health and Safety

When used improperly or by untrained individuals, various methods used in MDM projects could pose risks to humans. Methods analyzed that could pose risks to human health and safety include the use of explosives, chemicals, firearms, snares, foothold traps, conibear traps, and harassment with pyrotechnics. A formal risk assessment of WS' operational management methods found that risks to human safety were low (USDA 1997). WS' SOPs include measures intended to mitigate or reduce the effects on human health and safety and are presented in Chapter 3. Risk to members of the public from WS' use of explosives to remove beaver dams, pyrotechnics to harass offending animals, or from use of chemicals, firearms, snares, foothold traps or body-gripping traps to take mammals would remain low due to adherence to WS' policies, required safety precautions, and training.

In those situations where a non-federal cooperator has already made the decision to remove or otherwise manage a mammal species to stop damage with or without WS' assistance, WS' participation in carrying out the action will not affect the environmental status quo. In some situations, dependent upon the skills and abilities of the non-federal entity, WS' involvement may actually have a beneficial effect on the human environment when compared to the environmental status quo in the absence of such involvement.

4.1.1.3.1 Safety and Efficacy of Chemical Methods

WS' personnel use binary explosives to remove beaver dams in certain situations. WS' personnel who use explosives are certified through comprehensive training and must be able to demonstrate competence and safety in their use. They are also required to adhere to WS' policies as well as regulations related to explosives use, storage, and transportation enforced by the ATF, OSHA, and the USDOT. When explosives are used, signs are placed to warn the public of those activities. Where dams are near roads, police or other road officials are used to stop traffic and public entry; an approach also used by Road Department crews when they use explosives, to ensure public safety. Therefore, no adverse effects to public safety are expected from the use of explosives by WS in Kentucky.

Under the proposed alternative, WS may use certain EPA-registered pesticides, including zinc phosphide, for some rodent damage management, AP and sodium nitrate gas cartridges as anti-coagulant rodent baits, and den fumigants. All those chemicals are regulated by EPA under FIFRA, and Kentucky Pesticide Control Laws. Their use by WS' personnel is carefully defined in WS' directives. Based on a thorough Risk Assessment, APHIS concluded that, when the WS' program uses chemical methods, including those referenced above, in accordance with label directions, they are highly selective to target individuals or populations, and such use has negligible effects on the

environment (USDA 1997). Therefore, MDM programs in Kentucky, where such chemicals are used, are not expected to adversely affect public safety.

Rodenticides are anticoagulants used to control commensal rodents and some field rodents around buildings and other structures. Common anticoagulants include warfarin and diphacinone. Anticoagulants are normally classified as multiple-dose toxicants. For the materials to be effective, animals must feed on the bait more than once. However, some newer formulations only require a single feeding to be effective. Bait for rats and mice must be continuously available for 2-3 weeks for effective population control.

Zinc phosphide is a metallic toxicant most often used for rat, vole, muskrat, and nutria damage control. The odor of zinc phosphide is attractive to rodents but repulsive to most other animals. Tarter emetic is sometimes added to bait used to control rats. This safety feature will cause most other species to regurgitate any zinc phosphide baits they may consume. Its effectiveness for rat control is not compromised because rats are unable to regurgitate.

Aluminum phosphide is a fumigant for certain burrowing rodents and moles. AP reacts with atmospheric moisture to release phosphine (PH_3) gas. Phosphine gas is a potent mammalian toxicant.

Gas Cartridges are placed in burrows/dens and are burned to create carbon monoxide gas to euthanize animals. Applicators must exercise caution to avoid burns to the skin or surrounding vegetation.

Non-lethal MDM chemicals that might be used or recommended by WS include repellents. Such chemicals must undergo rigorous testing and research to prove safety, effectiveness, and low environmental risks before EPA or FDA would register them. Any operational uses of chemical repellents would be in accordance with labeling requirements under FIFRA and state pesticide laws and regulations that are established to avoid unreasonable adverse effects on the environment. Following labeling requirements and use restrictions are a built-in mitigation measure that would assure that use of registered chemical products would avoid significant adverse effects on human health and safety.

Drugs used in capturing, handling, and euthanizing wildlife for wildlife hazard management purposes include ketamine hydrochloride, xylazine (Rompun), sodium pentobarbital, Beuthanasia-D, and a mixture of tiletamine and zolazepam (Telazol). Meeting the requirements of the AMDUCA should prevent any significant adverse impacts on human health with regard to this issue. Mitigation measures that would be part of the SOPs include:

- All drug use in capturing and handling wildlife 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), wildlife hazard 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 to avoid release of animals that may be consumed by hunters 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 drugs would be released well before state-controlled hunting/trapping seasons, which would give the drug time to completely metabolize out of the animals' systems before they might be taken and consumed by humans. In some instances, animals collected for control purposes would be euthanized when they are 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.

By following those procedures in accordance with AMDUCA, wildlife management programs would avoid any significant impacts on human health with regard to this issue.

4.1.1.3.2 Effects on Human Health and Safety from Non-Chemical MDM Methods

Firearms and pyrotechnics are only used by WS' personnel who are experienced in handling and using them. WS' personnel use firearms to shoot mammals and euthanize animals caught in traps. WS' personnel are trained and given refresher courses to maintain awareness of firearm and pyrotechnic safety and handling as prescribed by WS' policy. Therefore, no adverse effects to public safety are expected from the use of firearms or pyrotechnics by WS in Kentucky.

WS' personnel use snares and body-gripping (e.g. conibear) traps, and foothold traps to take target mammals. Snares and traps are strategically placed to minimize non-target take and minimize exposure to the public. Signs are used to post properties where traps are set to alert the public of their presence. In addition, large body-gripping traps are restricted to water sets according to WS' policy, which further reduces threats to public safety.

Therefore, no adverse effects to public safety are expected from the use of firearms, snares, foothold traps, conibear traps, and pyrotechnics by WS in Kentucky.

4.1.1.3.3 Effects on Human Health and Safety from not Conducting MDM

People are concerned with potential disease threats and injury and loss of human life as a result of aircraft striking mammals. An IWDM strategy, a combination of lethal and non-lethal means, has the greatest potential of successfully reducing this risk. All WDM methods could possibly be implemented and recommended by WS.

4.1.1.4 Effects on Socio-cultural Elements and Economics of the Human Environment

4.1.1.4.1 Effects on Human Affectionate-Bonds and Aesthetic Values of Wild Mammal Species

As discussed in subsection 2.2.3.1, some people form human affectionate-bonds with individual wild or feral mammals. For such, removal of those individual animals is considered objectionable because those animals may be considered pets, or the relationship which exists may be similar to that experienced with domestic pets. A number of professionals in the field of psychology have studied human behavior in response to attachment to pet animals (Gerwolls 1994, Marks and Koepke 1994, Zasloff 1996, Archer 1999, Ross and Baron-Sorensen 1998, Meyers 2000) and observations made regarding this are probably applicable to close bonds which could exist between people and wild animals. Humans experience affection for pet animals, which is similar in scope and meaning to human-human affections for some (Stephens and Hill 1996, Boyce 1998). Disruption of this relationship may cause a sense of loss, the experiences of grief, the need for healing, and acceptance of the loss and rebuilding, which can include establishing new bonds with other animals or engaging in other activities (Lefrancois 1999).

If humans establish affectionate relationships with wild animals that are comparable to that for domestic companion animals, removal of individual animals from certain sites by WS' MDM actions may result in severing of those established bonds. However, as those affected individuals follow the usual human pattern related to the experience of loss, they will experience recovery and may establish new bonds with other animals.

WS' MDM actions rarely remove all mammals or even all mammals of one species from a locale where actions occur. Individuals wishing to establish bonds with wild animals will still be able to

interact with them. WS' MDM programs are not therefore, expected to markedly affect this element of the human environment.

Some individuals obtain aesthetic benefit from viewing animals in the wild and may feel that removal of animals from a locale by WS' MDM programs could affect their aesthetic enjoyment. In addition, some people do not believe that some mammals should even be harassed to stop or reduce damage problems. Some of them are concerned that their ability to view mammals is lessened by WS' non-lethal harassment efforts. Regarding this, the public's ability to view wild mammals in a particular area would be more limited if the mammals are removed or relocated. However, immigration of mammals from other areas could possibly replace the animals removed or relocated during a damage management action. The opportunity to view or feed other wildlife would also be available if an individual makes the effort to visit other areas with adequate habitat and local populations of the species of interest. In addition, WS' MDM actions rarely remove all mammals or even all mammals of one species from a locale where actions occur. Sometimes the live capture and translocation or killing of some mammals results in complete, but usually temporary, removal of all of those mammals from one property, but adjacent properties in nearby neighborhoods still contain other mammals of the same species. In some instances in Kentucky where WS conducts such activities, other mammals are observed to re-populate the project area within a short time.

Again, as previously discussed, some individuals are offended by the presence of overabundant mammal species, and feel that their overall enjoyment of other mammals is diminished by the presence of such species. In cases where WS' MDM actions reduce the numbers of such overabundant species, the removal or relocation of those animals would have the potential to actually enhance the aesthetic value of other wildlife for those affected humans, and would also have the potential to positively affect their view of wildlife in general.

In those situations where a non-federal cooperator has already made the decision to remove or otherwise manage a mammal species to stop damage with or without WS' assistance, WS' participation in carrying out the action will not affect the environmental status quo. In some situations, dependent upon the skills and abilities of the non-federal entity, WS' involvement may actually have a beneficial effect on the human environment when compared to the environmental status quo in the absence of such involvement.

4.1.1.4.2 Effects on Aesthetics and Value of Property Damaged by Mammals

Damage to property would be expected to decrease under this alternative since all available damage management methods and strategies would be available for WS' use and consideration. Reducing or alleviating damage caused by mammals will allow for the restoration of property value and the aesthetic value of property damage by mammals.

In those situations where a non-federal cooperator has already made the decision to remove or otherwise manage a mammal species to stop damage with or without WS' assistance, WS' participation in carrying out the action will not affect the environmental status quo. In some situations, dependent upon the skills and abilities of the non-federal entity, WS' involvement may actually have a beneficial effect on the human environment when compared to the environmental status quo in the absence of such involvement.

4.1.1.5 Effects on Wetlands

Most MDM activities conducted by WS in Kentucky do not have the potential to affect wetlands, since they are not conducted near or in wetlands. However, WS' MDM activities related to wetlands or their environs, such as beaver dam removal, are conducted according to federal and state laws and guidelines enacted to minimize impacts to such habitats, and to provide guidance for such conduct. In addition, landowners are required to obtain the appropriate permits from the USACE for removal of beaver dams of certain specifications and types specified by law, in order that regulatory agency oversight might be able to determine effects for such actions. Further, WS does not remove dams in established wetlands except to

restore mitigation wetlands, but does so in instances, and at sites, where normal drainage may be restored to reduce damage and effects on natural habitat or other human resources.

Under this alternative, beaver impounded areas would be removed by hand or with explosives for the purpose of returning streams, channels, dikes, culverts, and irrigation canals to their original function. WS removes most beaver impoundments because they have flooded areas such as roads, crops, merchantable timber, pastures, and other types of property or resources that were not previously flooded. During FY 1998-2006, a total of 77 dams were removed during WS' beaver damage management activities. Among those, 63 were removed by hand and 14 were removed with binary explosives (USDA 2007). Most dams removed were created as a result of recent beaver activity because WS' personnel receive most requests soon after affected resource owners discover damage and become aware of the WS' program.

Dams are 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 Clean Water Act (see Section 2.2.4 and Appendix B). The majority of impoundments that WS removes have been in existence for only a few months or years. These are not considered true wetland habitat and, therefore, do not possess the same wildlife habitat values as established wetlands.

WS' compliance with wetland protection laws and regulations assures that WS' activities will not adversely affect wetland habitats. Because of protective protocols which have been established for MDM actions relative to wetlands, through appropriate SOPs and those previously discussed safeguards and checks, WS has determined that MDM activities in Kentucky will have no adverse effect on wetlands.

In those situations where a non-federal cooperator has already made the decision to remove or otherwise manage a mammal species to stop damage with or without WS' assistance, WS' participation in carrying out the action will not affect the environmental status quo. In some situations, dependent upon the skills and abilities of the non-federal entity, WS' involvement may actually have a beneficial effect on the human environment when compared to the environmental status quo in the absence of such involvement.

4.1.1.6 Humaneness of Methods Used by WS

Regarding humaneness and animal welfare concerns, under this alternative, methods viewed by some persons as inhumane would be employed. Despite SOPs designed to maximize humaneness as described in Subsections 2.3.5 and 3.4, the perceived stress and trauma associated with being held in foothold traps or snares until WS' personnel arrive at the trap or snare site to dispatch or release the animal, is unacceptable to some persons. In addition, those methods may be used in "drown sets," in which the animal drowns shortly after being caught, which is also considered inhumane by some persons. Other MDM methods used to take target animals including shooting and body-gripping traps (i.e., conibear) result in a relatively humane death because the animals die instantly or within seconds to a few minutes. Those methods however, are also considered inhumane by some individuals.

WS uses EPA-registered and approved pesticides, such as zinc phosphide, AP, burrow and den fumigants, and anti-coagulants, to manage damage caused by some mammals, especially rodents, in Kentucky. Some individuals consider the use of such chemicals to be inhumane. Pesticide labels and MSDS for chemicals used in the WS' MDM program would be adhered to and followed to ensure those products are used as humanely as possible.

WS' personnel are experienced and professional in their use of management methods, and methods are applied as humanely as possible. Under this Alternative, mammals would be trapped as humanely as possible or shot by experienced WS' personnel using the best and most appropriate method(s) available. Some persons may perceive those methods as inhumane because they oppose all lethal methods of damage management.

WS has improved the selectivity and humaneness of management techniques through research and development. Research is continuing to bring new findings and products into practical use. Until new findings and products are found practical, a certain amount of animal suffering could occur when some

MDM methods are used in situations where non-lethal damage management methods are not practical or effective.

In those situations where a non-federal cooperator has already made the decision to remove or otherwise manage a mammal species to stop damage with or without WS' assistance, WS' participation in carrying out the action will not affect the environmental status quo. In some situations, dependent upon the skills and abilities of the non-federal entity, WS' involvement may actually have a beneficial effect on the human environment when compared to the environmental status quo in the absence of such involvement.

4.1.2 Alternative 2 – Mammal Damage Management through Technical Assistance Only

4.1.2.1 Effects on Wildlife

4.1.2.1.1 Effects on Target Mammal Populations

Under this alternative, WS would have no impact on target mammal populations in Kentucky because the program would not provide any operational MDM activities. The program would be limited to providing recommendations or demonstrations only. Some resource owners experiencing damage may implement their own damage management strategies, request assistance from private businesses, or take no action. Some mammal populations would continue to increase where trapping and shooting pressure was low and may decline or stabilize where trapping and shooting pressure was adequate.

Since affected resource owners would likely lethally remove the damaging mammal that would no longer be removed by WS, private efforts to reduce or prevent mammal damage and perceived disease transmission risks could increase, which could result in similar or even greater effects on those populations than the proposed action. However, for the same reasons shown in the population effects analysis in section 4.1.1.1, it is unlikely that target mammal populations would be adversely impacted by implementation of this alternative. It is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal use of other chemicals which could cause unknown effects on target mammal populations (USDA 1997, White et al. 1989, USFWS 2001, FDA 2003).

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

Under this alternative, WS would have no direct impact to non-target wildlife species populations, including T&E species in Kentucky. All requests for assistance would be addressed using technical assistance and through demonstration of methods available. Both non-lethal and lethal methods could be recommended and demonstrated based on those legally available for use by the requestor. Based on WS' technical assistance, those experiencing damage could implement WS' recommendations, employ other methodologies, seek assistance from private business, or take no action. Potential impacts from WS' recommendations would be based on the requestor's knowledge, skill, and abilities in implementing those recommendations and an understanding of the species responsible for doing the damage.

Therefore, WS' involvement could reduce any potential risks to non-targets and T&E species if WS' recommendations and guidance are followed compared to a person who implements damage management methods will little to no knowledge of the methods employed, the species responsible for the damage, or potential T&E species in the vicinity of the action. However, requestors may be more inclined to conducted damage management based on WS' recommendations, which could lead to an increased risk to T&E species that might inhabit the damage management area. As part of WS' recommendation and demonstration, T&E impacts could be discussed with those requesting assistance which would facilitate implementation of those methods to avoid T&E impacts if WS recommendations are followed.

Compared to Alternative 1, the potential effects to non-targets and T&E species under this Alternative would likely be similar to slightly higher since requestors receiving recommendations from WS are

more likely to implement those recommendations which could increase risks to non-targets and T&E species if those recommendations are not followed. However, compared to Alternative 3, the potential impacts of this alternative could be lower since under Alternative 3, WS' would refer all those requesting assistance to other agencies and private business with no exchange of potential impacts to T&E species from methods available for use to resolve damage. If WS' recommendation are not followed by those requesting assistance then T&E impacts would likely be similar to Alternative 3.

4.1.2.2 Effects on Human Health and Safety

4.1.2.2.1 Safety and Efficacy of Chemical Methods

Concerns about human health and safety risks from WS' use of chemical MDM methods would be alleviated because no such use would occur. WS would provide technical advice to those persons requesting assistance. Resource owners could use information provided by WS or implement their own damage reduction program without WS' technical assistance. Negative impacts to human health and safety resulting from the improper use of chemical control methods should be less than Alternative 3 when WS' technical advice is followed.

4.1.2.2.2 Effects on Human Health and Safety from Non-Chemical MDM Methods

Concerns about human health and safety risks from WS' use of non-chemical MDM methods would be alleviated because no such use would occur. WS would provide technical advice to those persons requesting assistance. Resource owners could use information provided by WS or implement their own damage reduction program without WS' technical assistance. Negative impacts to human health and safety resulting from the improper use of non-chemical control methods should be less than Alternative 3 when WS' technical advice is followed.

4.1.2.2.3 Effects on Human Health and Safety from not Conducting MDM

Resource owners could use the information provided by WS or implement their own damage reduction program without WS' technical assistance. When WS' technical advice is requested and followed, disease and mammal aircraft strike threats to human health and safety should be less than Alternative 3. However, resource owners' efforts to reduce or prevent conflicts could result in less experienced persons implementing control methods. Therefore, adverse impacts to human health and safety could be greater under this alternative than the proposed action alternative dependent upon the skills and abilities of the person implementing MDM control methods.

4.1.2.3 Effects on the Socio-cultural Elements and Economics of the Human Environment

4.1.2.3.1 Effects on Human Affectionate-Bonds and Aesthetic Values of Wild Mammal Species

WS would provide technical advice to those persons requesting assistance. Resource owners could use the information provided by WS or implement their own damage reduction program without WS' technical assistance. No wildlife would be taken by WS under this alternative. Resource owners could employ any non-lethal or lethal methods legally available for use either after receiving technical assistance from WS or from employing those methods without WS' involvement. Therefore, WS would have no impact on human affection-bonds or on aesthetic values of wildlife. However, resource owners could employ methods that could potentially result in the take of wildlife resulting in concerns for human affection-bonds and aesthetic values similar to Alternative 1. The extent of effects on human affection-bonds and aesthetics would depend on the knowledge, skills, and abilities of those resource owners employing damage management methods. WS' technical assistance is likely to increase the proficiency of methods used by resources owners resulting in take levels likely less than expected under Alternative 1 but more than Alternative 3.

4.1.2.3.2 Effects on Aesthetics and Value of Property Damaged by Mammals

WS would provide technical advice to those persons requesting assistance. Resource owners could use the information provided by WS or implement their own damage reduction program without WS' technical assistance. When WS' technical advice is requested and followed, impacts on those persons adversely affected by mammal damage should be less than Alternative 3. However, resource owners' efforts to reduce or prevent conflicts could result in less experienced persons implementing control methods. Therefore, mammal damage could be greater under this alternative than the proposed action alternative dependent upon the skills and abilities of the person implementing MDM control methods.

4.1.2.4 Effects on Wetlands

WS would have no direct impact on wetlands. WS would provide technical advice to those persons requesting assistance. Resource owners could use the information provided by WS or implement their own damage reduction program without WS' technical assistance. Overall impacts to wetlands should be less than Alternative 3 when WS' technical advice is requested and followed.

4.1.2.5 Humaneness of Methods Used by WS

The issue of humaneness as it relates to WS under this alternative is not applicable because resource owners or others would be responsible to implement the damage management methods. WS would provide technical advice to those persons requesting assistance. Resource owners could use the information provided by WS or implement their own damage reduction program without WS' technical assistance. Many of the methods considered inhumane by some individuals and groups might still be used by resource owners. Overall impacts should be less than Alternative 3 when WS' technical advice is requested and followed.

4.1.3 Alternative 3 - No WS' Involvement in MDM

4.1.3.1 Effects on Wildlife

4.1.3.1.1 Effects on Target Mammal Populations

Alternative 3 would not allow any WS' MDM in Kentucky. There would be no effect on target mammal species by WS' activities from this alternative. WS would provide no assistance for MDM to any local, state, or federal government entities, industries, private businesses, or citizens in Kentucky. The KDFWR, KDA, NWCOs, and representatives of private businesses and government entities could still conduct some level of MDM.

Some mammal populations would continue to increase where trapping and shooting pressure was low and may decline or stabilize where trapping and shooting pressure was adequate. Some resource owners experiencing damage may trap or shoot mammals, or hire private trappers, but would receive no guidance from WS regarding those options. Other resource owners experiencing damage may take illegal or unsafe action against local populations of mammals out of frustration of continued damage resulting in unknown impacts to those populations (USDA 1997). The lack of WS' involvement would not prevent resource owners from implementing damage management practices using methods legally available for use. Therefore, take of mammals in Kentucky could continue to occur despite the lack of WS' involvement. Overall impacts on statewide mammal populations may be similar to or greater than the proposed action alternative, since affected resource owners would likely lethally remove the damaging mammal that would no longer be removed by WS.

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

Alternative 3 would not allow any WS' MDM in Kentucky. There would be no effect on non-target or T&E species by WS' activities from this alternative. WS would provide no assistance for MDM to any local, state, or federal government entities, industries, private businesses, or citizens in Kentucky. The

KDFWR, KDA, NWCOs, and representatives of private businesses and government entities could still conduct some level of MDM.

In the absence of WS' assistance, some resource owners may attempt to trap mammals or hire private trappers with little or no trapping experience. This could result in greater take and suffering of non-target wildlife. Private individuals may trap mammals year-round with the appropriate permits and would not be restricted to WS' self-imposed mitigation measures. Methods formerly used by WS when MDM programs were conducted, such as foothold and quick-kill traps, snares, and shooting, would probably increase as previously listed entities sought to reduce damage. This could result in less experienced persons implementing use of traps and snares without modifications to improve selectivity for target species, or to reduce animal stress. Furthermore, those resource owners or trappers would be more likely than WS' personnel to trap non-target species and not report non-target take to regulatory authorities. Some resource owners experiencing damage may take illegal or unsafe action, including the illegal use of chemical toxicants, against local populations of mammals out of frustration from continued damage resulting in unknown impacts to plant and wildlife populations (USDA 1997).

One anticipated outcome of no WS' MDM program is a likely increase in damage and associated beaver-created impoundments if resource owners did not remove beaver dams. Those impoundments would likely have an impact on other wildlife and plant species. The extent and nature of the impacts would depend upon the size of the beaver created impoundment and the diversity of plant and animal species in the area. Some species would flourish in the newly created environment, while others would diminish.

4.1.3.2 Effects on Human Health and Safety

4.1.3.2.1 Safety and Efficacy of Chemical Control Methods Used in MDM

WS would have no impact on this issue. Concerns about human health and safety risks from WS' use of chemical MDM methods would be alleviated because no such use would occur. Resource owners could use any legal MDM chemical available to them, including EPA-registered chemicals, rodenticides, and the use of explosives, to remove beaver dams. Without professional assistance or proper training in the use of chemical MDM methods, there is the potential for increased risks to public safety. Resource owners inexperienced in the safe and proper use of chemical MDM methods may attempt to resolve mammal damage problems.

The potential for illegal use of chemical toxicants under this alternative might pose threats to human health and safety if such chemicals were used indiscriminately in areas used by humans, or where such chemicals might be transported into the human food chain.

4.1.3.2.2 Effects on Human Health and Safety from Non-Chemical MDM Methods

WS would have no impact on this issue. Concerns about human health and safety risks from WS' use of non-chemical MDM methods would be alleviated because no such use would occur. Resource owners could use any legal MDM non-chemical available to them, including pyrotechnics, traps, snares, and firearms. Without professional assistance or proper training in the use of non-chemical MDM methods, there is the potential for increased risks to public safety. Resource owners inexperienced in the safe and proper use of non-chemical MDM methods may attempt to resolve mammal damage problems. These increased risks are associated with the improper or inexperienced use of damage management methods such as trapping and shooting.

4.1.3.2.3 Effects on Human Health and Safety from not Conducting MDM

WS would have no impact on this issue. Mammal damage would likely continue to increase unless resource owners implemented an effective MDM program in the absence of WS. Resource owners could implement their own damage reduction program without WS' assistance. Resource owners'

efforts to reduce or prevent conflicts could result in less experienced persons implementing control methods. Therefore, adverse impacts to human health and safety could be greater under this alternative than the proposed action alternative dependent upon the skills and abilities of the person implementing MDM control methods.

4.1.3.3 Effects on the Socio-cultural Elements and Economics of the Human Environment

4.1.3.3.1 Effects on Human Affectionate-Bonds and Aesthetic Values of Wild Mammal Species

WS would have no impact on this issue. The impacts of this alternative to stakeholders would be variable depending on their values towards wildlife and compassion for their neighbors. Some people would support this alternative because they enjoy seeing mammals, or having mammals nearby. However, while WS would take no action under this alternative, other individuals or entities could, and likely would, conduct damage management activities resulting in impacts similar to Alternative 1.

4.1.3.3.2 Effects on Aesthetics and Value of Property Damaged by Mammals

WS would have no impact on this issue. Resource owners receiving damage from mammals would likely strongly oppose this alternative because they would bear the damage caused by mammals. Resource owners' efforts to reduce or prevent conflicts could result in less experienced persons implementing control methods. Therefore, mammal damage could be greater under this alternative than the proposed action alternative dependent upon the skills and abilities of the person implementing MDM control methods. Mammal damage would likely continue to increase unless an effective damage management program was implemented by non-WS personnel.

4.1.3.4 Effects on Wetlands

WS would have no impact on wetlands. Under this alternative, beaver dam breaching/removal needs would be met by private, state, or local government entities. Some beaver impounded areas that WS would advise against draining might be drained under private or local government management, which could have potential adverse effects on wetland habitats in limited circumstances.

4.1.3.5 Humaneness of Methods Used by WS

WS would have no impact on this issue. This alternative would be considered humane by those people that believe WS should not be involved in MDM. However, even though WS would not be involved in MDM activities in Kentucky, resource owners could use any lethal and non-lethal method legally available to them to reduce mammal damage in the absence of WS' assistance, with impacts on humaneness dependent upon the experience of the person implementing the control method. Some resource owners may take illegal action against localized populations of mammals out of frustration of continued damage (USDA 1997). These illegal actions may be less humane than methods used by experienced WS' personnel.

4.2 SUMMARY OF POTENTIAL IMPACTS

Each of the three analyzed Alternatives would have varying effects related to the 5 issues. Alternative 1 would probably have the overall lowest effects on the environment (Table 4.4). Alternative 3 would probably have the highest effects on the environment, followed closely by Alternative 2.

Table 4.4 - Alternative Effects on Issues Compared

Issues/Alternatives	Alternative 1. Integrated MDM Program	Alternative 2. MDM Through Technical Assistance Only	Alternative 3. No WS' Involvement in MDM
Effects on Wildlife	*Low effect.* WS reductions in local target mammal population numbers; would not adversely affect state populations. No adverse affect on non-target species by WS. Some species could be affected positively by MDM actions.	*Low to moderate effect.* No effect by WS on target mammal populations and non-target species. If resource owners conduct their own MDM, impacts on target mammal populations could be similar or greater than the proposed action; increased possibility that non-targets species maybe taken, less likely than Alt. 3.	*Low to moderate effect.* No effect by WS on target mammal populations and non-target species. If resource owners conduct their own MDM without WS, impacts on target mammal populations could be similar or greater than the proposed action; increased possibility that non-targets species maybe taken.
Effects on Human Health and Safety	***(Methods)*** *- Low effect.* Methods used by WS would be safe with no probable risk of human health and safety. ***(Mammal Threats)*** *- Moderate to high effect.* The proposed action has the greatest potential of successfully reducing this risk.	***(Methods)*** *– Low to moderate effect.* No effect by WS. Resource owner's impacts would be variable dependent upon experience and knowledge of person implementing methods. ***(Mammal Threats)*** *- Low to high effect.* Impacts would be variable dependent upon experience and knowledge of person implementing methods.	***(Methods)*** *– Low to moderate effect.* No effect by WS. Resource owner's impacts would be variable dependent upon experience and knowledge of person implementing methods. ***(Mammal Threats)*** *- Low to high effect.* Impacts would be variable dependent upon experience and knowledge of person implementing methods.
Effects on Socio-Cultural Elements And Economics Of the Human Environment	Variable effects. Some would oppose this alternative, others would support it. Those people adversely affected by wildlife damage would likely favor this alternative.	Variable effects. Some would oppose this alternative, others would support it. No effect by WS. Resource owners would likely conduct MDM activities no longer conducted by WS resulting in impacts similar to the proposed program; Damage may not be reduced in a timely and effective manner for some projects.	Variable effects. Some would oppose this alternative, others would support it. No effect by WS. Resource owners would likely conduct MDM activities no longer conducted by WS resulting in impacts similar to the proposed program.
Effects on Wetlands	No probable effect by WS.	Low to Moderate effect. No effect by WS. Variable effects by non-WS personnel; impacts to wetlands should be less than Alternative 3 when WS' technical advice is requested and followed.	Low to Moderate effect. No effect by WS. Variable effects by non-WS personnel; some beaver impoundments might be drained which WS would advise against.
Humaneness Of Methods Used by Wildlife Services	Variable effect. Methods viewed by some people as inhumane would be used.	No effect by WS. Resource owner's impacts would be variable dependent upon experience and knowledge of person implementing methods.	No effect by WS. Resource owner's impacts would be variable dependent upon experience and knowledge of person implementing methods.

4.3 CUMULATIVE IMPACTS OF THE PROPOSED ALTERNATIVE BY ISSUE

Cumulative impacts, as defined by CEQ (40 CFR 1508.7), are impacts to the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts may result from individually minor, but collectively significant, actions taking place over time.

Under Alternatives 1, WS would address damage associated with mammals in a number of situations throughout the State. The WS' MDM program would be the primary federal program with MDM responsibilities; however, some state and local government agencies may conduct MDM activities in Kentucky as well. Through ongoing coordination with those agencies, WS is aware of such MDM activities and may provide technical assistance in such efforts. WS does not normally conduct direct damage management activities concurrently with such agencies in the same area, but may conduct MDM activities at adjacent sites within the same time frame. In addition, commercial pest control companies may conduct MDM activities in the same area.

The potential cumulative impacts analyzed below could occur either as a result of WS' MDM program activities over time, or as a result of the aggregate effects of those activities combined with the activities of other agencies and individuals.

4.3.1 Cumulative Impacts on Wildlife Including Target, Non-target, and T&E Species

Evaluation of MDM program actions of the proposed alternative relative to target, non-target, and T&E species in the previous portions of this EA indicated that no significant cumulative, immediate effects are expected. MDM program actions would be occurring simultaneously, over time, with other natural processes and human-generated changes that are currently taking place. Those activities include, but are not limited to:

- Natural mortality of target, non-target, and T&E species
- Human-induced mortality of target and non-target species through hunting, MDM, and other activities
- Human and naturally induced alterations of wildlife habitat
- Annual and perennial cycles in wildlife population densities

All those factors play a role in the dynamics of wildlife populations, and any or all may act to produce cumulative effects on those populations. Normally, MDM is necessary to reduce damage caused by a species when some or all of those elements have contrived to elevate target species populations on a local, regional, or national scale, or place target species populations at a juncture to cause damage to resources. WS' actions taken to minimize or eliminate damage being caused by overabundant populations, or individuals of a species causing damage, is constrained as to scope, duration and intensity, for the purpose of minimizing or avoiding impacts to the environment, including wildlife. WS evaluates damage occurring, including other affected elements and the dynamics of the damaging species, determines appropriate strategies to minimize effects on environmental elements, applies damage management actions, and subsequently monitors and adjusts/ceases damage management actions (Slate et al. 1992). This process allows WS to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative impacts to target, non-target, and T&E species.

No significant cumulative impacts on target and non-target wildlife are expected from WS' MDM actions based on the following considerations:

1. Historical outcomes of WS' MDM programs to address the target species identified in this EA

No significant cumulative effects have been identified in WS' MDM programs addressing target species identified in this EA, nor for associated non-target species, including T&E, as a result of program activities or components implemented over time.

2. SOPs and mitigation strategies built into WS' MDM program processes (Subsection 3.4)

Operational safeguards are designed to protect wildlife from negative effects of WS' MDM actions, and are tailored to respond to changes in wildlife populations which could result from unforeseen environmental changes which might produce negative cumulative effects. This would include those changes occurring from sources other than WS-conducted MDM programs. Alterations in MDM programs, which are appropriate to any changes that indicate important cumulative negative effects to wildlife, are defined through SOPs and mitigation measures, and implementation is ensured through monitoring, in accordance with the WS' Decision Model (Slate et al. 1992).

3. Current status of potentially affected species, including target, non-target, and T&E

Natural and human-induced mortality patterns for target, non-target, and T&E species evaluated in this EA are expected to remain essentially unchanged in Kentucky. This is true for both elements outside WS' MDM-conducted programs, and the programs themselves. Evaluation in previous portions of this EA determined that WS' activities would not adversely affect target, non-target, and T&E species. As a result, no significant cumulative effects are expected from repetitive MDM programs over time in the fairly static set of conditions affecting wildlife currently in Kentucky.

4.3.2 Cumulative Impacts on Human Health and Safety

Non-Chemical Methods

All non-chemical MDM methods, such as trapping, snaring, shooting, and harassment methods are used and expended within a limited time frame, are not residual, and do not possess properties capable of inducing significant cumulative impacts on human health and safety.

Chemical Methods

Lethal chemical MDM methods may include the use of ZP, AP, anti-coagulants, and gas cartridges. ZP, AP, and anti-coagulant baits are used in MDM programs in Kentucky to manage damage caused by rodents. Gas cartridges (sodium nitrate) are used to manage damage being caused by groundhogs and coyotes. Therefore, consideration for their uses, properties, and fate as it will be applied in Kentucky is an important consideration.

Zinc Phosphide is a finely ground gray-black powder that is practically insoluble (solubility = 1 ppm) in water and alcohol; therefore, it is unlikely to be mobile in soils. It breaks down to elemental zinc and phosphine gas when exposed to moisture or under acidic conditions. The decomposition rate of ZP in the soil depends on soil moisture and pH, with complete decomposition in 30 days in moderately moist soils. The residue of ZP is not expected to accumulate in the soils between applications, or in animal tissues. The phosphine gas produced during breakdown is a colorless gas with a high vapor pressure and so is generally prevented from accumulating in low areas. Ultimately, the phosphine is transformed into inorganic phosphate (USDA 1997). Those factors indicate that no significant cumulative effects to human health and safety are expected from the use of this chemical in WS' MDM programs in Kentucky.

ZP is available to certified pesticide applicators in Kentucky. Any non-WS' programs that might employ ZP for purposes specified on product labels would not collectively produce cumulative effects for the same reasons outlined for WS' MDM programs. Therefore, no significant cumulative effects on human health and safety are expected from all combined activities involving ZP for the management of damage caused by species for which the product is registered for use.

Aluminum phosphide is available in tablet form as a fumigant for rodent burrows, to manage damage being caused by such rodents as moles, ground squirrels, groundhogs, voles, and Norway rats. It is not soluble in water, but will react with moist air to produce phosphine gas. It is stable under dry conditions. It is not persistent in soil systems because it decomposes to phosphine gas rapidly on contact with moisture and soil. The rate of decomposition of the tablets varies from less than three and up to five days or more, depending on moisture and temperature according to the MSDS. Ultimately, phosphine gas is transformed into harmless inorganic phosphate. Phosphine gas is a colorless gas with a vapor pressure of 33.5 atm at 20°C, much higher than other fumigants. The high vapor pressure generally prevents the accumulation of

this gas in low areas, in spite of a specific gravity of 1.17, compared to specific gravity for air of 1.0. AP is insoluble in water and therefore, not expected to be particularly mobile in soils. At the same time, accumulation in soils is not significant due to the decomposition of AP in the presence of moisture. AP does not accumulate in animal tissue (USDA 1997). Based on properties and fate of AP when used as a fumigant in WS' MDM programs in Kentucky, no significant cumulative effects to human health and safety are expected from its use.

AP is available to certified pesticide applicators in Kentucky. However, because of properties and fate of this chemical, such use would not introduce any cumulative effects which might adversely impact human health and safety. Therefore, no significant cumulative effects on human health and safety are expected from all combined activities involving AP use for the management of damage caused by rodents.

Sodium nitrate is the principle active chemical in gas cartridges, 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). Burning sodium nitrate however, as in the use of a gas cartridge as a fumigant in a rodent burrow or coyote den, is believed to produce mostly simple organic and inorganic gases, using all of the available sodium nitrate. In addition, the drinking water tolerance level for this chemical is 10 mg/L, a relatively large amount, according to EPA Quality Criteria for Water (EPA 1986a, EPA 1986b). 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 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. Coyote gas cartridges contain sodium nitrate and charcoal. None of the additional ingredients in those two formulations are 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). No gas residues remain at the treatment site where either formulation is used, for any period of time (USDA 1997), and so, no significant cumulative effects from the presence of gases can be expected. Based on properties and fate of sodium nitrate and its components as used in gas cartridges as a fumigant in WS' MDM programs in Kentucky, no significant cumulative effects to human health and safety are expected from its use in such programs.

Gas cartridges are available to the public in Kentucky and this method might be used by some. Any non-WS' programs that might employ gas cartridges for purposes specified on product labels would not collectively produce cumulative effects for the same reasons outlined for WS' MDM programs. Therefore, no significant cumulative effects on human health and safety are expected from all combined activities involving gas cartridge use for the management of damage caused by rodents and coyotes.

Non-lethal chemicals may also be used or recommended by the WS' MDM program in Kentucky. Characteristics of those chemicals and use patterns indicate that no significant cumulative impacts related to environmental fate are expected from their use in WS' MDM programs in Kentucky (USDA 1997).

4.3.3 Cumulative Impacts on Socio-cultural Elements and Economics of the Human Environment

Four aspects of this issue have been identified in this EA (Subsection 2.2.3):

- possible disruption of human affectionate-bonds which some people develop with individual wild or feral mammals,
- possible decrease in aesthetic enjoyment which some people gain by feeding, and viewing wild or feral mammals,
- decrease in aesthetic enjoyment of feral or wild mammals experienced by some people as a result of overabundant species present,
- degradation or loss of value of properties by some people as a result of the presence of too many individuals of a species.

This subsection evaluates possible cumulative effects of each of those elements.

4.3.3.1 Cumulative Impacts on Human Affectionate-bonds

In the wild, few animals in the U.S. have life spans approaching that of humans. Species evaluated in this EA have life spans ranging from a few months for some small rodents, a maximum of 20-25 years for black bears, and over 100 years for some species of turtles. Most wild mammals viewed frequently by people, such as squirrels, raccoons, and white-tailed deer, live less than five years. Mortality is high among wildlife populations and specific individuals within a species may experience death early in life. This is a natural occurrence and humans 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 1994, Marks and Koepke 1994, Zasloff 1996, Ross and Baron-Sorensen 1998, Archer 1999, Meyers 2000) and observations made regarding this are probably applicable to close bonds which 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 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 which 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 (Parkes 1979, Lefrancois 1999).

Some mammals with which humans have established affectionate bonds may be removed from some project sites by WS' MDM actions in Kentucky. Other individuals of the same species continue to be present in the area and people 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 which might be removed from a specific location by WS' MDM actions. Therefore, no significant cumulative effects on human affectionate bonds are expected from WS' MDM programs in Kentucky. Other actions by entities other than WS may disrupt human affectionate bonds with wildlife, such as natural wildlife mortality, hunter take, and other occurrences, in combination with the removal or dispersal of animals by WS is not expected to collectively and cumulatively affect this element of the human environment.

4.3.3.2 Cumulative Impacts on Aesthetic Enjoyment of Wildlife

Those who enjoy viewing wildlife may experience a temporary reduction in being able to view wildlife at some sites where WS' MDM programs have removed animals. However, other animals may replace those removed, and other animals may be viewed and enjoyed at adjacent locations. Because effects on aesthetic enjoyment gained by viewing wildlife are temporary, no significant cumulative effects are expected as a result of WS' MDM actions. Actions taken by entities other than WS may temporarily and locally reduce the presence of wildlife for public viewing, such as natural wildlife mortality, hunter take, and other occurrences, combined with removal of animals by WS, are not expected to collectively or increasingly alter the current availability of wildlife, in the long-term, or on a state-wide, regional, or national scale. Wildlife will still be available for aesthetic enjoyment, and so no overall significant cumulative effects are expected regarding this element of the human environment.

Some people experience a decrease in aesthetic enjoyment of wildlife because they feel that overabundant species are objectionable and interfere with their enjoyment of wildlife in general. Continued increases in numbers of individuals of those species or the continued presence of what is viewed as too many individuals could lead to further degradation of such people's enjoyment of any wildlife.

The removal of some individuals among those species through WS' MDM actions could positively affect their aesthetic enjoyment of remaining individuals and species, and might reduce the possibility of cumulative degradation of the public's attitude about a species, or wildlife in general. However, WS' activities are not expected to have any significant cumulative effects on this element of the human environment.

4.3.3.3 Cumulative Impacts on Economic Loss Resulting From Overabundant Wildlife

Landowners, business owners, and managers of land in public trust are sometimes concerned with losses that occur as a result of excessive populations of a species, and, over time, such large populations have the ability to greatly affect the quality of such resources and increase anxiety and frustration of those landowners. Cumulative damage can occur over time, if no remedy is found. Removal of some individuals of such large populations of mammals could positively affect economic elements at those sites and reduce the likelihood of cumulative effects, which could result from recurrent damage. However, WS' activities are not expected to have any significant cumulative effects on this element of the human environment.

4.3.4 Cumulative Impacts on Wetlands

WS' MDM programs that sometimes occur in wetlands or wetland-like habitat are beaver and muskrat damage management. In those activities, WS' activities do not result in net loss of established wetlands, nor do MDM activities result in progressive or cumulative reductions of established wetlands, or in cumulative damage or cumulative alterations of established wetlands. Therefore, WS' MDM programs, considered collectively with all other MDM activities by other entities in Kentucky, are not expected to have any significant cumulative effects on wetlands in the State.

4.3.5 Cumulative Impacts on Concerns about Humaneness of MDM Methods

WS continues to seek other methods and to improve current technology to improve humaneness of methods in managing damage caused by mammals. Cooperation with individuals and organizations involved in animal welfare continues to be an agency priority for the purpose of evaluating WS' strategies and defining research aimed at developing methods for MDM programs. Because WS continues to develop and implement more humane methods as technology advances, no significant cumulative effects from WS' MDM actions in Kentucky are expected in relation to this element of the human environment. Combined MDM activities of other entities which have the potential to affect concerns about humaneness of MDM methods, coupled with all WS' MDM activities, are not expected to have any significant cumulative effects on this element of the human environment.

4.4 SUMMARY OF CUMULATIVE IMPACTS

No significant cumulative environmental impacts are expected from any of the three alternatives, including the Proposed Action. Under the Proposed Action, the lethal removal of mammals would not have a significant impact on overall mammal populations in Kentucky, but some local reductions may occur. Management activities will not negatively impact other protected flora and fauna in Kentucky. The Proposed Action is supported by the KDFWR, the agency responsible for managing mammals and other flora and fauna in the State. No T&E species or critical habitat would be adversely impacted by the Proposed Action. Therefore, WS has determined that the Proposed Action would not likely adversely affect any species protected under the ESA or state wildlife laws. No risk to the public or pet health and safety is expected by WS' activities since only trained and experienced wildlife biologists and wildlife specialists would conduct and recommend management methods for mammal damage. There is a slight increased risk to public safety when control activities are conducted by persons that reject WS' assistance and recommendations, but not to a significant extent.

Under Alternative 3, management actions taken by non-federal entities would be considered the environmental status quo. In those situations where a non-federal cooperator has already made the decision to remove or otherwise manage mammal species to stop damage with or without WS' assistance in Alternatives 1, 2, and 3, WS' participation in carrying out the action will not affect the environmental status quo. In some situations, dependent

upon the skills and abilities of the non-federal entity, WS' involvement may actually have a beneficial effect on the human environment when compared to the environmental status quo in the absence of such involvement.

Although some persons will likely be opposed to WS' participation in management activities to reduce mammal damage, the analysis in this EA indicates that WS' IWDM program will not result in significant cumulative adverse impacts on the quality of the human environment.

5.0 CHAPTER 5: LIST OF PREPARERS AND PERSONS CONSULTED

5.1 LIST OF PREPARERS

David Reinhold, USDA-APHIS-WS, National Environmental Manager
Ryan Wimberly, USDA-APHIS-WS, Environmental Management Coordinator
Brett Dunlap, USDA-WS, TN/KY State Director, Madison, TN
Keith Stucker, USDA-WS, District Supervisor Louisville, KY
David Lingo, USDA-WS, District Supervisor, Jackson, TN
Jordona D. Kirby, USDA-WS, Wildlife Specialist, Louisville, KY
Keith Blanton, USDA-WS, District Supervisor Knoxville, TN

5.2 LIST OF PERSONS AND AGENCIES CONSULTED

U.S. Fish and Wildlife Service
Lee Andrews, Ecological Services
Brent Harrell, T&E Species

Kentucky Department of Fish and Wildlife Resources
Dr. Jonathan Gassett, Commissioner
David McChesney, Wildlife Division Program Manager (Formerly Regional Coordinator, Bluegrass Region)

Kentucky Department of Agriculture
Richie Farmer, Commissioner

Kentucky Cooperative Extension Service
Dr. Tom Barnes, Extension Wildlife Specialist

Kentucky Cabinet for Health and Family Resources, Department for Public Health
William D. Hacker, Commissioner

Kentucky Environmental and Public Protection Cabinet, Department for Environmental Protection
Tom C. Vanarsdall, Division of Water
John Dovak, Division of Water

U.S. Tennessee Valley Authority
Stanford Davis, Senior NEPA Specialist

APPENDIX A

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APPENDIX B

METHODS AVAILABLE TO WS IN KENTUCKY TO MANAGE DAMAGE CAUSED BY MAMMALS

Mammal Damage Management Methods

Resource owners and government agencies have used a variety of techniques to reduce mammal damage. However, all lethal and non-lethal methods developed to date have limitations based on costs, logistics, or effectiveness. Below is a discussion of MDM methods currently available to the Kentucky WS program. If other methods are proven effective and legal to use in Kentucky, they could be incorporated into the KY WS' program, based upon NEPA compliance.

Nonchemical Wildlife Damage Management Methods

Nonchemical management methods consist primarily of tools or devices used to repel, capture or kill a particular animal or local populations of wildlife to alleviate resource damage. Methods may be non-lethal (e.g., fencing, frightening devices, etc.) or lethal (e.g., firearms, Conibear traps, snares, etc.). If WS' personnel apply those methods on private lands, an *Agreement for Control on Private Property* must be signed by the landowner or administrator authorizing the use of each damage management method. Nonchemical methods used by WS include:

Exclusion pertains to preventing access to resources through fencing or other barriers. Fencing of small critical areas can sometimes prevent animals which cannot climb from entering areas of protected resources. Fencing of culverts, drain pipes, and other water control structures can sometimes prevent beaver from building dams which plug those devices. In those applications, however, consideration must be given for water flow so that the fence does not act to catch and hold water-borne debris. Fencing, especially if it is installed with an underground skirt, can prevent access to areas for many mammal species that dig, including coyotes, fox, woodchucks, beaver, nutria, and muskrat. Areas such as airports, yards or hay meadows may be fenced. Hardware cloth or other metal barriers can sometimes be used to prevent girdling and gnawing of valuable trees and to 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 can also be used on dams or levies at times, especially to deter muskrat, woodchucks, and other burrowing rodents. Electrical water barriers have proven effective in limited situations for beaver; an electrical field through the water in a ditch or other narrow channel, or hot-wire suspended just above the water level in areas protected from public access, have been effective at keeping beaver out. The effectiveness of an electrical barrier is extended when used in conjunction with an odor or taste cue that is emitted because beaver will avoid the area even if the electrical field is discontinued (Kolz and Johnson 1997). Similarly, electric fences of various constructions have been used effectively to reduce damage to various crops by deer, raccoons, and other species (Craven and Hygnstrom 1994, Boggess 1994b).

Cultural Methods and Habitat Management includes the application of practices which 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, removing trees along stream banks to discourage the presence of beaver, or planting lure crops on fringes of protected crops. Continual destruction of beaver dams and removal of dam construction materials on a daily basis will sometimes cause beaver to move to other locations, although this strategy can be far more expensive than removing beaver in conjunction with dam removal. Water control devices such as the 3-log drain (Roblee 1983), 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 ponds to desirable levels that do not cause damage. Such methods have variable results and rarely provide acceptable levels of control unless used in an integrated program with other strategies.

Removal of trees from around buildings can sometimes reduce damage associated with tree squirrels and raccoons. However, squirrels are able to climb a variety of surfaces and have been observed gaining access to the roofs of homes in urban environments by climbing brick and stone siding and by traveling from roof to roof along power lines (B. Dunlap, WS, pers. comm. 2007).

Some mammals that cause damage in urban environments 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. Making trash and garbage unavailable and removing all pet food from outside during nighttime hours can reduce the presence of problem raccoons and opossums. If tree squirrels or chipmunks are damaging property or causing a nuisance, care in preventing them from obtaining bird seed left in bird feeders can often greatly reduce their presence. This may mean hanging bird feeders by thin wire from tree limbs, or constructing mounting poles which cannot be climbed by those animals.

Removal of Beaver Dams That Cause Flooding Damage is generally conducted to maintain existing stream channels and drainage patterns, and reduce flood waters that have affected established silviculture, agriculture, and ranching activities or drainage structures such as culverts. Beaver dams are made from natural debris such as logs, sticks, and mud that beaver take from the immediate area. It is this portion that is dislodged during a beaver dam removal operation. The impoundments that WS removes are normally from recent beaver activity and have not been in place long enough to take on the qualities of a true wetland (i.e. hydric soils, aquatic vegetation, preexisting function). Unwanted beaver dams can be removed by hand with a rake or power tools (e.g., a winch), or with explosives. Explosives are used only by WS' personnel specially trained and certified to conduct such activities, and only binary explosives are 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 by hand or with binary explosives 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. Because beaver dams involve waters of the U.S., removal is regulated under Section 404 of the Clean Water Act.

Wetlands are recognized by three characteristics: hydric soils, hydrophytic vegetation, and general hydrology. Hydric soils are either 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, debris is discharged into the water. The debris that ends up in the water is considered "incidental fallback" or discharge fill. However, in most beaver dam removal operations, the material that is displaced., if considered to be discharge, is exempt from permit requirements under 33 CFR 323 or 330. A permit would be required if the impoundment caused by a beaver dam was considered a true wetland. WS' personnel survey the beaver dam site and impoundment and determine whether conditions exist suggesting that the area may be a wetland as defined above. If such conditions exist, the landowner is asked the age of the dam or how long he/she has known of its presence to determine whether Swampbuster, Section 404 permit exemptions or NWPs allow removal of the dam. If not, the landowner is required to obtain a Section 404 permit before the dam will be removed by WS' personnel.

The following information explains Section 404 exemptions and conditions that pertain to the removal of beaver dams.

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 U.S. 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 those drainages do not include the immediate or gradual conversion of a wetland (i.e. beaver ponds greater than 5 years old) 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 removed 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 drainageways 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 drainageway 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 removal 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 removed 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.

Kentucky regulates discharges into the waters of the State through the Environmental and Public Protection Cabinet (formerly Natural Resources and Environmental Protection Cabinet), KDEP, Division of Water, and grants exemptions from permitting for discharges based on guidelines and exemptions provided by the USACE. Kentucky Division of Water does not consider removal of beaver dams by WS in the state to require permits in those situations exempted by the USACE (T. VanArsdall, Kentucky Division of Water, pers. comm. 2002).

33 CFR 330 - NWP Program. The Corps 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 in order to qualify for their use. Individual beaver dam removal activities 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 removal done under a specific NWP.

The USACE reevaluated its NWP during 2001-02 and presented revised guidelines in 2002 (USACE 2002). Based on those guidelines, NWPs can be used except in any component of the National Wild and Scenic River System (16 U.S.C. §§ 1271 -1287 as amended) such as the designated reaches of the Red River in Wolfe County, Kentucky, and any other rivers or reaches and their corridors in Kentucky which have been designated as part of the Wild Rivers system authorized by The Kentucky Wild Rivers Act and administered by 401 KAR 4:125 with statutory authority under KRS 146.270. Any beaver dam removal in

those designated areas which might be contemplated by WS may require consultation with the USACE and Kentucky Division of Water to obtain permits for any such activities.

401 KAR 5:026. Designation of uses of surface waters in Kentucky. KRS 224.10-100 requires the Kentucky Environmental and Public Protection Cabinet to develop and conduct a comprehensive program for the management of water resources and to provide for the prevention, abatement, and control of pollution. Pursuant to that, 401 KAR 5:002, 5:029, 5:030, and 5:031 establish procedures to protect the surface waters of the Commonwealth, and thus protect water resources. This administrative regulation applies the designated uses described in 401 KAR 5:031 to the surface waters of the Commonwealth. This administrative regulation also makes all surface waters subject to the general criteria specified in 401 KAR 5:031, Section 2. The Scope of Designation provided in 401 KAR 5:026 declares that all surface waters listed shall be designated for the specific uses provided for and outlined in Kentucky statutes until they are redesignated in accordance with the procedures outlined for such waters. The designated uses for Kentucky's water resources are:

(a) Warm water aquatic habitat;
(b) Cold water aquatic habitat;
(c) Primary contact recreation;
(d) Secondary contact recreation;
(e) Domestic water supply; and
(f) Outstanding state resource water

In addition to those designations for water resources in Kentucky, a special class designation is assigned to some water resource categorized collectively as "Special Use Waters". Some of the aforementioned designations fall into this special group. These waters have unique characteristics related to T&E species, special natural resource protection, conservation or use agendas of interest to Kentuckians, or elements of those. Of those, four types are of special concern, which may be related to the removal of beaver dams. They are: Cold Water Aquatic Habitat (CAH), Outstanding Natural Resource Waters (ONRW), Outstanding State Resource Waters (OSRW), and Exceptional Waters (EXW) (J. Dovak, Division of Water, Water Quality Branch, pers. comm. 2003). If WS contemplates removing beaver dams within designated areas of those water resource types in Kentucky, consultation with the Environmental and Public Protection Cabinet, KDEP, Division of Water, would be conducted to determine the feasibility of such activities and to obtain guidance and obtain permits where necessary.

NWP 3 authorizes the rehabilitation of those structures, such as culverts, homes, and bridges, destroyed by floods and "discrete events" such as beaver dams provided that the activity is commenced within 2 years of the date when the beaver dam was established.

NWP 18 allows minor discharges of dredged and fill material, including the removal of beaver dams, into all waters of the U.S. provided that the quantity of discharge and the volume of excavated area does not exceed 25 cubic yards below the plane of the ordinary high water mark (this is normally well below the level of the beaver dam) and will not cause the loss of more than 1/10 acre of special aquatic site, including wetlands. 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, or if the discharge is in a special aquatic site, including wetlands. Beaver dams rarely would exceed 2 or 3 cubic yards of backfill into the waters and probably no more than 5 cubic yards would ever be exceeded. Therefore, this stipulation is not restrictive. Beaver dams periodically may be removed in a special aquatic area, but in most instances the aquatic site will be returned to normal. However, if a true wetland exists, and beaver dam removal is not allowed under another permit, then a permit must be obtained from the District Engineer.

NWP 27 provides for the discharge of dredge and fill 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 USFWS or NRCS to conduct restoration; a voluntary wetland restoration project documented by NRCS; or notified the District Engineer according to "notification" procedures.

On Federal lands, including Corps 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 removal of a beaver dam would be allowed as long as it was not a true wetland (i.e., 5 or more years old), and for non-federal public and private lands the appropriate agreement, project documentation, or notification is in place.

A quick response without delays 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 removal of the majority of beaver dams that WS in Kentucky 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 those 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.

Lure crops/alternate foods are crops planted or other food resources provided to mitigate the potential loss of higher value crops.

Animal behavior modification refers to tactics that deter or repel damaging mammals and thus, reduce damage to the protected resource. These 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 those techniques are only effective for a short time before wildlife habituate to them (Conover 1982). Devices used to modify behavior in mammals include:

- electronic guards (siren strobe-light devices)
- propane exploders
- pyrotechnics
- laser lights
- human effigies
- harassment / shooting into groups or herds

Live Capture and Relocation can be accomplished through the use of cage traps, snares, and foothold traps to capture some species of mammals for the purpose of translocating them for release to wild sites. WS sometimes uses those methods to conduct MDM programs in Kentucky when the target animal(s) can legally be relocated or can be captured and handled with relative safety by WS' personnel. Live capture and handling of wild 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 humans. For that reason, WS may limit this method to specific situations and certain species. Excessive populations may make this a poor wildlife management strategy for some 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. The AVMA, the National Association of State Public Health Veterinarians, and the Council of State and Territorial Epidemiologists all oppose the relocation of mammals because of the risk of disease transmission, particularly for small mammals such as raccoons or skunks (CDC 1990). Although relocation is not necessarily precluded in all cases, it would in many cases be logistically impractical and biologically unwise in Kentucky, and is evaluated by WS on a case-by-case basis.

Trapping can utilize a number of devices, including foothold traps, cage-type traps, and Conibear (body-gripping) traps, foot snares, and neck/body snares. For a description of those methods the reader is referred to the FEIS, Appendix J (USDA 1997). These techniques are usually implemented by WS' personnel because of the technical training required to use such devices. A formal risk assessment of all mechanical

devices used by the WS' MDM program in Kentucky is in the FEIS, Appendix P (USDA 1997). Below is a brief summary of foothold trap and snare usage.

Foothold Traps can be effectively used to capture a variety of mammals. Foothold traps are either 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 foothold trap's selectivity. An additional advantage is that foothold traps can allow for the on-site release of non-target animals. The use of foothold traps requires more skill than some methods, but they are indispensable in resolving many damage problems.

Snares are capture devices comprised of a cable formed in a loop with a locking device and placed in travel ways. Most snares are also equipped with a swivel to minimize cable twisting and breakage. Snares are also easier than foothold traps to keep operational during periods of inclement weather. Snares set to catch an animal around the body or legs are usually a live-capture method.

Cage traps are live capture traps used to trap a variety of small-to-medium-sized mammals. Cage traps come in a variety of sizes, are made of galvanized wire mesh, and consist of a treadle in the middle of the cage that triggers the door to close behind the animal being trapped.

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 clam when closed. When set, the trap is opened to allow an animal to enter the *clam shells*, when tripped the *clam shells* close around 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 (>$300 per trap), 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 snares, footholds, or body-grip traps, and may cause serious and debilitating injury to river otters (Blundell et al. 1999).

Body-grip (e.g., Conibear-type) Traps are designed to cause the quick death of the animal that activates the trap. The size 330 Conibear trap is generally used for beaver exclusively in aquatic habitats, with placement depths varying from a few inches to several feet below the water surface. Placement is in travel ways or at lodge or burrow entrances created or used by the target species. The animal captured as it travels through the trap and activates the triggering mechanism. Safety hazards and risks to humans are usually related to setting, placing, checking, or removing the traps. Body-grip traps present a minor risk to non-target animals because of the placement in aquatic habitats and below the water surface.

Shooting is selective for target species and may involve the use of spotlights and either a handgun, shotgun or rifle. Shooting is an effective method to remove a small number of mammals in damage situations, especially where trapping is not feasible. Removal of specific animals in the problem area can sometimes provide immediate relief from a problem. Shooting is sometimes utilized as one of the first lethal damage management options because it offers the potential of resolving a problem more quickly and selectively than some other methods, but it is not always effective. Shooting may sometimes be one of the only damage management options available if other factors preclude setting of damage management equipment. WS' personnel receive firearms safety training to use firearms that are necessary for performing their duties.

Denning is the practice of finding coyote dens and eliminating the young, adults, or both to stop an ongoing predation problem or prevent future depredation on livestock. Till and Knowlton (1983) documented the cost-effectiveness and high degree of efficacy in denning practices for resolving predation problems due to coyotes killing lambs. 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. 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 (see discussion of gas cartridge under *Chemical Management Methods*).

Hunting/Trapping: WS sometimes recommends that 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 populations of mammals.

Aerial Shooting or aerial hunting (shooting from an aircraft) is a commonly used coyote damage management method; it especially can be effective in removing offending coyotes that have become "bait-shy" to trap sets or are not susceptible to calling and shooting. WS uses aerial hunting to remove coyotes, fox, wolves, feral swine, feral goats, feral dogs, bobcats, and other permitted animals. Aerial hunting is mostly species-selective and can be used for immediate control to reduce livestock and natural resource losses if weather, terrain, and cover conditions are favorable. 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 rugged terrain and timbered areas. In broken timber or deciduous cover, aerial hunting is more effective in winter when snow cover improves visibility and leaves have fallen. The WS' program aircraft-use policy helps ensure that aerial hunting 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.

Chemical Wildlife Damage Management Methods

All pesticides used by WS are registered under the FIFRA and administered by the EPA and KDA. All WS' personnel in Kentucky who apply restricted - use pesticides are certified pesticide applicators by KDA and have specific training by WS for WDM pesticide application. The EPA and KDA require pesticide applicators to adhere to all certification requirements set forth in the FIFRA. No chemicals are used by WS on public or private lands without authorization from the land management agency or property owner or manager. The following chemical methods have been proven to be selective and effective in reducing damage by mammals for which each pesticide is registered for use. Specifics related to those chemicals and a summary of their use in Kentucky is provided below.

Zinc phosphide (ZP) is a rodenticide which is registered as a Restricted Use Pesticide (RUP) because of its hazard to non-target organisms and its acute oral toxicity (ExToxNet 2006a). RUPs may be purchased and used only by certified applicators. Some formulations of this rodenticide are classified as highly toxic and require the Signal Word DANGER - POISON on the label. Others are either moderately toxic or only slightly toxic, and thus require the Signal Words WARNING or CAUTION, respectively. Trade names for commercial products containing ZP include Arrex, Commando, Denkarin Grains, Gopha-Rid, Phosvin, Pollux, Ridall, Ratol, Rodenticide AG, Zinc-Tox and ZP.

ZP is an inorganic compound that is used to control rats, mice, voles, ground squirrels, prairie dogs, nutria, muskrats, feral rabbits, and gophers. It is also used as a tracking powder for the control of house mice. It is applied to crop areas and non-crop areas including lawns, golf courses, highway medians, and areas adjacent to wetlands. It may be formulated as a grain based bait, as scrap bait, or as a paste. Rodenticide baits usually contain 0.5 to 2.07% ZP, pastes approximately 5 to 10%.

ZP ingested orally reacts with water and acid in the stomach and produces phosphine gas, which may account in a large part for observed toxicity. In rats, the LD_{50} for the technical product (80 to 90% pure) is 40 mg/kg, while the LD_{50} values for lower concentration formulations are slightly higher, indicating lower acute toxicity. In sheep, the LD_{50} ranges from 60 to 70 mg/kg. The compound is nonirritating to the skin and eyes. Rats fed ZP over a wide range of doses experienced toxic effects. Increased liver, brain, and kidney weights, and lesions on those organs, were noted in rats exposed to around 14 mg/kg/day. Body hair loss, reduction in body weight, and reduction of food intake were all noted at 3.5 mg/kg/day. The study was conducted over 13 weeks. There have been no observed symptoms of chronic poisoning due to ZP exposure in humans. However, it has been suggested that chronic exposure to sublethal concentrations for extended periods of time may produce toxic symptoms.

Small amounts of the rodenticide fed to experimental animals may have produced an 80% absorption of zinc as well. Zinc in sufficient concentrations may have an emetic effect. Hypophosphite may be excreted in the urine as a metabolite of ZP. There is little tendency for the compound to concentrate in living tissue, as it is readily converted to phosphine.

ZP is highly toxic to wild birds. The most sensitive birds are geese (LD50 of 7.5 mg/kg for the white-fronted goose). Pheasants, mourning doves, quail, mallard ducks, and the horned lark are also very susceptible to this compound. Blackbirds are less sensitive.

ZP is highly toxic to freshwater fish. The fish species which have been evaluated include bluegill sunfish (LC_{50} of 0.8 mg/L) and rainbow trout (LC_{50} of 0.5 mg/L) [1]. Carp were also found to be susceptible to ZP, especially in weakly acidic water.

ZP is also toxic to non-target mammals when ingested directly. Nearly 60 studies have been conducted on the toxicity of this rodenticide to wild animals. Secondary toxicity to mammalian predators (animals eating other animals that had been exposed to the compound) from ZP is rather low, primarily because the compound does not significantly accumulate in the muscles of target species. Some of the toxic effects to predators have been due to the ingestion of ZP that was in the digestive tract of the target organism. Studies on secondary organisms have focused on coyotes, fox, mink, weasels, and birds of prey. Under field conditions, most of the toxic effects to non-target wildlife are due to direct exposures resulting from misuse or misapplication of this rodenticide.

ZP is used in WS' MDM programs in Kentucky in accordance with label restrictions in a manner defined by application guidelines on the label. Application procedures and baits used are determined by formulations allowed by labeling and the species targeted. Most ZP applications in Kentucky are for vole damage management, although some applications for Norway rats and other species are conducted.

Aluminum phosphide (ExToxNet 2006b) is a Restricted Use Pesticide so may be purchased and used only by certified applicators. It is in EPA Toxicity Class I and products containing it must bear the signal word DANGER. AP was first registered for use in the U.S. in the late 1950s. Current trade or other names include Fastphos, Fumitoxin, Gastoxin, Max-Kill, Phosfume, Phostoxin and Weevilcide. Al-phos, Celphide, Celphine, Celphos, Detia-Gas-Ex, and Quick Tox may have been used in previous formulations.

AP 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, etc.) 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. AP is available in pellet and tablet form, and is also available in porous blister packs, sachets or as dusts. As in the case of Phostoxin, it may be formulated as 55% active ingredient along with ammonium carbamate and inert ingredients.

Phostoxin and AP can cause acute toxicity. Neither are absorbed dermally; rather main routes of exposure are through ingestion and inhalation. They are highly toxic via both those routes. The reported rodent oral LD_{50} is 11.5 mg/kg for Phostoxin, with that for the technical compound presumably lower. AP ingested orally reacts with water and stomach acids to produce phosphine gas, which may account in a large part for observed toxicity. Phosphine generated in the gastrointestinal tract is readily absorbed in to the bloodstream, and it is readily absorbed through the lung epithelium.

In chronic toxicity studies, rats fed AP-fumigated chow averaging 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 was 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.

AP is used in Kentucky MDM programs primarily as a small field rodent and mole fumigant for burrows. It is used in accordance with label restrictions in a manner defined by application guidelines on the label. Use in Kentucky is infrequent and amounts used are very small.

Warfarin and Diphacinone are anticoagulant rodenticides used to control commensal rodents and some field rodents around buildings and other structures. Common anticoagulants include warfarin and diphacinone. Anticoagulants are normally classified as multiple-dose toxicants. For the materials to be effective, animals must feed on the bait more than once. However, some newer formulations only require a single feeding to be effective. Bait for rats and mice must be continuously available for 2 to 3 weeks for effective population control.

Ketamine (Ketamine HCl) is a dissociative anesthetic that is used to capture wildlife, primarily mammals, birds, and reptiles. 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 (Fowler and Miller 1999). 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 (tiletamine) is another anesthetic used in wildlife capture. It is 2.5 to 5 times more potent than ketamine; therefore, it generally works faster and lasts longer. Currently, tiletamine can only be purchased as Telazol, which is a mixture of two drugs: tiletamine and zolazepam (a tranquilizer). Muscle tension varies with species. Telazol produces extensive muscle tension in dogs, but produces a more relaxed anesthesia in coyotes, wolves, and bears. It is often the drug of choice for those wild species (Fowler and Miller 1999). This drug is sold in a powder form and must be reconstituted with sterile water before use. Once mixed with sterile water, the shelf life is four days at room temperature and 14 days if refrigerated.

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 (Fowler and Miller 1999). 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. There are DEA restrictions on who can possess and administer this drug. Some states may have additional requirements for personnel training and particular sodium pentobarbital products available for use in wildlife. Certified WS' personnel are authorized to use sodium pentobarbital and dilutions for euthanasia in accordance with DEA and state regulations.

Gas Cartridges are registered as a fumigant by the EPA (Reg. No. 56228-21) and is used in conjunction with denning operations. 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 den. Carbon monoxide euthanasia is recognized by the AVMA as an approved and humane method to kill animals (Beaver et al. 1987).

CO_2 is sometimes used to euthanize mammals which are captured in live traps and when relocation is not a feasible option. Live mammals are placed in a chamber and sealed shut. CO_2 gas is released into the chamber and the animal die quickly after inhaling the gas. This method is approved as a euthanizing agent by the AVMA. CO_2 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 also the gas released by dry ice. The use of CO_2 by WS for euthanasia purposes is exceedingly minor and inconsequential to the amounts used for other purposes by society.

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. Only a few repellents are commercially available for mammals, and are registered for only a few species. Repellents are not available for many species which may present damage problems, such as some predators or furbearing species. Repellents are variably effective and depend to a great extent on resource to be protected, time and length of application, and sensitivity of the species causing damage. Table B.1. lists some species which may respond to repellents and some repellents which have been registered or determined to be useful in attempting to reduce damage. Again, acceptable levels of damage control are usually not realized unless repellents are used in conjunction with other techniques.

Table B.1. List of Common Mammal Species and Repellents Available

Species (common name)	Repellent*
Chipmunks	Napthalene (in confined spaces); Thiram, bitrax, or ammonium soap applied to flowers, bulbs, seeds., vegetation
House Mice	Napthalene (in confined spaces) Ropel ®
Field Mice	Napthalene
Norway Rats	Ropel ®
Tree Squirrels	Ropel ®, Napthalene, Capsaicin, Registered Polybutenes
Black Bears	Capsaicin Spray
Feral Dogs	Capsaicin and Anise Oil
Bats	Napthalene (limited efficacy); Illumination, Air drafts / ventilation, Sticky deterrents (limited efficacy)
Cottontail Rabbits	Wide variety of taste repellents, mostly thiram-based

* All repellents listed may be variably effective in reducing damage and may have other effects on surfaces where applied and on other animals or plants. Read labels carefully.

APPENDIX C

Material Safety Data Sheets

1. MATERIAL SAFETY DATA SHEET: GAS CARTRIDGE, EPA REGISTRATION NUMBER 56228-2

SECTION 1: MATERIAL IDENTIFICATION

DESCRIPTION: A fused cartridge, that when ignited in a confined woodchuck, ground squirrel, or prairie dog den, produces toxic carbon monoxide gas.

Trade Name: Gas cartridge

Synonyms: Woodchuck Cartridge

MANUFACTURER: United States Department of Agriculture
Animal and Plant Health Inspection Service, Wildlife Services
Riverdale, MD 20737
Phone: (301) 734-7921

EMERGENCY CONTACT NUMBER: 1-800-535-5053

SECTION II. INGREDIENTS AND HAZARDS

Active Ingredients: Sodium Nitrate 53%, Charcoal 28%: Total 81%

Inert Ingredients: Fullers Earth 10%, Borax 9%: Total 19%

Total Ingredients: 100%

Hazards: After fuse ignites cartridge, toxic carbon monoxide gas is produced.

SECTION III. PHYSICAL DATA

Water Solubility: Negligible

Specific Gravity: Unknown

Appearance and Odor: Gray-colored, hard-compacted, granular material in a cardboard tube; practically odorless. Carbon monoxide, a highly poisonous, odorless, and tasteless gas, is produced after the cartridge is ignited by the fuse.

FIRE AND EXPLOSION DATA

Flash Point: No Data

Auto-Ignition Temperature: No Data

Flammability Limits: No Data

Extinguish by covering with water, dry chemical, or soil to exclude air. Firefighters should wear a self-contained breathing apparatus.

SECTION V. REACTIVE DATA

Gas cartridges are relatively stable; they react with oxidizing agents.

SECTION VI. HEALTH HAZARD INFORMATION

Gas cartridges produce toxic fumes, when burned. Fumes may be harmful if inhaled. Inhalation overexposure can cause headache, nausea, dizziness, weakness, unconsciousness, and death.

FIRST AID: Call a physician immediately. If inhaled, and person has poisoning symptoms, transfer victim to fresh air. Have victim lie down and keep warm. If respiration has stopped, use artificial respiration. If available, pure oxygen should be given.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL OR LEAK: Pick up spilled gas cartridge and replace in original container.

DISPOSAL: Check with local, state, and federal regulations; if acceptable, soak in water, crush, and dispose of in approved landfill; or, bury in at least six inches of loose soil.

SECTION VIII. SPECIAL PROTECTION INFORMATION

In cases of fire in storage areas, self-contained breathing apparatus is necessary for firefighters.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Once ignited by the fuse, the cartridge will burn vigorously until completely spent, and is capable of causing severe burns to exposed skin and clothes. High temperatures and flame can ignite dry grass, leaves, and other flammable materials. **Do not use cartridges in burrows that extend under porches or buildings.** Fuses are very flammable. Store in areas that protect them against contact with materials that may cause ignition.

October 1999, Reviewed 3-8-00

2. MATERIAL SAFETY DATA SHEET: LARGE GAS CARTRIDGE, EPA REGISTRATION NUMBER 56228-21

SECTION I. MATERIAL IDENTIFICATION

DESCRIPTION: A fused cartridge, that when ignited in a confined coyote, red fox, or striped skunk den, produces toxic carbon monoxide gas.

Trade Name: Large Gas Cartridge

Synonym: Denning Cartridge

MANUFACTURER: United States Department of Agriculture
Animal and Plant Health Inspection Service, Wildlife Services
Riverdale, MD 20737
Phone: (301) 734-7921

EMERGENCY CONTACT NUMBER: 1-800-535-5053

SECTION II. INGREDIENTS AND HAZARDS

Active Ingredients: Sodium Nitrate 53%, Charcoal 28%: Total 81%

Inert Ingredients:	Fullers Earth 10%, Borax 9%: Total 19%
Total Ingredients:	100%
Hazards:	After fuse ignites cartridge, toxic carbon monoxide gas is produced.

SECTION III. PHYSICAL DATA

Water Solubility:	Negligible
Specific Gravity:	Unknown
Appearance and Odor:	Gray-colored, hard-compacted, granular material in a cardboard tube; practically odorless. Carbon monoxide, a highly poisonous, odorless, and tasteless gas, is produced after the cartridge is ignited by the fuse.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point:	No Data
Auto-Ignition Temperature:	No Data
Flammability Limits:	No Data

Extinguish by covering with water, dry chemical, or soil to exclude air. Firefighters should wear a self-contained breathing apparatus.

SECTION V. REACTIVE DATA

Gas cartridges are relatively stable; they react with oxidizing agents.

SECTION VI. HEALTH HAZARD INFORMATION

Gas cartridges produce toxic fumes, when burned. Fumes may be harmful if inhaled. Inhalation overexposure can cause headache, nausea, dizziness, weakness, unconsciousness, and death.

FIRST AID:	Call a physician immediately. If inhaled, and person has poisoning symptoms, transfer victim to fresh air. Have victim lie down and keep warm. If respiration has stopped, use artificial respiration. If available, pure oxygen should be given.
SPILL OR LEAK:	Pick up spilled gas cartridge and replace in original container.
DISPOSAL:	Check with local, state, and federal regulations; if acceptable, soak in water, crush, and dispose of in approved landfill; or, bury in at least six inches of loose soil.

SECTION VIII. SPECIAL PROTECTION INFORMATION

In cases of fire in storage areas, self-contained breathing apparatus is necessary for firefighters.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Once ignited by the fuse, the cartridge will burn vigorously until completely spent, and is capable of causing severe burns to exposed skin and clothes. High temperatures and flame can ignite dry grass, leaves, and other flammable

materials. **Do not use cartridges in burrows that extend under porches or buildings.** Fuses are very flammable. Store in areas that protect them contact with materials that may cause ignition.

October 1996, Reviewed 3-8-00

3. MATERIAL SAFETY DATA SHEET: GRAIN BAIT CONTAINING ZINC PHOSPHIDE, EPA REGISTRATION NUMBERS: 56228-3, 14

SECTION I. MATERIAL IDENTIFICATION

DESCRIPTION: Zinc Phosphide-coated grain for controlling rodent populations.

Trade Name: Zinc Phosphide-treated grain bait

Synonyms: Grain bait

MANUFACTURER: United states Department of Agriculture
Animal and Plant Health Inspection Service, Wildlife Services
Riverdale, MD 20737
Phone: (301) 734-7921

EMERGENCY CONTACT NUMBER: 1-800-535-5053

SECTION II. INGREDIENTS AND HAZARDS

Active Ingredients: Zinc Phosphide 2.0% or less

Inert ingredients: 98.0% or more

Rat Oral LD50: 56228-3: 1.82% ZnP, 911 mg/kg

56228-14: 2.0% ZnP, 888 mg/kg

No personal exposure limit (PEL) has been established for those products. Normal exposure may be created by dust released while handling; under abnormal conditions decomposition of products could create a more hazardous situation. If ingested, poisoning will occur.

SECTION III. PHYSICAL DATA (Active Ingredient)

Specific Gravity (H_20=1): Close to 1.0 (depends on coating)

Volatiles: Neglig1ble

Solubility in Water: Negligible

Appearance and Odor: Gray, free-flowing, granular powder with no particular distinctive odor; dust leaves a slight metallic taste in mouth.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point: Not Applicable

Auto-Ignition Temperature: No Data

Flammability Limits: No Data

Contact with strong oxidizers may cause heat/explosion. Like every grain product, this can reach self-ignition temperature in storage because of fermentation induced by moisture and warm conditions; finely dispersed dust particles in the air can be a fire or explosion hazard.

Extinguishing Media: Dry Chemical-carbon dioxide, powder or foam. Avoid contact with water.

SECTION V. REACTIVE DATA

This is a stable material at room temperature, when dry and kept in closed containers. Moisture reacts with zinc phosphide to produce phosphine, a highly-toxic and spontaneously-flammable gas. In contact with acids, the release of phosphine is more rapid, while in contact with oxidizers, the essentially organic nature of the product creates a high risk of fire. Upon burning, it forms zinc oxide and phosphorus oxides. Full protective equipment is required for all clean-up activities if this product is reacting to water or acids.

SECTION VI. HEALTH HAZARD INFORMATION

There is no established PEL for this product or its active ingredient. Inhalation of dust released by this product can be irritating; in large quantities, the zinc phosphide presents a potential risk because of phosphine exposure. Pulmonary symptoms may be produced, which could include delayed onset of severe pulmonary edema; treating-physician should be made aware of the presence of zinc phosphide and surveillance maintained for sufficient time in cases of serious exposure.

Any person applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness, should be seen by a physician immediately.

FIRST AID: Call a physician OR Poison Control Center IMMEDIATELY.

IF SWALLOWED: Immediately call a Poison Control Center or physician, or transport the patient to the nearest hospital. Do not drink water. Do not administer anything by mouth or make the patient vomit unless advised to do so by a physician.

IF INHALED: Remove victim to fresh air. Apply artificial respiration if necessary.

IF ON SKIN OR IN EYES: Flush with plenty amounts of water. Remove contaminated clothing and wash affected areas with soap and water. Get medical attention if irritation persists.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL OR LEAK: Use dust respirator and rubber gloves when cleaning up any spills. Return to the original container, if possible, or a similar-type container. If WET, collect in plastic bags for disposal; maintain good ventilation around collected material to reduce risk of exposure to phosphine. Flush contaminated area with copious amount of water. Neutralize any acid with sodium carbonate.

DISPOSAL: For waste disposable purposes, this product will be considered an acute hazardous waste. Scrap material can be burned in an approved incinerator or buried in an approved landfill in accordance with existing EPA and/or state regulations. Consult with state and local agencies for applicable disposal methods and techniques. If approved by appropriate agencies, the empty grain bag may be burned or disposed of in sanitary landfill.

SECTION VIII. SPECIAL PRECAUTIONS AND COMMENTS

In using this material, follow suitable precautions to control dust, thus preventing fire and health hazards. Use good personal hygiene practices and keep product away from food, beverages, cosmetics, or tobacco products. Users should refrain from smok1ng while handling this product.

SECTION IX. SPECIAL PROTECTION INFORMATION

Store in a dry and well ventilated area, away from oxidizing agents and sources of heat or ignition. If handling produces dust, wear dust respirator and goggles or face shield, together with gloves. Follow good housekeeping practices where this material is used or stored to prevent any accumulation or contamination.

Revised: 7-11-95, Reviewed 3-9-00

4. MATERIAL SAFETY DATA SHEET: ZINC PHOSPHIDE CONCENTRATE, EPA REGISTRATION NUMBER 56228-6

SECTION I. MATERIAL IDENTIFICATION

DESCRIPTION:	Zinc Phosphide Concentrate
Active Ingredient:	63% Zinc Phosphide
Synonyms:	Zinc Phosphide Rodenticide
MANUFACTURER:	United States Department of Agriculture Animal and Plant Health Inspection Service, Wildlife Services Riverdale, MD 20737 Phone: (301) 734-7921

EMERGENCY CONTACT NUMBER: 1-800-535-5053

SECTION II. INGREDIENTS AND HAZARDS

Active Ingredients:	Zinc Phosphide, powder, 63.20%, (93% technical), CAS #1314-84-7
Impurities (in technical):	4.72% Magnesium Carbonate, powder
Inert Ingredients:	32.08%
CAS# 546-93-0	100.00%

SECTION III. PHYSICAL DATA (Active Ingredient)

Specific Gravity (H_2O=1): 4.7

Volatiles:	Negligible
Solubility in Water:	Insoluble
Appearance and Odor:	Gray powder with garlic-like odor
Boiling Point:	20,120 °C
Melting Point:	4,200 °C

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point:	Not Applicable
Auto-Ignition Temperature:	No Data
Flammability Limits:	No Data

Extinguishing Media: Carbon dioxide, dry sand, or foam.

Special Fire-Fighting Procedures: Wear a self-contained breathing apparatus and protective clothing.

Unusual Fire and Explosion Hazards: DO NOT use water. Reaction produces toxic and flammable phosphine gas and forms zinc and phosphorous oxides upon burning.

SECTION V. REACTIVITY DATA

Avoid contact with oxidizing materials, acids, and water. Hazardous decomposition or byproducts produce zinc and phosphorous oxides, and phosphine gas. Hazardous polymerization will not occur.

SECTION VI. HEALTH HAZARD INFORMATION

There is no established PEL for this product or its active ingredient. Inhalation of dust released by this product can be irritating; in large quantities, the zinc phosphide presents a potential risk because of phosphine gas exposure. Pulmonary symptoms may be produced, which could include delayed onset of severe pulmonary edema; treating physician should be made aware of the presence of zinc phosphide and surveillance maintained for sufficient time in cases of serious exposure.

Rat Oral LD50: 40.5-46.7 mg/kg

Normal exposure may be created by dust released while handling; under abnormal conditions decomposition of products could create a more hazardous situation. If ingested, poisoning will occur.

Any person applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness should be seen by a physician immediately.

Summary of Risks**:** This product is classified as an acute rodenticide. Its mode of action involves the evolution of phosphine gas in the stomach, which is toxic.

FIRST AID: Call a physician OR Poison Control Center IMMEDIATELY.

IF SWALLOWED: Contact a physician or Poison Control Center immediately, or transport the patient to the nearest hospital. DO NOT DRINK WATER. DO NOT administer anything by mouth or make the patient vomit unless advised to do so by a physician. (Primary Route of Entry)

IF INHALED: Move person to fresh air; may produce nausea, chills, vomiting, diarrhea, and abdominal pain in extreme cases. May lead to respiratory irritation. Apply artificial respiration and/or administer oxygen, as needed. (Lesser Primary Route of Entry)

SKIN CONTACT: Immediately flush area with large amounts of water; then wash with soap and water for a minimum of 10 minutes.

EYE CONTACT: Flush with water for a minimum of 10 minutes. Get medical attention if irritation persists.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL OR LEAK: Restrict access to spill area. Use vinyl or rubber gloves, a NIOSH-approved respirator, chemical safety glasses, and protective clothing. If DRY, return to the original container if possible, or a similar type container. If WET, collect in plastic bags for disposal;

maintain good ventilation around collected material to reduce risk of exposure to phosphine gas.

DISPOSAL: For waste disposable purposes, this product will be considered an acute hazardous waste. Scrap material can be burned in an approved incinerator or buried in an approved landfill in accordance with existing EPA and/or state and local regulations. Consult with state and local agencies for applicable disposal methods and techniques.

SECTION VIII. SPECIAL PRECAUTIONS AND COMMENTS

In using this material follow suitable precautions to control dust, thus preventing fire and health hazards. Use good personal hygiene practices and keep product away from food, beverages, cosmetic or tobacco products. Users should refrain from smoking while handling this product.

SECTION IX. SPECIAL PROTECTION INFORMATION

Store in dry and well ventilated area, away form oxidizing agents and sources of heat or ignition. If handling produces dust, wear dust mask and goggles/face shield, and gloves. Follow good housekeeping practices where this material is used or stored to prevent any accumulation or contamination.

Revised 7-18-97, Reviewed 3-8-00

APPENDIX D

THREATENED AND ENDANGERED SPECIES IN KENTUCKY

Animals -- 33

Status	***Species/Listing Name***
E	Bat, gray (*Myotis grisescens*)
E	Bat, Indiana (*Myotis sodalis*)
E	Bat, Virginia big-eared (*Corynorhinus (=Plecotus) townsendii virginianus*)
E	Bean, Cumberland (pearlymussel) Entire Range; Except where listed as Experimental Populations (*Villosa trabalis*)
E	Beetle, American burying (*Nicrophorus americanus*)
E	Catspaw (=purple cat's paw pearlymussel) Entire Range; Except where listed as Experimental Populations (*Epioblasma obliquata obliquata*)
E	Clubshell Entire Range; Except where listed as Experimental Populations (*Pleurobema clava*)
E	Combshell, Cumberlandian Entire Range; Except where listed as Experimental Populations (*Epioblasma brevidens*)
E	Curlew, Eskimo (*Numenius borealis*)
T	Dace, blackside (*Phoxinus cumberlandensis*)
E	Darter, relict (*Etheostoma chienense*)
E	Elktoe, Cumberland (*Alasmidonta atropurpurea*)
E	Fanshell (*Cyprogenia stegaria*)
E	Mucket, pink (pearlymussel) (*Lampsilis abrupta*)
E	Mussel, oyster Entire Range; Except where listed as Experimental Populations (*Epioblasma capsaeformis*)
E	Mussel, scaleshell (*Leptodea leptodon*)
E	Pearlymussel, cracking Entire Range; Except where listed as Experimental Populations (*Hemistena lata*)
E	Pearlymussel, dromedary Entire Range; Except where listed as Experimental Populations (*Dromus dromas*)
E	Pearlymussel, littlewing (*Pegias fabula*)
E	Pigtoe, rough (*Pleurobema plenum*)

E Pimpleback, orangefoot (pearlymussel) (*Plethobasus cooperianus*)

T Plover, piping except Great Lakes watershed (*Charadrius melodus*)

E Pocketbook, fat (*Potamilus capax*)

E Puma (=cougar), eastern (*Puma (=Felis) concolor couguar*)

E Riffleshell, northern (*Epioblasma torulosa rangiana*)

E Riffleshell, tan (*Epioblasma florentina walkeri (=E. walkeri)*)

E Ring pink (mussel) (*Obovaria retusa*)

E Shiner, palezone (*Notropis albizonatus*)

E Shrimp, Kentucky cave (*Palaemonias ganteri*)

E Sturgeon, pallid (*Scaphirhynchus albus*)

E Tern, least interior pop. (*Sterna antillarum*)

E Wartyback, white (pearlymussel) (*Plethobasus cicatricosus*)

E Wolf, gray Lower 48 States, except where delisted; where XN; and Mexico. (*Canis lupus*)

Plants -- 8

Status	***Species/Listing Name***
E	Clover, running buffalo (*Trifolium stoloniferum*)
E	Goldenrod, Short's (*Solidago shortii*)
T	Goldenrod, white-haired (*Solidago albopilosa*)
T	Potato-bean, Price's (*Apios priceana*)
E	Rock-cress, Braun's (*Arabis perstellata*)
T	Rosemary, Cumberland (*Conradina verticillata*)
E	Sandwort, Cumberland (*Arenaria cumberlandensis*)
T	Spiraea, Virginia (*Spiraea virginiana*)

APPENDIX E

SUMMARY INFORMATION REGARDING T&E MUSSEL SPECIES FOUND IN KENTUCKY

Species/ Common name	ESA Status/ Conservation Rank	KY Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05*	Population Distribution/ Abundance	Threats
Alasmidonta atropurpurea CUMBERLAND ELKTOE	LE/ S1	Jackson, Laurel, McCreary, Pulaski, Rockcastle, Whitley	Upper Cumberland, Rockcastle, Upper Cumberland-Lake Cumberland, South Fork Cumberland, Collins. The habitat ranges from small creeks to medium-sized rivers. The mussel is most common in smaller stream habitats. Preferred habitat appears to be shallow flats or pools with slow current and sand substrate with scattered cobble/boulder material, although it will occur in mud or rocky substrates and faster currents	May be locally abundant at particular sites, distribution is fragmented and often restricted to relatively short stream sections.	Acid mine run-off, Siltation from logging, agriculture, and other poor land-use practices, oil spills (Marsh Creek Population)

Species/ Common name	ESA Status/ Conservation Rank	KY Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05*	Population Distribution/ Abundance	Threats
Cyprogania stegaria Fanshell mussel	LE/S1	Allen, Barren, Boyd, Bracken, Butler, Campbell, Carter, Cumberland, Edmonson, Fleming, Green, Greenup, Harrison, Hart, Henderson, Henry, Jefferson, Kenton, Larue, Lawrence, Lewis, Livingston, Lyon, Mason, Mercer, Monroe, Muhlenberg, Nelson, Nicholas, Ohio, Owen, Pendleton, Powell, Robertson, Russell, Spencer, Todd, Warren, Wayne, Woodford	Middle Allegheny-Redbank, Lower Allegheny, Upper Ohio, Upper Ohio-Shade, Upper Kanawha, Big Sandy, Little Scioto-Tygarts, Ohio Brush-Whiteoak, Middle Ohio-Laughery, Licking, South Fork Licking, Upper Kentucky, Lower Kentucky, Upper Green, Barren, Middle Green, Upper Wabash, Middle Wabash-Deer, Tippecanoe, Middle Wabash-Little Vermilion, Middle Wabash-Busseron, Lower Wabash, Lower White, Upper East Fork White, Lower East Fork White, Upper Cumberland-Lake Cumberland, Caney, Lower Cumberland, Red., Silver-Little Kentucky, Salt, Rolling Fork, Lower Ohio-Little Pigeon. Characteristic habitat is medium to large streams. It has been found in river habitats with gravel substrates and a strong current, in both deep and shallow water.	Only three reproducing populations known: The Green and Licking rivers in Kentucky and the Clinch River in Tennessee. No estimates of population size or estimates in KY; rare throughout its range in the Tennessee and Ohio river systems and extremely rare in Virginia. Most of the remaining fanshell populations are small and all are geographically isolated from each other.	Siltation, drainage of bottomland lakes, swamps, and prairie marshes, desiccation during drought, species introductions, pollution, impoundments, and increased water temperatures. Pollution through point (industrial and residential discharge) and non-point (siltation, herbicide and fertilizer run-off) sources is perhaps the greatest on-going threat.
Dromus dromas Dromedary pearly mussel	LE,XNSX	None identified	Obey, Upper Cumberland-Cordell Hull, Caney , Lower Cumberland-Old Hickory Lake. A riffle dwelling species occurring at shoals with sand and gravel and moderate current velocities, but also found in deeper, slower moving water in Tennessee.	At least prehistorically, Dromus was one of the most abundant species in the TN River. Apparently declining at 4 remaining populations, only older individuals found in Tennessee River. A 1980 survey by Virginia Tech and TVA found nine occurrences in Virginia. Currently the dromedary is reduced to possibly three reproducing populations. There is no known distribution in Kentucky, and no abundance data for Kentucky.	Impoundments, siltation and pollution leading to water quality and habitat deterioration, inadequate sewage treatment, coal mining, oil and gas drilling and poor land-use practices.

Species/ Common name	ESA Status/ Conservation Rank	KY Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05*	Population Distribution/ Abundance	Threats
Epioblasma brevidens Cumberlandian combshell	LE,XNS1	Cumberland, Laurel, McCreary, Pulaski, Rockcastle, Russell, Wayne	Rockcastle, Upper Cumberland-Lake Cumberland, South Fork Cumberland, Caney, Lower Cumberland-Old Hickory Lake, Lower Cumberland-Sycamore. The habitat ranges from large creeks to large rivers, in substrates ranging from coarse sand to mixtures of gravel, cobble, and boulder-sized particles.	Historically distributed throughout the Cumberlandian region of the Tennessee and Cumberland River systems. Populations are currently known from Buck Creek in Kentucky and through a few miles of the Big South Fork Cumberland River in Kentucky. Populations are restricted to limited areas of five river drainages and some of those may no longer be reproducing. All populations are in decline due to pollution, particularly from mining activities, and the inundation of habitat by reservoirs.	Much of its former habitat has been inundated by reservoirs and considerable other portions have been devastated by acid mine run-off. Various forms of pollution and poor land use practices (e.g., siltation) threaten survival of remaining EOs.
Epioblasma capsaeformis Oyster mussel	LE,XNS1	Cumberland, Laurel, McCreary, Pulaski, Russell, Wayne, Whitley	Upper Cumberland, Rockcastle, Upper Cumberland-Lake Cumberland, South Fork Cumberland, Caney. Associated with riffle areas exhibiting high energy flows, high water quality, and rocky substrates. Inhabits moderate to swift currents in large creeks and rivers in substrates composed of coarse sand to boulder-sized particles, rarely mud. It may be associated with beds of *Justicia Americana* (water willow) bordering the main channel of the riffle.	Once a commonly found species (1970s), but abundance has dropped. Historically, was distributed throughout the Cumberlandian region of the Tennessee and Cumberland River drainages in Alabama, Kentucky, Tennessee, and Virginia. Post-1985 records are in nine tributaries, some of those occurrences (Clinch and Duck rivers and the Big South Fork River) are relatively healthy.	Much of its former habitat has been inundated by reservoirs and considerable other portions of its range have been devastated by acid mine run-off. Various forms of pollution and poor land use practices (e.g. siltation) threaten survival of remaining EOs.
Epioblasma florentina walkeri TAN RIFFLESHELL	LE/SX	None identified	South Fork Cumberland, Stones, Harpeth. Found in headwaters, riffles, and shoals in sand and gravel substrates.	No known distribution in Kentucky and no abundance data for Kentucky. A new population was found in the Upper Clinch River and Indian Creek. The population from the Middle Fork Holston River in Virginia may no longer be extant.	No information.

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Epioblasma obliquata obliquata CATSPAW	LE,XNS1	None identified	Lower Ohio River and its KY tributaries of the Licking, Green and Kentucky Rivers; Ohio Brush-Whiteoak, Middle Ohio-Laughery, Upper Green, Middle Green, Upper Cumberland-Lake Cumberland, Lower Cumberland-Old Hickory Lake, Lower Ohio-Little Pigeon. Inhabits large river systems in sand and gravel substrates in runs and riffles. Appears to require swiftly moving water.	Three extant populations of E. *obliquata obliquata* are thought to exist; one in the Green River in Kentucky, the Cumberland River in Tennessee, and the Killbuck Creek in Ohio. Has been extirpated from a large portion of its range.	Problems associated with land-use in the Killbuck Creek watershed threaten the *E. obliquata obliquata* population. Impoundments, siltation, drainage of bottomland lakes, swamps, and prairie marshes, desiccation during drought, species introductions, pollution and increased water temperatures; reduced water flow resulting in a reduction in water oxygen; Residential, mineral and industrial development.
Epioblasma torulosa rangiana NORTHERN RIFFLESHELL	LE, SI	Bath, Edmonson, Franklin, Grayson, Green, Hart, Kenton, Mercer, Nelson, Pendleton, Rowan, Spencer, Taylor, Warren, Woodford	Upper Allegheny, Conewango, Middle Allegheny-Tionesta, French, Middle Allegheny-Redbank, Shenango, Upper Kanawha, Elk, Ohio Brush-Whiteoak, Middle Ohio-Laughery, Licking, Lower Kentucky, Upper Green, Barren, Middle Wabash-Deer, Tippecanoe, Middle Wabash-Busseron, Upper White, Driftwood, Lower East Fork, White, Salt, Rolling Fork. Found in riffles, on a bottom of firmly packed and rather fine gravel, in swiftly flowing, shallow water or coarse grave; also, in riffle areas of smaller streams.	No data on abundance. Historically occurred throughout much of the Ohio River watershed but range has been dramatically reduced to eight to ten populations scattered over four states and one province.	Impoundments, siltation, drainage of bottomland lakes, swamps, and prairie marshes, desiccation during drought, species introductions, pollution and increased water temperatures; reduced water flow resulting in a reduction in water oxygen; Residential, mineral and industrial development.

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Epioblasma torulosa torulosa TUBERCLED BLOSSOM	LE,XN SX	None identified	Upper Kanawha, Middle Wabash-Deer, Middle Wabash-Little Vermilion, Middle Wabash-Busseron, Lower Wabash, Lower White, Upper East Fork White, Lower East Fork White, Lower Cumberland-Old Hickory Lake. Habitat characterized by riffles or shoals in shallow water with sandy gravel substrate and rapid currents.	Extinct	No data
Hemistena lata CRACKING PEARLY MUSSEL	LE,XNSX	None identified	Lower Wabash, Upper Clinch, Powell, Lower Clinch, Upper Elk, Lower Tennessee-Beech, Lower Duck, Buffalo. Abundant in sand, gravel, and cobble substrates in swift currents or mud and sand in slower currents	Originally inhabited the Ohio, Cumberland, and Tennessee river systems. It has been extirpated from most of its former range but some viable populations may persist in the upper Clinch River in Tennessee. Reduced to possibly 3 reproducing populations in the Tennessee River system in VA and TN. There are no known distribution or abundance data for Kentucky.	Impoundments, siltation and pollution leading to water quality and habitat deterioration. Inadequate sewage treatment, coal mining, oil and gas drilling and poor land-use practices. Residential, mineral and industrial development.

Species/ Common name	ESA Status/ Conservation Rank	KY Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05*	Population Distribution/ Abundance	Threats
Lampsilis orbiculata PINK MUCKET	LE/S2	Bath, Boone, Butler, Campbell, Carroll, Cumberland, Greenup, Hart, Henderson, Jefferson, Kenton, Lewis, Livingston, Lyon, Marshall, McCracken, Pendleton, Rowan, Russell, Spencer, Warren, Wayne	Middle Allegheny-Redbank, Lower Monongahela, Upper Ohio, Upper Ohio-Shade, Upper Kanawha, Elk, Raccoon-Symmes, Little Scioto-Tygarts, Ohio Brush-Whiteoak, Middle Ohio-, Licking , Upper Green, Barren, Lower Wabash, Upper Cumberland-Lake Cumberland, Obey, Caney, Lower Cumberland-Old Hickory Lake, Lower Cumberland, Silver-Little Kentucky, Salt, Lower Ohio-Little Pigeon, Lower Ohio, Holston, Lower French Broad, Nolichucky, Watts Bar Lake, Upper Clinch, Lower Clinch , Middle Tennessee-Chickamauga, Guntersville Lake, Wheeler Lake, Pickwick Lake, Lower Tennessee-Beech, Kentucky Lake, Lower Tennessee. Characterized as a large river species, although in recent years it has survived and reproduced in impoundments with river-lake conditions but never in standing pools of water. Found in waters with strong currents, rocky substrates, with depths up to about 1 m and in deeper waters with slower currents and sand and gravel substrate.	Considered as an Interior Basin species in origin. Formerly scattered throughout the Mississippi, Tennessee, Ohio and Cumberland river systems. This species has never been collected in large numbers from any one site or drainage. Most surveys only find one to five individuals.	Known threats include modification of habitat (e.g., dams and dredging), degradation of water quality, and over harvest by commercial mussel industry. Siltation, pollution, and channelization in the Ohio River are also threats.

Species/ Common name	ESA Status/ Conservation Rank	KY Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05*	Population Distribution/ Abundance	Threats
Obovaria retusa RING PINK	LE/S1	Ballard, Boone, Butler, Campbell, Carroll, Cumberland, Edmonson, Greenup, Hart, Henderson, Jefferson, Kenton, Lewis, Livingston, Lyon, Marshall, McCracken, Mercer, Monroe, Pulaski, Russell, Todd, Trigg, Warren, Wayne, Woodford	Upper Ohio, Little Scioto-Tygarts, Ohio Brush-Whiteoak, Middle Ohio-Laughery, Lower Kentucky, Upper Green, Barren, Middle Wabash-Deer, Middle Wabash-Little Vermilion, Middle Wabash-Busseron, Lower Wabash, Lower White, Lower East Fork White, Upper Cumberland-Lake Cumberland, Lower Cumberland-Old Hickory Lake, Lower Cumberland, Red., Silver-Little Kentucky, Blue-Sinking, Lower Ohio-Little Pigeon, Lower Ohio, Lower Tennessee-Beech, Kentucky Lake, Lower Tennessee. Dennis characterized preferred habitat as large rivers. Gravel and sand bars are preferred. Because of reservoir construction on those large rivers, most historic occurrences have been inundated.	Known from five relic populations, but only two are likely viable. Loss of habitat due to impoundments is probably the primary cause for decline. Other threats include gravel dredging, channel maintenance, and incidental take from commercial mussel harvesting. The Green River population is threatened by diminished water quality due to oil and gas production.	Loss of habitat due to impoundments is probably the primary cause for decline. Other threats include gravel dredging, channel maintenance, and incidental take from commercial mussel harvesting. The Green River population is threatened by diminished water quality due to oil and gas production.
Pegias fabula LITTLEWING PEARLYMUSSEL	LE/S1	Jackson, Laurel, Logan, McCreary, Pulaski, Rockcastle, Todd, Wayne	Rockcastle, Upper Cumberland-Lake Cumberland, South Fork Cumberland, Collins, Caney, Stones, Red., North Fork Holston, South Fork Holston, Upper Little Tennessee, Upper Clinch, Powell, Upper Elk. Common at the head of riffles, but also found in and below riffles on sand and gravel substrates with scattered cobbles. Also inhabits sand pockets between rocks, cobbles and boulders, and underneath large rocks. It is restricted to small, cool streams.	In Kentucky, it is found at three sites in the southeastern part of the state. Distribution is limited to Horse Lick Creek, Jackson, and Rockcastle County and Big and Little South Forks of the Cumberland River, McCreary and Wayne Counties.	Deterioration of water quality, especially from acid mine drainage is the primary threat to the species. It is also affected by domestic pollution and impoundments.

Species/ Common name	ESA Status/ Conservation Rank	KY Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05*	Population Distribution/ Abundance	Threats
Plethobasus cicatricosus WHITE WARTYBACK	LE/SX	None identified	Middle Wabash-Deer, Middle Wabash-Little Vermilion, Middle Wabash-Busseron, Lower Wabash, Caney , Lower Cumberland-Old Hickory Lake, Holston, Powell, Lower Clinch, Pickwick Lake, Lower Tennessee-Beech. Presumed to inhabit shoals and riffles in large rivers like the Tennessee.	No live specimens have been collected in over 30 years and no estimates of population size or abundance have been made. The only recent record was the collection of a fresh dead shell from a commercial shell pile in 1979 and 1982 below Pickwick Dam near Savannah, Tennessee. Both collections were older specimens. There is no known distribution in Kentucky and no abundance data for Kentucky.	Smith (1971) ranked the causes of extirpation or declines in fish species as follows: siltation, drainage of bottomland lakes, swamps, and prairie marshes, desiccation during drought, species introductions, pollution, impoundments, and increased water temperatures. All of those factors render habitats unsuitable, cause extirpations, and lead to the isolation of populations thereby increasing their vulnerability to extirpation for many aquatic species (including mussels) throughout North America. Pollution through point (industrial and residential discharge) and non-point (siltation, herbicide and fertilizer run-off) sources is perhaps the greatest on-going threat to this species and most freshwater mussels. Residential, mineral and industrial development also poses a significant threat.
Plethobasus cooperianus ORANGEFOOT PIMPLEBACK	LE/S1	Ballard, Bullitt, Butler, Campbell, Carroll, Clinton, Crittenden, Cumberland, Grayson, Hancock, Jefferson, Kenton, Lewis, Livingston, Lyon, Marshall, McCracken, Monroe, Ohio, Russell, Trigg, Trimble, Warren, Wayne	Upper Ohio, Ohio Brush-Whiteoak, Middle Ohio-Laughery, Upper Green, Rough, Lower Wabash, Upper Cumberland-Lake Cumberland, Lower Cumberland-Old Hickory Lake, Lower Cumberland , Silver-Little Kentucky, Salt, Lower Ohio-Little Pigeon, Lower Ohio, Lower French Broad, Watts Bar Lake, Powell, Lower Clinch, Middle Tennessee-Chickamauga, Guntersville Lake, Wheeler Lake, Lower Tennessee-Beech, Upper Duck, Lower Duck, Kentucky Lake, Lower Tennessee. Found in large rivers in sand, gravel, and cobble substrates in riffles and shoals in deep water and steady currents.	No estimates of population size or abundance have been made. Presently restricted to the Tennessee, Cumberland, and lower Ohio rivers where it is rare. Between 1979 and 1982 a large number of fresh-dead shells were collected from a shell buyer's cookout camp below Pickwick Dam. Juveniles also found in muskrat middens along the Tennessee River in Hardin County, Tennessee. Individuals are rare but regularly reported from the lower Ohio River near Metropolis, Illinois. Parmalee et al. (1980) reported finding live individuals near Bartlett's Bar on the Cumberland River in 1979 and represent the only live records in the river since Neel and Allen (1964).	Smith (1971) ranked the causes of extirpation or declines in fish species as follows: siltation, drainage of bottomland lakes, swamps, and prairie marshes, desiccation during drought, species introductions, pollution, impoundments, and increased water temperatures. All of those factors render habitats unsuitable, cause extirpations, and lead to the isolation of populations thereby increasing their vulnerability to extirpation for many aquatic species (including mussels) throughout North America. Pollution through point (industrial and residential discharge) and non-point (siltation, herbicide and fertilizer run-off) sources is perhaps the greatest on-going threat to this species and most freshwater mussels. Residential, mineral and industrial development also poses a significant threat.

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Pleurobema clava CLUBSHELL	LE,XNS1	Allen, Bath, Boyle, Bracken, Bullitt, Butler, Campbell, Edmonson, Gallatin, Garrard, Grayson, Green, Hardin, Harrison, Hart, Jefferson, Kenton, Livingston, Lyon, Marshall, Meade, Mercer, Nelson, Owen, Pendleton, Robertson, Spencer, Taylor, Warren, Woodford	Middle Allegheny-Tionesta, French, Middle Allegheny-Redbank, Conemaugh, Kiskiminetas, Lower Allegheny, West Fork, Cheat, Lower Monongahela, Upper Ohio, Shenango, Mahoning, Beaver, Connoquenessing, Little Muskingum-Middle Island, Little Kanawha, Elk, Ohio Brush-Whiteoak, Middle Ohio-Laughery, Licking, South Fork Licking, Lower Kentucky, Upper Green, Barren, Rough, Upper Wabash, Eel, Middle Wabash-Deer, Tippecanoe, Middle Wabash-Little Vermilion, Vermilion , Middle Wabash-Busseron, Embarras, Lower Wabash, Upper White, Lower White, Driftwood, Flatrock-Haw, Upper East Fork White, Lower East Fork White, Caney, Lower Cumberland, Silver-Little Kentucky, Salt, Rolling Fork, Blue-Sinking, Lower Ohio-Bay, Lower Tennessee-Beech, Lower Tennessee.	No detailed abundance estimates have been done on this species. Known from short reaches of 12 streams.	Threatened by domestic and industrial waste and navigation developments in the upper Ohio and Wabash river watersheds. Stansbery believed that various pesticides were at least partially responsible for the overall decrease in the fauna of areas in which P. CLAVA was present. Proposed coal mining in the Elk River watershed may threaten that population. The introduced zebra mussel could also pose a significant threat.

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Pleurobema plenum ROUGH PIGTOE	LE, S1	Butler, Campbell, Clinton, Cumberland, Edmonson, Green, Hart, Kenton, Lewis, Mercer, Monroe, Pendleton, Pulaski, Russell, Warren, Wayne, Woodford	Middle Allegheny-Redbank, Upper Ohio, Ohio Brush-Whiteoak, Middle Ohio-Laughery, Licking, Lower Kentucky, Upper Green, Barren, Middle Green, Middle Wabash-Deer, Tippecanoe, Middle Wabash-Little Vermilion, Middle Wabash-Busseron, Lower Wabash, Lower East Fork White, Upper Cumberland-Lake Cumberland, Lower Cumberland-Old Hickory Lake, Upper Clinch, Lower Clinch, Middle Tennessee-Chickamauga, Wheeler Lake, Pickwick Lake, Lower Tennessee-Beech, Kentucky Lake. Found in medium to large rivers in sand, gravel, and cobble substrates in shoals.	Currently present in an undetermined number of miles below three Tennessee River mainstem dams (Pickwick, Wilson, and Guntersville) and the upper Clinch River between river miles 323 and 154. Although reported by Parmalee et al. (1980) from the middle Cumberland River between 1977 and 1979, it was not found in recent surveys by Tennessee Valley Authority (1976) or Sickel and Chandler (1996). Presently confined to under 20 sites in the Tennessee, Clinch, Cumberland, Barren and Green rivers.	Smith (1971) ranked the causes of extirpation or declines in fish species as follows: siltation, drainage of bottomland lakes, swamps, and prairie marshes, desiccation during drought, species introductions, pollution, impoundments, and increased water temperatures. All of those factors render habitats unsuitable, cause extirpations, and lead to the isolation of populations thereby increasing their vulnerability to extirpation for many aquatic species (including mussels) throughout North America. Pollution through point (industrial and residential discharge) and non-point (siltation, herbicide and fertilizer run-off) sources is perhaps the greatest on-going threat to this species and most freshwater mussels.
Potamilus capax FAT POCKETBOOK	LE/S1	Carlisle, Crittenden, Henderson, Jefferson, Livingston, McCracken, Union	Middle Wabash-Deer, Tippecanoe, Middle Wabash-Busseron, Lower Wabash, Little Wabash, Lower White, Silver-Little Kentucky, Highland-Pigeon, Lower Ohio-Bay, Lower Ohio. Found in sand, mud, and fine gravel substrates and flowing water. Also found in larger rivers in slow-flowing water (often near the bank) in mud or sand.	No abundance indicators in Kentucky; Restricted to about twenty sites in the lower Wabash and Ohio rivers, the St. Francis River System of Arkansas, and the bootheel of Missouri.	Loss of habitat due to dredging and impoundments is the primary reason for the decline of the species. Mussels are particularly susceptible to dredging and must be relocated in order to survive.
Quadrula fragosa WINGED MAPLELEAF	LE,XNS1	None identified	No information provided for Watershed Region 05. Appears to have inhabited medium-sized and large rivers.	Extant EOs are only known from one ten mile section of the lower St. Croix River the Ouachita River in Arkansas, and possibly in Oklahoma. There is no known distribution in Kentucky and no abundance data for Kentucky.	Chemical and organic pollution, alteration and inundation of river channels and siltation have, and continue to have, a severe negative impact on this species. Commercial harvest of shells may also be a threat. A single catastrophic event could possibly cause the extinction of this species.

Species/ Common name	ESA Status/ Conservation Rank	KY Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05*	Population Distribution/ Abundance	Threats
Villosa trabalis CUMBERLAND BEAN	LE,XNS1	Clinton, Cumberland, Jackson, Laurel, Lincoln, McCreary, Pulaski, Rockcastle, Russell, Wayne, Whitley	Upper Cumberland, Rockcastle, Upper Cumberland-Lake Cumberland, South Fork Cumberland, Obey, Caney, North Fork Holston, Holston, Nolichuck, Upper Clinch, Emory, Hiwassee. Found in sand, gravel, and cobble substrates in waters with moderate to swift currents and depths less than 1 meter.	Population size estimates are unknown. Records are sporadic in the upper Cumberland drainage, yet is fairly common there and known from Pulaski County to Cumberland Falls, Whitley County, Kentucky. It is also known from Rockcastle River and its tributary Laurel Fork, Jackson, Rockcastle, and Laurel Counties, Kentucky; also, Little South Fork of the Cumberland River, Wayne County, Kentucky, and the Hiwassee River, Polk County, Tennessee.	Habitat modification, sedimentation, and water quality degradation are the major threats to this species.