ENVIRONMENTAL ASSESSMENT

AQUATIC RODENT DAMAGE MANAGEMENT IN OKLAHOMA

Prepared by:

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

In Cooperation With:

OKLAHOMA DEPARTMENT OF AGRICULTURE
FOOD AND FORESTRY (ODAFF)

January 2015

TABLE OF CONTENTS

ACRONYMS

AMDUCA	Animal Medicinal Drug Use Clarification Act
APHIS	Animal and Plant Health Inspection Service
CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWA	Clean Water Act
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLIR	Forward Looking Infrared
FR	Federal Register
FY	Fiscal Year
IV	Intravenous
IC	Intracardiac
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NWP	Nationwide Permit
NWRC	National Wildlife Research Center
ODAFF	Oklahoma Department of Food and Forestry
ODWC	Oklahoma Department of Wildlife Conservation
PL	Public Law
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
USC	United States Code
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Services
WS	United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services

CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 PURPOSE

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS)[1] program in Oklahoma continues to receive requests for assistance or anticipates receiving requests for assistance to resolve or prevent damage occurring to agricultural resources, natural resources, and property, including threats to human safety, associated with beaver (*Castor canadensis*), muskrats (*Ondatra zibethicus*), and nutria (*Myocastor coypus*). This document will collectively refer to those mammal species as aquatic rodents. Individual damage management projects conducted by the WS program could be categorically excluded from further analysis under the National Environmental Policy Act (NEPA), in accordance with APHIS implementing regulations for the NEPA (7 CFR 372.5(c), 60 FR 6000-6003).

The purpose of this Environmental Assessment (EA) is to evaluate cumulatively the individual projects that WS could conduct to manage damage and threats to agricultural resources, property, natural resources, and threats to people caused by aquatic rodent species. This EA will assist in determining if the proposed cumulative management of damage caused by aquatic rodents could have a significant impact on the environment based on previous activities conducted by WS and based on the anticipation of conducting additional efforts to manage damage caused by those species. Because the goal of WS would be to conduct a coordinated program to alleviate damage in accordance with plans, goals, and objectives developed to reduce damage, and because the program's goals and directives[2] would be to provide assistance when requested, within the constraints of available funding and workforce, it is conceivable that additional damage management efforts could occur. Thus, this EA anticipates those additional efforts and the analyses would apply to actions that may occur in any locale and at any time within Oklahoma as part of a coordinated program. This EA analyzes the potential effects of damage management when requested, as coordinated between WS, the Oklahoma Department of Agriculture, Food, and Forestry (ODAFF), and the Oklahoma Department of Wildlife Conservation (ODWC).

The EA evaluates the need for action to manage damage associated with aquatic rodents in the State, the potential issues associated with managing damage, and the environmental consequences of conducting different alternatives to meet the need for action while addressing the identified issues. WS initially developed the issues and alternatives associated with managing damage caused by aquatic rodents in consultation with the ODWC. The ODWC has regulatory authority to manage populations of aquatic rodent species in the State. To assist with additional issues and alternatives to managing damage associated with aquatic rodents in Oklahoma, WS will make this EA available to the public for review and comment prior to the issuance of a Decision[3].

WS previously developed two EAs that addressed WS' activities to manage damage associated with aquatic rodents. Based on the analyses of those EAs, WS signed a Decision and Finding of No Significant Impact selecting the proposed action alternative. The proposed action alternative implemented a damage management program using a variety of methods in an integrated approach. WS

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

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

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

is preparing this EA to: 1) facilitate planning, 2) promote interagency coordination, 3) streamline program management, 4) clearly communicate to the public the analysis of individual and cumulative impacts of proposed activities, and 5) evaluate and determine if there would be any potentially significant or cumulative effects from the alternative approaches developed to meet the need for action. Since this EA will re-evaluate activities conducted under the previous EAs, this analysis and the outcome of the Decision issued based on the analyses in this EA will supersede the previous EAs that addressed managing damage caused by aquatic rodents. The analyses contained in this EA are based on information derived from WS' Management Information System, published documents (see Appendix A), interagency consultations, and public involvement.

This EA will analyze several alternatives to address the need for action and assist in determining if the proposed management of damage associated with aquatic rodents could have a significant impact on the environment for both people and other organisms. This EA will also document and inform the public of the environmental consequences that could occur from implementing the alternatives to comply with the NEPA. In addition, WS, the ODAFF, and the ODWC will use this EA to coordinate efforts associated with meeting the need for action.

1.2 NEED FOR ACTION

Some species of wildlife have adapted to and have thrived in human altered habitats. Those species, in particular, are often responsible for the majority of conflicts between people and wildlife. Those conflicts often lead people to request assistance with reducing damage to resources and to reduce threats to human safety.

Historically, habitat conditions and exploitation by Native Americans likely limited beaver populations in North America, since climax forest types that historically covered the eastern United States have a relatively low carrying capacity for beaver in comparison with forests in younger growth stages, and beaver were important to Native Americans for food, clothing, tools, and items of trade. Those factors, coupled with the onset of the North American fur trade by Europeans in the early 1600s and the westward advancement of settlement, led to the decline in beaver populations in North America (Lowery 1974, Hill 1976, Woodward 1983, Novak 1987, Baker and Hill 2003). Beaver pelts were the most important item in the early fur trade (Wright 1987). Through overharvest and loss of habitat, the beaver population in the United States rapidly declined in the late 1800s and early 1900s with beaver nearly trapped to extinction by the late 1890s (Hill 1976, Wesley 1978, Baker and Hill 2003). In the 1700s, beaver harvests remained high, but harvests declined continually during the 1800s and reached a record low between 1900 and 1919 (Novak 1987).

The pelts of beaver, muskrat, and nutria were common in many fur markets and provided economic revenue for many people. In addition, people have used the meat of beaver, muskrat, and nutria for food, primarily by subsistence hunters and trappers; however, some organizations have promoted muskrat and nutria meat as table fare in restaurants. People have also used their meat to produce food for pets and pen-raised alligators. After the formation of federal, state, and provincial wildlife conservation agencies and the enactment of new regulations that controlled beaver harvest, beaver populations began to recover. In addition, many states began restocking programs in the 1920s through the 1950s (Hill 1982, Baker and Hill 2003). Today, beaver occur throughout most of North America, including Canada, Alaska, all 48 contiguous states of the United States, and northern portions of Mexico (Deems and Pursley 1978, Novak 1987, Baker and Hill 2003, Linzey and NatureServe 2013).

Following the decimation of the beaver population in the late 1800s and early 1900s, the number of beaver trappers declined. As beaver populations began to recover and trapping seasons were re-opened, the number of beaver trappers and demand for fur had declined. Consequently, interest in harvesting

beaver declined, which allowed the beaver population to expand and continue to increase. Today, beaver occur throughout most of their original range (Hill 1982, Novak 1987, Baker and Hill 2003) and beaver are now often viewed as a nuisance species because of the damage they can cause (Hill 1976, Hill 1982, Woodward 1983, Woodward et al. 1985, Novak 1987, Dickson 2001, Baker and Hill 2003). Although beaver may cause extensive damage, they can be beneficial in many situations, especially where their activities do not compete with human use of the land or property (Wade and Ramsey 1986). Beaver can be ecosystem engineers that construct dams that impound water, trap sediment, and increase the productivity of riparian zones (Rosell et al. 2005). Positive ecological influences on wetland habitats (Arner et al. 1967*a*, Arner et al. 1967*b*, Reese and Hair 1976, Pollock et al. 2004, Pollock et al. 2012, Pollock et al. 2014) and economic gains from fur production (Arner and Dubose 1978*a*, Arner and Dubose 1978*b*) make beaver important animals in the United States. Opinions and attitudes of individuals, communities, and organizations vary greatly and are primarily influenced and formed by the positive and negative experiences of the person or entity expressing the judgment (Hill 1982, Baker and Hill 2003). Property ownership, options for public and private land use, and effects on adjacent property impact public attitudes toward beaver (Hill 1982, Baker and Hill 2003). In some situations, the damage and threats caused by beaver outweigh the benefits (Grasse and Putnam 1955, Woodward et al. 1985, Novak 1987, Baker and Hill 2003).

Woodward et al. (1976) found that 24% of landowners who reported beaver activity on their property indicated benefits to having beaver ponds on their land. However, many landowners desire assistance with beaver pond management (Hill 1976, Lewis 1979, Woodward et al. 1985). Some of the benefits of beaver ponds include activities, such as photography, trapping, hunting, and fishing. Beaver ponds also can provide a potential water source for livestock, and the ecological value of beaver ponds in the natural environment can be important. For example, beaver ponds can contribute to the stabilization of water tables, help reduce rapid run-off from rain (Wade and Ramsey 1986, Pollock et al. 2014), and serve as basins for the entrapment of streambed silt and eroding soil (Hill 1982, Baker and Hill 2003, Pollock et al. 2014). Beaver ponds can also function as sinks, helping to filter nutrients and reduce sedimentation downstream; thereby, maintaining the quality of nearby water systems (Arner and Hepp 1989). Pollock et al. (2014) proposed using beaver to restore degraded stream ecosystems.

Beaver may increase habitat diversity by flooding and opening forest habitats, which can result in greater interspersion of successional stages and subsequently increases the floral and faunal diversity of a habitat (Hill 1982, Arner and Hepp 1989, Baker and Hill 2003). Hood and Bayley (2008) found that ponds with beaver had nine times more open-water than when beaver were not present in those same ponds. Creation of standing water, edge, and plant diversity, all in close proximity, results in excellent wildlife habitat (Hill 1982, Baker and Hill 2003, Cooke and Zack 2008). Habitat modification by beaver, primarily dam building and tree cutting, can benefit many species of wildlife (Jenkins and Busher 1979, Arner and DuBose 1982, Hill 1982, Arner and Hepp 1989, Medin and Clary 1990, Medin and Clary 1991, Baker and Hill 2003, Cooke and Zack 2008). The impounding of water by beaver through their dam building activities may be beneficial to some fish, reptiles, amphibians, waterfowl, shorebirds, and furbearers, such as muskrats, river otter (*Lontra canadensis*), and mink (*Neovision vison*) (Arner and DuBose 1982, Naimen et al. 1986, Miller and Yarrow 1994, Stevens et al. 2007). Hood and Larson (2014) found that beaver could alter shallow-water wetlands, which can influence aquatic invertebrate diversity and abundance. Hood and Larson (2015) found that beaver can increase the volume-to-surface area ratio of impoundments by nearly 50% and can increase the average perimeter edge of water impoundments by over 575% through their digging and channeling behaviors. Beaver created impoundments can also be attractive to warm water fishes (Hanson and Campbell 1963, Pullen 1967). Pollock et al. (2004) concluded that beaver ponds could be an integral part of increasing the production of Coho Salmon (*Oncorhynchus kisutch*) in a river basin within Washington. Pollock et al. (2012) also proposed encouraging beaver activities in an Oregon stream system to restore salmon habitat. Stevens et al. (2007)

found that beaver created impoundments on small streams in the Boreal Foothills of west-central Alberta in Canada contained a higher number of three species of frogs than those streams with no obstructions.

Beaver impoundments can provide aesthetic and recreational opportunities for wildlife observation through the attractiveness of habitat diversity and environmental education (Wade and Ramsey 1986). In addition, beaver ponds may be beneficial to threatened and endangered (T&E) species. For example, beaver ponds in Mississippi over three years in age were found to have developed plant communities that increased their value as nesting and brood rearing habitat for wood ducks (Arner and DuBose 1982). Reese and Hair (1976) found that beaver pond habitats were highly attractive to a large number of birds throughout the year and that the value of the beaver pond habitat to waterfowl was minor when compared to other species of birds (Novak 1987). Cooke and Zack (2008) suggested that beaver dams could be important to creating riparian conditions that foster rich and abundant bird communities in semiarid regions.

Like beaver, muskrats not only have economic value from the sale of their meat and pelt, but they are an indigenous species to North America that fill an important niche in the ecosystem. Historically, muskrats have been the most heavily utilized furbearer in North America with six to 20 million harvested annually since about 1935 (Boutin and Birkenholz 1997). Muskrats provide opportunities for recreation and satisfaction to people that like to observe wildlife in a natural setting. In the prairie pothole region of the United States and Canada, muskrats clear or open small areas through feeding and house building in otherwise dense cattail marshes. The small openings create nesting and brood rearing habitat for nesting waterfowl.

Nutria, which are native to Central and South America, were introduced with the "*fur ranching*" trade. The establishment of nutria in the wild occurred after accidental and intentional releases prior to 1950. In some areas, nutria were released to control aquatic weeds (Wade and Ramsey 1986, Kinler et al. 1987). Trappers and conservation agencies initially regarded newly established feral populations of nutria as a new fur resource. The species provided a means of income for hunters and trappers through the sale of meat and fur. From 1977 to 1984, people harvested approximately $7.3 million worth of nutria fur in the United States (Boutin and Birkenholz 1997, Kinler et al. 1987). Nutria can also provide a major food source for wild alligators (Valentine et al. 1972, Wolfe et al. 1987). However, Lowe et al. (2000) ranked nutria as one of the 100 worst invasive species in the world.

All wildlife, including beaver, muskrat, and nutria, can have either positive or negative values depending on the perspectives and circumstances of individual people. In general, people regard wildlife as providing economic, recreational, and aesthetic benefits. For some people, knowing that wildlife exists in the natural environment provides a positive benefit to many people. However, activities associated with wildlife may result in economic losses to agricultural resources, natural resources, property, and threaten human safety. Therefore, an awareness of the varying perspectives and values are required to balance the needs of people and the needs of wildlife. When addressing damage or threats of damage caused by wildlife, wildlife damage management professionals must consider not only the needs of those directly affected by wildlife damage but a range of environmental, sociocultural, and economic considerations as well.

Resolving wildlife damage problems requires consideration of both sociological and biological carrying capacities. The wildlife acceptance capacity, or cultural carrying capacity, is the limit of human tolerance for wildlife or the maximum number of a given species that can coexist compatibly with local human populations. Biological carrying capacity is the land or habitat's ability to support healthy populations of wildlife without degradation to the species' health or their environment during an extended period of time (Decker and Purdy 1988). Those phenomena are especially important because they define the sensitivity of a person or community to a wildlife species. For any given damage situation, there are varying

thresholds of tolerance exhibited by those people directly and indirectly affected by the species and any associated damage. This damage threshold determines the wildlife acceptance capacity. While the biological carrying capacity of the habitat may support higher populations of wildlife, in many cases the wildlife acceptance capacity is lower. Once the wildlife acceptance capacity is met or exceeded, people begin to implement population or damage management to alleviate damage or address threats to human health and safety.

Wildlife damage management is the alleviation of damage or other problems caused by or related to the behavior of wildlife and can be an integral component of wildlife management (Berryman 1991, The Wildlife Society 2010). The threat of damage or loss of resources is often sufficient for people to initiate individual actions and the need for damage management can occur from specific threats to resources. Those species have no intent to do harm. They utilize habitats (*e.g.*, feed, shelter, reproduce) where they can find a niche. If their activities result in lost economic value of resources or threaten human safety, people often characterize this as damage. When damage exceeds or threatens to exceed an economic threshold and/or pose a threat to human safety, people often seek assistance with resolving damage or reducing threats to human safety. The threshold triggering a request for assistance is often unique to the individual person requesting assistance and many factors can influence when people request assistance (*e.g.*, economic, social, aesthetics). Therefore, what constitutes damage is often unique to the individual person. What one individual person considers damage, another person may not consider as damage. However, the use of the term "*damage*" is consistently used to describe situations where the individual person has determined the losses associated with wildlife is actual damage requiring assistance (*i.e.*, has reached an individual threshold). Many people define the term "*damage*" as economic losses to resources or threats to human safety; however, "*damage*" could also occur from a loss in the aesthetic value of property and other situations where the behavior of wildlife was no longer tolerable to an individual person.

The need for action to manage damage and threats associated with aquatic rodents in Oklahoma arises from requests for assistance[4] received by WS. WS receives requests to reduce or prevent damage from occurring to four major categories: agricultural resources, natural resources, property, and threats to human safety. WS and the ODAFF have identified those aquatic rodent species most likely to be responsible for causing damage to those four categories in the State based on previous requests for assistance. Table 1.1 lists WS' technical assistance projects involving aquatic rodent damage or threats of damage to those four major resource types in Oklahoma from the federal fiscal year[5] (FY) 2009 through FY 2013. WS provides technical assistance to those persons requesting assistance with resolving damage or the threat of damage. Technical assistance provides information and recommendations on activities to alleviate aquatic rodent damage that the requester could conduct without WS' direct involvement in managing or preventing the damage. This EA discusses technical assistance activities further in Chapter 3. Table 1.1 does not include direct operational assistance projects conducted by WS where a person requested WS' assistance through the direct application of methods.

The technical assistance projects conducted by WS are representative of the aquatic rodent species that cause damage and threats in Oklahoma. As shown in Table 1.1, WS has conducted technical assistance projects in Oklahoma involving 11,282 people from FY 2009 through FY 2013 associated with those aquatic rodent species addressed in this assessment.

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

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

Table 1.1 – Number of people provided technical assistance by WS, FY 2009 - FY 2013†

Species	Fiscal Year					TOTAL
	2009	2010	2011	2012	2013	
Beaver	1,926	2,445	3,045	2,737	1,098	**11,251**
Muskrat	6	10	3	9	2	**30**
Nutria	0	0	0	0	1	**1**

†Table 1.1 does not include requests for direct operational assistance that WS received from FY 2009 through FY 2013

Miller (1983) estimated that the annual damage in the United States caused by beaver alone was $75 to $100 million. The value of beaver damage is perhaps greater than that of any other single wildlife species in the United States. Arner and Dubose (1982) estimated the economic damage that beaver caused in the southeastern United States exceeded $4 billion over a 40-year period. Aquatic rodent species can cause damage to or pose threats to a variety of resources. For example, Fowler et al. (1994) documented more than $50 million in damages to a variety of resources caused by beaver in Louisiana. In Oklahoma, most requests for assistance that WS receives are associated with damage or threats of damage that aquatic rodent species can cause to property. The following subsections of the EA provide more information on aquatic rodent damage to those four categories.

Need for Aquatic Rodent Damage Management to Protect Human Health and Safety

Zoonosis (*i.e.*, wildlife diseases transmissible to people) can be a major concern of cooperators when requesting assistance with managing threats from aquatic rodents. Individuals or property owners that request assistance with aquatic rodents frequently are concerned about potential disease risks but are unaware of the types of diseases those animals could transmit. In many circumstances, when human health concerns are the primary reason for requesting WS' assistance there may have been no actual cases of transmission of disease to people by aquatic rodents. Thus, the risk of disease transmission would be the primary reason for requesting assistance from WS.

In most cases when human exposure occurs, the presence of a disease vector across a broad range of naturally occurring sources, including occurring in wildlife populations, can complicate determining the origin of the vector. Disease transmission directly from wildlife to people is uncommon. However, the infrequency of such transmission does not diminish the concerns of those people requesting assistance since disease transmission could occur. WS actively attempts to educate the public about the risks associated with disease transmission from wildlife to people through technical assistance and by providing technical leaflets on the risks of exposure.

Beaver, which are carriers of the intestinal parasite *Giardia lamblia*, can contaminate human water supplies and cause outbreaks of the disease Giardiasis in people (Woodward 1983, Beach and McCulloch 1985, Wade and Ramsey 1986, Miller and Yarrow 1994). Giardiasis is an illness caused by a microscopic parasite that the Centers for Disease Control and Prevention (CDC) report as one of the most common causes of waterborne disease in people across the United States during the last 15 years (CDC 2012). People can contract giardiasis by swallowing contaminated water or putting anything in their mouth that has touched the fecal matter of an infected animal or person. Symptoms of giardiasis include diarrhea, cramps, and nausea (CDC 2012). Beaver are also carriers of tularemia, a bacterial disease that is transmittable to people through bites by insect vectors, bites of infected animals, or by handling animals or carcasses that are infected (Wade and Ramsey 1986). In cattle ranching sections of Wyoming, Skinner et al. (1984) found that the fecal bacteria count was much higher in beaver ponds than in other ponds, something that can be a concern to ranchers and recreationists.

Beaver activity in certain situations can become a threat to public health and safety (*e.g.*, burrowing into or flooding of roadways and railroad beds can result in serious accidents) (Miller 1983, Woodward 1983). Increased water levels in urban areas resulting from beaver activity can lead to unsanitary conditions and potential health problems by flooding septic systems and sewage treatment facilities (DeAlmeida 1987, Loeb 1994). Beaver can dig burrows into embankments with underwater entrances along shorelines and burrowing may not be readily evident until serious damage has occurred. When water levels drop, beaver often expand the entrances of their burrows to keep pace with the retreating water level. In addition, when water levels rise, beaver often expand the entrances upward. Those burrows can collapse when people or animals walk upon them and when crossed over with heavy equipment (*e.g.*, mowers, tractors). Beaver damming activity can also create conditions favorable to mosquitoes and can hinder mosquito control efforts or result in population increases of these insects (Wade and Ramsey 1986). While the presence of these insects is largely a nuisance, mosquitoes can transmit diseases, such as encephalitis (Mallis 1982) and West Nile Virus (CDC 2000). Furthermore, damming of streams sometimes increases the presence of aquatic snakes, including the poisonous cottonmouth (*Agkistrodon piscivorus*) (Wade and Ramsey 1986).

Although reports of rabies in beaver and muskrats are not common, those species of aquatic rodents have tested positive for rabies in the United States. Between 2008 and 2012, two muskrats and 10 beaver across the United States have tested positive for the rabies virus (see Table 1.2). Beaver infected with the rabies virus have aggressively attacked pets and people (Brakhage and Sampson 1952, CDC 2002, Caudell 2012). In 2001, a beaver tested positive for rabies that was exhibiting aggressive behavior by charging canoes and kayaks on a river in Florida (CDC 2002). A beaver that tested positive for rabies attacked a person wading in a New York river during 2012 (Caudell 2012). The person suffered six puncture wounds over their body and underwent treatment for rabies (Caudell 2012). No reports of positive rabies tests in nutria have occurred.

Table 1.2 – Muskrat and beaver reported with rabies in the United States, 2008 – 2012[†]

	Year					
Species	**2008**	**2009**	**2010**	**2011**	**2012**	**TOTAL**
Beaver	1	2	0	3	4	**10**
Muskrat	0	1	1	0	0	**2**

[†]Based on information from Blanton et al. (2009), Blanton et al. (2010), Blanton et al. (2011), Blanton et al. (2012), Dyer et al. (2013)

There are several pathogens and parasites that nutria can transmit to people, livestock, and pets (LeBlanc 1994). However, the role of nutria in the spread of diseases, such as equine encephalomyelitis, leptospirosis, hemorrhagic septicemia (pasteurellosis), paratyphoid, and salmonellosis, is unknown. Nutria also may host a number of parasites, including the nematodes and blood flukes that cause nutria- or swimmers-itch (*Strongyloides myopotami* and *Schistosoma mansoni*, respectively)**,** the protozoan responsible for giardiasis, tapeworms (*Taenia spp*.), and common flukes (*Fasciola hepatica*). The threat of disease may be an important consideration in some situations, such as when livestock drink from water contaminated by nutria feces and urine.

Burrowing by rodents, such as muskrats, nutria and beaver, may sometimes threaten earthen dams as they form networks of burrows, which can weaken such structures, causing erosion and failure. Such incidents can threaten the safety and lives of people living downstream from the dam. For that reason, managers of such sites are concerned with preventing excessive burrowing by those animals at dam sites. Much of the damage caused by muskrats is primarily through their burrowing activity (Perry 1982, Miller 1994, Linzey 1998) in dikes, dams, ditches, ponds, and shorelines. Muskrats can dig burrows into banks and levees, which can compromise the integrity of embankments (Perry 1982, Linzey 1998). Muskrats can dig burrows with underwater entrances along shorelines and burrowing may not be readily evident until serious damage has occurred. When water levels drop, muskrats often expand the holes and tunnels to

keep pace with the retreating water level. Additionally, when water levels rise muskrats expand the burrows upward. Those burrows can collapse when people or animals walk over them and when heavy equipment (*e.g.*, mowers, tractors) crosses over.

Disease Surveillance and Monitoring

Public awareness and health risks associated with zoonoses (*i.e.*, diseases of animals that are transmissible to people) have increased in recent years. This EA briefly addressed some of the more commonly known zoonotic diseases associated with aquatic rodents. Those zoonotic diseases remain a concern and can pose threats to human safety where people encounter aquatic rodents. WS has received requests to assist with reducing damage and threats associated with several aquatic rodent species in Oklahoma and could conduct or assist with disease monitoring or surveillance activities for any of the aquatic rodent species addressed in this EA. Most disease sampling would occur ancillary to other wildlife damage management activities (*i.e.*, disease sampling would occur after wildlife have been captured or lethally removed for other purposes).

Need for Aquatic Rodent Damage Management to Alleviate Agricultural Damage

Beaver are the largest member of the Order Rodentia in North America, which consists of species that have upper and lower incisors (teeth) that grow continually. To prevent the overgrowth of the incisors, beaver must wear down their teeth through gnawing. Beaver feed and gnaw on woody vegetation to keep teeth worn to appropriate levels. This feeding and gnawing behavior often girdles trees and other woody vegetation leading to the death of the vegetation. Beaver also feed on agricultural crops, such as soybeans and corn (Chapman 1949, Roberts and Arner 1984). Where beaver are located near agricultural fields, consumption of crops can be high. During stomach content analyses of beaver, Roberts and Arner (1984) found that the stomachs of 83% of the beaver sampled in the summer near soybean fields contained only soybeans. From FY 2009 through FY 2013, Oklahoma WS has recorded $123,758 in crop damage from beaver ($93,224 was verified and $30,534 was reported). This damage occurred to corn, soybeans, and pecan orchards. Damage is typically from feeding/gnawing or the flooding of crops.

Flooding damage associated with beaver occurs when crops or pastures are inundated causing the death of plants. Flooding can also prevent access of agricultural producers to crops or livestock to forage areas. Beaver dams across irrigation canals can prevent irrigation activities and flood surrounding cropland. Beaver often burrow into earthen embankments of canals, which can weaken the structural integrity of the structure through erosion and by allowing water to seep into the interior of the structure. Beaver damage can lead to the failure of the embankments leading to costly repairs of the embankment and the potential for flooding.

Aquaculture, the cultivation of finfish and invertebrates in captivity, has grown exponentially in the past several decades (Price and Nickum 1995). 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). Damage to aquaculture resources could occur from the economic losses associated with muskrats killing, consuming, and/or injuring fish and other commercially raised aquatic wildlife. Also of concern to aquaculture facilities is the transmission of diseases by muskrats and beaver from the outside environment to aquaculture facilities, between impoundments, and from facility to facility. Given the confinement of aquatic wildlife inside impoundments at aquaculture facilities and the high densities of those organisms in the impoundments, the introduction of a disease can result in substantial economic losses since the entire impoundment is likely to become infected, which can result in extensive mortality. Although the actual transmission of diseases through transport by muskrats and beaver is difficult to document, large rodents have the capability of spreading diseases through fecal droppings and possibly through other mechanical means such as on fur and feet.

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, rice, and soybeans (Perry 1982). Nutria depredation on crops also occurs (LeBlanc 1994). Crops that nutria have damaged include corn, milo (grain sorghum), sugar and table beets, alfalfa, wheat, barley, oats, peanuts, various melons, and a variety of vegetables from home gardens and truck farms.

Need for Aquatic Rodent Damage Management to Alleviate Natural Resources Damage

Aquatic rodents can also cause damage to natural resources. From FY 2009 through FY 2013, beaver activity caused $38,350 in damage to natural resources ($35,700 in verified damage and $2,650 in reported damage). Natural resources can be those assets belonging to the public that government agencies, as representatives of the people, often manage and hold in trust. Such resources may be plants or animals, including threatened or endangered species, historic properties, or habitats in general. Examples of natural resources in Oklahoma may include parks and recreational areas; natural areas, including unique habitats or topographic features; threatened or endangered plants and animals; and any plant or animal populations that the public has identified as a natural resource.

Beaver activities can also destroy habitat (*e.g.*, free-flowing water, riparian areas, and bird roosting and nesting areas), which can be important to many species. Patterson (1951) and Avery (1992) reported that the presence of beaver dams could negatively affect some fisheries. Beaver dams may adversely affect stream ecosystems by increasing sedimentation in streams upstream of the dam; thereby, affecting wildlife that depend on clear water such as certain species of fish and mussels. Stagnant water impounded by beaver dams can increase the temperature of water impounded upstream of the dam, which can negatively affect aquatic organisms. Beaver dams can also act as barriers that inhibit movement of aquatic organisms and prevent the migration of fish to spawning areas.

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 (*e.g.*, crayfish), and young birds. Muskrats may also feed upon fish, frogs, and small turtles. Muskrats could feed upon some mussels and small turtles that the United States Fish and Wildlife Service (USFWS) list as T&E species under the ESA and numerous mussels, snails, crustaceans, fish, frogs, turtles, and birds that muskrats consume could be state listed. For example, Neves and Odom (1989) reported that muskrats appeared to be inhibiting the recovery of some endangered mussel species, and they were likely placing pigtoe mussels in further jeopardy along 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).

Nutria primarily inhabit brackish or freshwater marshes, but are also found in swamps, rivers, ponds, and lakes. Nutria live in dense vegetation, in abandoned burrows, or in burrows they dig along stream banks or shorelines (Wade and Ramsey 1986). Nutria are almost entirely herbivorous and eat animal material (mostly insects) incidentally. In some parts of their range, nutria occasionally eat freshwater mussels and crustaceans. Marshes are generally wetlands frequently or continually inundated with water, characterized by emergent soft-stemmed vegetation that are adapted to saturated soil conditions. The

emergent vegetation associated with marsh habitats often form thick, fibrous root mats that stabilizes the underlying soil and acts to catch soil sediments in the water.

The digging and feeding behavior of nutria can be destructive to marsh ecosystems. Nutria forage directly on the emergent vegetation and the vegetative root mat in a wetland, leaving a marsh pitted with digging sites and fragmented with deeply cut swimming canals. When nutria compromise the fibrous vegetative mat, emergent marshlands are quickly reduced to unconsolidated mudflats. The complete loss of emergent vegetation and root mats that occur from nutria are often called "*eat-outs*", where the foraging and digging behavior of nutria completely denude large areas of marsh vegetation. Those denuded areas are devoid of most plant life and essentially become mud flats, providing fewer habitats for the spawning and production of fish and shellfish, birds and other aquatic mammals, and is the greatest direct impact of nutria (Haramis 1997, Haramis 1999, Southwick Associates 2004). The denuding of marsh vegetation can expose the soil and accelerate erosion associated with tidal currents and wave action along with a general lowering of existing elevation levels in marshlands. The loss of vegetation can also facilitate saltwater intrusion into marsh interiors. For example, in Louisiana, nutria have damaged an estimated 100,000 acres of coastal marsh (Kinler et al. 1987). Nutria are opportunistic feeders and eat approximately 25% of their body weight daily (LeBlanc 1994).

Need for Aquatic Rodent Damage Management to Alleviate Property Damage

Aquatic rodents cause damage to a variety of property types in Oklahoma each year. Property damage can occur in a variety of ways. Aquatic rodent damage to property occurs primarily through direct damage to structures. Beaver can flood land, roads, and railways. They can girdle trees, consume landscaping, and burrowing activities may cause significant damage to earthen dams and roadways. In addition, aquatic rodents crossing runways and taxiways near water bodies contribute to risk of aircraft strikes that can also cause substantial damage requiring costly repairs and aircraft downtime. These types of beaver activities in Oklahoma led to $309,050 in verified and reported property damages from FY 2009 through FY 2013 based on requests for assistance received by WS. In Oklahoma, beaver regularly undermine floating boat docks, gnawing and removing the foam floatation causing docks be less buoyant or sink.

Beaver often will gnaw through trees and other woody vegetation for use in dam building, food caches, and the building of lodges. The girdling and felling of trees and other woody vegetation can cause economic losses, can threaten human safety and property when trees fall, and the loss of trees can be aesthetically displeasing to property owners. The loss of timber (*e.g.*, from flooding, gnawing) is the most common type of damage associated with beaver (Hill 1976, Lewis 1979, Hill 1982, Woodward et al. 1985, Baker and Hill 2003). Tracts of bottomland hardwood timber up to several thousand acres in size may be lost to beaver activity (Miller and Yarrow 1994). Timber damage caused by beaver in the southeastern United States has been estimated at $2.2 million annually in Mississippi (Arner and Dubose 1982), $2.2 million in Alabama (Hill 1976), $45 million in Georgia (Godbee and Price 1975), and $14.5 million in Louisiana in 1993 (Fowler et al. 1994).

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

Beaver often inhabit sites in or adjacent to urban/suburban areas and cut or girdle trees and shrubs in yards, undermine yards and walkways by burrowing, flood homes and other structures, destroy pond and reservoir dams by burrowing into levees, gnaw on boat houses and docks, and cause other damage to private and public property (Wade and Ramsey 1986). Additionally, impounded water may damage roads

and railroads by saturating roadbeds or railroad beds. Burrowing by beaver, muskrats, and nutria can comprise the banks of roadbeds and railroad beds.

Their burrowing activities can also pose risks to earthen dams that retain water (Federal Emergency Management Agency 2005). The burrowing activities of muskrats likely caused the failure of a levee holding back floodwaters along the Mississippi River. The muskrat burrows likely weakened the structure and caused the levee to collapse (Caudell 2008). In addition, aircraft have struck beaver and muskrats at air facilities in the United States (Dolbeer et al. 2014) and strikes could occur at air facilities in the State.

Damage caused by muskrats is usually not a major problem, but can be important in some situations (Wade and Ramsey 1986), such as in aquaculture systems or when burrowing into earthen embankments. Economic loss is often associated with muskrat feeding and burrowing into banks, dikes, levees, shorelines, and dams associated with ponds, lakes, and drainages (Perry 1982, Miller 1994, Linzey 1998). In some states, damage may be as much as $1 million per year (Miller 1994). Elsewhere, economic losses caused by muskrats may be limited and confined primarily to burrowing or feeding on desirable plants in farm ponds. In such areas, the cost of the damage can often outweigh the benefits of having a muskrat population present in the pond.

Burrowing activity of muskrats can seriously weaken dams and levees (Perry 1982) causing them to leak or collapse. Loss of water from irrigated areas or flooding may lead to loss of crops (Wade and Ramsey 1986). Entrances to burrows are normally underwater and may not be evident until serious damage has occurred. Associated burrows and dens can erode along the shorelines of lakes and create washouts of associated properties when they collapse, posing a hazard to humans, livestock, and equipment used on site.

Nutria can also burrow into the foam floatation under boat docks and wharves, causing these structures to lean and sink. Nutria burrow under buildings, which may lead to uneven settling or failure of the foundations. Burrows can weaken roadbeds, railroad beds, stream banks, dams, and dikes, which may collapse when rain or high water saturate the soil or when subjected to heavy objects on the surface (*e.g.*, vehicles, farm machinery, or grazing livestock). Rain and wave action can wash out and enlarge collapsed burrows, which can intensify the damage. Nutria girdle fruit, nut, and shade trees and ornamental shrubs. They also dig up lawns and golf courses when feeding on the tender roots and shoots of sod grasses. Gnawing damage to wooden structures is also common. Nutria feed on valuable wetland vegetation and cultivated crops such as sugar cane and rice (Wade and Ramsey 1986). Nutria may feed on the bark of trees, such as black willow (*Salix nigra*) and bald cypress (*Taxodium distichum*), in winter months when more preferred herbaceous vegetation is dormant.

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

1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

Actions Analyzed

This EA documents the need for managing damage caused by aquatic rodents, the issues associated with meeting that need, and alternative approaches to address those issues and to meet the need for action. WS mission is to provide federal leadership with managing damage and threats of damage associated with wildlife (see WS Directive 1.201). WS would only provide assistance when the appropriate property manager or property owner requested WS' assistance. WS could receive a request for assistance from a

property owner or manager to conduct activities on property they own or manage, which could include federal, state, tribal, municipal, and private land within the State of Oklahoma.

Appendix B of this EA discusses the methods available for use or recommendation under each of the alternative approaches evaluated[6]. The alternatives and Appendix B also discuss how WS and other entities could recommend or employ methods to manage damage and threats associated with aquatic rodents in the State. Therefore, the actions evaluated in this EA are the use or recommendation of those methods available under the alternatives and the employment or recommendation of those methods by WS to manage or prevent damage and threats associated with aquatic rodents from occurring when requested by the appropriate resource owner or manager. WS' activities that could involve the lethal removal of target aquatic rodent species under the alternatives, would only occur when agreed upon by the requester, and when permitted by State and local law, and only at levels agreeable to the ODWC.

Federal, State, County, City, and Private Lands

WS could continue to provide damage management activities on federal, state, county, municipal, and private land in Oklahoma when WS receives a request for such services by the appropriate resource owner or manager. In those cases where a federal agency requests WS' assistance with managing damage caused by aquatic rodents on property they own or manage, the requesting agency would be responsible for analyzing those activities in accordance with the NEPA. However, this EA could cover such actions if the requesting federal agency determined the analyses and scope of this EA were appropriate for those actions and the requesting federal agency adopted this EA through their own Decision based on the analyses in this EA. Therefore, the scope of this EA analyzes actions that could occur on federal lands, when requested.

Native American Lands and Tribes

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

Period for which this EA is Valid

If the preparation of an Environmental Impact Statement (EIS) is not warranted based on the analyses associated with this EA, WS would conduct reviews of activities conducted under the selected alternative to ensure those activities occurred within the parameters evaluated in this EA. This EA would remain valid until WS, in consultation with the ODWC, determined that new needs for action, changed

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

conditions, new issues, or new alternatives having different environmental impacts must be analyzed. At that time, WS would supplement this analysis or conduct a separate evaluation pursuant to the NEPA. Under the alternative analyzing no involvement by WS, no review or additional analyses would occur based on the lack of involvement by WS. The monitoring of activities by WS would ensure the EA remained appropriate to the scope of damage management activities conducted by WS in Oklahoma under the selected alternative, when requested.

Site Specificity

As mentioned previously, WS would only conduct damage management activities when requested by the appropriate resource owner or manager. In addition, WS' activities that could involve the lethal removal of aquatic rodents under the alternatives would only occur when agreed upon by the requester, and when permitted by State and local law, and only at levels agreeable to the ODWC.

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

Those aquatic rodent species addressed in this EA may occur statewide and throughout the year in the State; therefore, damage or threats of damage could occur wherever those aquatic rodents occur. Planning for the management of aquatic rodent damage must be viewed as being conceptually similar to the actions of other entities whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they would occur are unknown but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire departments, police departments, emergency clean-up organizations, and insurance companies. Although WS could predict some locations where aquatic rodent damage would occur, WS could not predict every specific location or the specific time where such damage would occur in any given year. In addition, the threshold triggering an entity to request assistance from WS to manage damage associated with aquatic rodents is often unique to the individual; therefore, predicting where and when WS would receive such a request for assistance would be difficult. This EA emphasizes major issues as those issues relate to specific areas whenever possible; however, many issues apply wherever aquatic rodent damage and the resulting management actions occurs and are treated as such.

Chapter 2 of this EA identifies and discusses issues relating to managing damage caused by aquatic rodents in Oklahoma. The standard WS Decision Model (Slate et al. 1992; see WS Directive 2.201) would be the site-specific procedure for individual actions that WS could conduct in the State (see Chapter 3 for a description of the Decision Model and its application). Decisions made using the model would be in accordance with WS' directives and Standard Operating Procedures (SOPs) described in this EA, as well as relevant laws and regulations in accordance with WS Directive 2.210. The analyses in this EA would apply to any action that may occur in any locale and at any time within Oklahoma. In this way, WS believes it meets the intent of the NEPA with regard to site-specific analysis and that this is the only practical way for WS to comply with the NEPA and still be able to accomplish its mission.

Summary of Public Involvement

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

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

1.4 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS

***Aquatic Rodent Damage Management EAs*:** WS and the ODAFF previously developed EAs that analyzed the need for action to manage damage associated with aquatic rodents for the East and West Districts of the WS program in Oklahoma. Changes in the need for action, the affected environment, and internal changes in District boundaries have prompted WS and the ODAFF to initiate this new analysis to address damage management activities in the State. This EA will address more recently identified changes and will assess the potential environmental impacts of program alternatives based on a new need for action, primarily a need to address damage and threats of damage associated with aquatic rodents, and changes in State laws in regard to managing aquatic rodent damage. Since this EA will re-evaluate activities conducted under the previous EAs to address the new need for action and the associated affected environment, the analysis and the outcome of the Decision issued based on the analyses in this EA will supersede the previous EAs that addressed aquatic rodent damage management.

1.5 AUTHORITY OF FEDERAL AND STATE AGENCIES

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

WS' Legislative Authority

The primary statutory authority for the WS program is the Act of March 2, 1931 (46 Stat. 1468; 7 USC 426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 426c). The WS program is the lead federal authority in managing damage to agricultural resources, natural resources, property, and threats to human safety associated with animals. WS' directives define program objectives and guide WS' activities when managing damage.

Authority of the United States Fish and Wildlife Service

The United States Fish and Wildlife (USFWS) is the primary federal agency responsible for conserving, protecting, and enhancing the nation's fish and wildlife resources and their habitats. The USFWS mission is to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people. Responsibilities are shared with other federal, state, tribal, and local entities.

However, the USFWS has specific responsibilities for the protection of threatened and endangered (T&E) species under the Endangered Species Act (ESA), migratory birds, inter-jurisdictional fish, and certain marine mammals, as well as for lands and waters that the USFWS administers for the management and protection of those resources, such as the National Wildlife Refuge System. Under 50 CFR 30.11, feral animals without ownership that have reverted to the wild from a domestic state may be taken by authorized federal or state personnel or by private persons operating under permit in accordance with applicable provisions of federal or state law or regulation on National Wildlife Refuges.

United States Environmental Protection Agency (EPA)

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

Oklahoma Department of Agriculture, Food and Forestry

The ODAFF is authorized by Title 2, O.S.2001,§12-1, A, to independently enter into cooperative agreements for the purpose of "*…conducting wildlife damage management for…other wildlife species causing destruction to livestock, poultry, crops, range land, forests and other resources, including human health and safety*". It further states that "*Wildlife damage management of …other wildlife species causing damage shall include but not be limited to hunting, trapping, or other practical methods for the control of wildlife damage*." These wildlife damage management authorizations are carried out through the ODAFF Wildlife Services Division who also conducts wildlife damage management activities statewide, and by cooperation with WS through a Memorandum of Understanding (MOU).

Oklahoma Department of Wildlife Conservation

The ODWC has the responsibility to manage all protected and classified wildlife in Oklahoma, except federally listed T&E species, regardless of the land class on which the animals are found (Title 29, §5-412, 412.1). The ODWC is authorized to cooperate with WS and ODAFF for wildlife damage management (ORS Title 29, §3-103,105, §4-135). A MOU with WS and ODAFF Wildlife Services further defines this level of cooperation.

Oklahoma State Department of Health

The Oklahoma State Department of Health has the authority to enter into an agreement with WS for conducting wildlife damage management for the protection of human health from wildlife threats.

1.6 COMPLIANCE WITH LAWS AND STATUTES

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

National Environmental Policy Act

All federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.). WS follows the CEQ regulations implementing the NEPA (40 CFR 1500 et seq.) along with the USDA (7 CFR 1b) and

the APHIS implementing guidelines (7 CFR 372) as part of the decision-making process. Those laws, regulations, and guidelines generally outline five broad types of activities that federal agencies must accomplish as part of any project: public involvement, analysis, documentation, implementation, and monitoring. The NEPA also sets forth the requirement that all major federal actions be evaluated in terms of their potential to significantly affect the quality of the human environment for the purpose of avoiding or, where possible, mitigating and minimizing adverse impacts. In part, the CEQ, through regulations in 40 CFR, Parts 1500-1508, regulate federal activities that could affect the physical and biological environment. In accordance with regulations of the CEQ and the USDA, the APHIS has published guidelines concerning the implementation of the NEPA (see 44 CFR 50381-50384).

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

Endangered Species Act (ESA)

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 consultations with the USFWS pursuant to Section 7 of the ESA to ensure that "*any action authorized... funded or carried out by such an agency . . . is not likely to jeopardize the continued existence of any endangered or threatened species . . . Each agency will use the best scientific and commercial data available*" (Sec.7 (a)(2)). Evaluation of the alternatives in regards to the ESA will occur in Chapter 4 of this EA.

Federal Insecticide, Fungicide, and Rodenticide Act

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

National Historic Preservation Act (NHPA) of 1966, as amended

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

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

The Native American Graves and Repatriation Act of 1990

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

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

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

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

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

Animal Medicinal Drug Use Clarification Act of 1994

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

Section 404 of the Clean Water Act

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

Section 401 of the Clean Water Act

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

Food Security Act

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

Flood Plain Management – Executive Order 11988

Executive Order 11988 requires federal agencies to avoid to the extent possible the long and short-term adverse effects associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "*each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities*".

Protection of Wetlands – Executive Order 11990

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

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

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

WS would use only legal, effective, and environmentally safe damage management methods, tools, and approaches. The EPA through the FIFRA, the ODAFF, the United States Drug Enforcement Administration, MOUs with land managing agencies, and WS' Directives would regulate chemical methods that could be available for use by WS pursuant to the alternatives. WS would properly dispose

of any excess solid or hazardous waste. WS does not anticipate the alternatives would result in any adverse or disproportionate environmental impacts to minority and low-income persons or populations. In contrast, the alternatives may benefit minority or low-income populations by reducing threats to public health and safety and property damage.

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

Children may suffer disproportionately for many reasons from environmental health and safety risks, including the development of their physical and mental status. WS 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 this proposal might have on children. The proposed activities would occur by using only legally available and approved methods where it is highly unlikely that activities conducted pursuant to the alternatives would adversely affect children. For these reasons, WS and the ODAFF conclude that it would not create an environmental health or safety risk to children from implementing the alternatives. Additionally, the need for action identified a need to reduce threats to human safety, including risks to children; therefore, cooperators could request WS' assistance with reducing threats to the health and safety of children posed by aquatic rodents.

Invasive Species - Executive Order 13112

Executive Order 13112 establishes guidance for federal agencies to use their programs and authorities to prevent the spread or to control populations of invasive species that cause economic or environmental harm or harm to human health. The Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law: 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations and provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education of invasive species. Pursuant to Executive Order 13112, the National Invasive Species Council has designated the nutria as meeting the definition of an invasive species. Lowe et al. (2000) ranked nutria as one of the 100 worst invasive species in the world.

Title 29, Oklahoma Statutes

Title 29 is the Game and Fish Laws for the State of Oklahoma. These Statutes establishes the State Wildlife Commission and gives ODWC management authority of the wildlife of the state, including aquatic rodents. Title 29 establishes important guidelines established by the legislature, to include wildlife definitions, methods of take, other conditions, and any exemptions.

Oklahoma Explosives and Blasting Regulation Act

In Oklahoma, the permitting and use of explosives is outlined in the Oklahoma Explosives and Blasting Regulation Act (Title 63 O.S.). This law is regulated by the Oklahoma Department of Mines.

1.7 DECISIONS TO BE MADE

Based on agency relationships, MOUs, and legislative authorities, WS is the lead agency for this EA, and therefore, responsible for the scope, content, and decisions made. As the authority for the management of aquatic rodent populations in the State, the ODWC was involved in the development of the EA and provided input throughout the EA preparation process to ensure an interdisciplinary approach according to the NEPA and agency mandates, policies, and regulations. The ODWC is responsible for managing wildlife in the State of Oklahoma, including those aquatic rodents addressed in this EA. The ODWC

establishes and enforces regulated hunting and trapping seasons in the State. WS' activities to reduce and/or prevent aquatic rodent damage in the State would be coordinated with the ODWC, which would ensure the ODWC has the opportunity to incorporate any activities WS' conducts into population objectives established for aquatic rodent populations in the State, or other concerns.

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

- Should WS conduct aquatic rodent damage management to alleviate damage when requested?
- Should WS conduct disease surveillance and monitoring in aquatic rodent populations when requested?
- Should WS implement an integrated methods approach, including technical assistance and direct operational assistance, to meet the need for action in Oklahoma?
- If not, should WS attempt to implement one of the alternatives to an integrated methods strategy?
- Would the proposed action or the other alternatives result in significant effects to the environment requiring the preparation of an EIS?

CHAPTER 2: AFFECTED ENVIRONMENT AND ISSUES

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

2.1 AFFECTED ENVIRONMENT

Beaver, nutria, and muskrats are semi-aquatic species that are closely associated with aquatic habitats. Those aquatic rodent species addressed in this EA are capable of utilizing a variety of aquatic habitats in the State. Those aquatic rodents addressed in this EA may occur throughout the year across the State where suitable aquatic habitat exists for foraging and shelter. Damage or threats of damage caused by those aquatic rodent species could occur statewide in Oklahoma wherever those aquatic rodents occur. However, damage management would only be conducted by WS when requested by a landowner or manager and only on properties where a MOU, work initiation document, or another comparable document were signed between WS and a cooperating entity.

The ideal beaver habitat consists of ponds, small lakes with muddy bottoms, and meandering streams, but can consist of artificial ponds, reservoirs, and drainage ditches that contain nearby food sources (Novak 1987). In the southern United States, beaver eat a large variety of woody foods, including loblolly pine (*Pinus taeda*), sweet gum (*Liquidambar styraciflua*), southern sweetbay (*Magnolia virginiana*), and spruce pine (*Pinus glabra*). The analysis of beaver stomach contents in Mississippi identified 42 species of trees, 36 genera of herbaceous plants, 4 types of woody vines, and many species of grass (Graminae) (Roberts and Arner 1984). Some of the common forbs eaten by beaver across the southern United States includes rice cutgrass (*Leersia oryzoides*), golden club (*Orontium aquaticum*), switchgrass (*Arundinaria tecta*), poison ivy (*Toxicodendron radicans*), soybean (*Glycine max*), and pondweed (*Potamogeton* spp.) (Novak 1987). In Oklahoma, beaver occur throughout the State where suitable aquatic habitats are available. Primary food sources of beaver in Oklahoma are cottonwood (*Populus deltoids*) and willow (*Salix* spp.) trees, along with Johnson grass (*Sorghum halepense*) roots but they will consume almost any type of bark, bud, root, and leaf (ODWC 2015).

The habitat requirements of muskrats are extremely flexible but they must have a source of permanent water and a protected area for shelter and raising young, such as a lodge built of vegetation or a den burrowed into banks (Boutin and Birkenholz 1997). Muskrats are scattered in suitable habitat throughout

the State inhabiting creeks, rivers, lakes, ponds, coastal marshes, and drainage ditches. Muskrats prefer areas with a steady water level and feed primarily on cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), and other aquatic grasses in freshwater marshes.

Nutria and muskrats have similar habitat requirements and generally, consist of areas with a source of permanent water and sufficient aquatic plant communities. Nutria occur along rivers, lakes, lagoons, marshes, and swamp areas with freshwater plant communities (Kinler et al. 1987). In Oklahoma, nutria are found in the far southeastern portion of the State (Tackett 2009).

Oklahoma encompasses 69,899 square miles (44.7 million acres), which consists of 68,603 square miles (43.9 million acres) of land area and 1,296 square miles (829,400 acres) of water (United States Census Bureau 2010). Upon receiving a request for assistance, WS could conduct activities to reduce aquatic rodent damage or threats of damage on federal, state, tribal, municipal, and private properties in Oklahoma. Areas where damage or threats of damage could occur include, but would not be limited to agricultural fields, vineyards, orchards, farmyards, dairies, ranches, livestock operations, aquaculture facilities, fish hatcheries, grain mills, grain handling areas, railroad yards, waste handling facilities, industrial sites, natural resource areas, park lands, and historic sites; state and interstate highways and roads; railroads, railroad beds, and their right-of-ways; property in or adjacent to subdivisions, businesses, and industrial parks; timberlands, croplands, and pastures; private and public property where burrowing aquatic rodents cause damage to structures, dams, dikes, ditches, ponds, and levees; public and private properties in rural/urban/suburban areas where aquatic rodents cause damage to landscaping and natural resources, property, and are a threat to human safety through the spread of disease. The area would also include airports and military airbases where aquatic rodents were a threat to human safety and to property; areas where aquatic rodents negatively affect wildlife, including T&E species; and public property where aquatic rodents were negatively affecting historic structures, cultural landscapes, and natural resources. Chapter 4 also contains additional information on the affected environment.

Environmental Status Quo

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

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

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

management action directed towards aquatic rodents should occur and even the particular methods that should be used, WS' involvement in the action would not affect the environmental status quo since the entity could take the action in the absence of WS' involvement. WS' involvement would not change the environmental status quo if the requester had conducted the action in the absence of WS' involvement in the action.

A non-federal entity could lethally remove aquatic rodents to alleviate damage without the need for a permit when those species are non-native or are unregulated by the ODWC. In addition, other entities could remove aquatic rodents to alleviate damage during the hunting and/or trapping season, and/or through the issuance of permits by the ODWC. In addition, most methods available for resolving damage associated with aquatic rodents would also be available for use by other entities. Therefore, WS' decision-making ability would be restricted to one of three alternatives. WS could take the action using the specific methods as decided upon by the non-federal entity, provide technical assistance only, or take no action. If WS' takes no action, another entity could take the action anyway using the same methods without the need for a permit, during the hunting or trapping season, or through the issuance of a permit by the ODWC. Under those circumstances, WS would have virtually no ability to affect the environmental status quo since the action would likely occur in the absence of WS' direct involvement.

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

2.2 ISSUES ASSOCIATED WITH AQUATIC RODENT DAMAGE MANAGEMENT

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

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

Issue 1 - Effects of Damage Management Activities on Target Aquatic Rodent Populations

A common issue when addressing damage caused by wildlife are the potential impacts of management actions on the populations of target species. Lethal and non-lethal methods would be available to resolve wildlife damage or threats to human safety.

Non-lethal methods could disperse or otherwise make an area unattractive to target species, which could reduce the presence of those species at the site and potentially the immediate area around the site where an entity employed those methods. Employing lethal methods could remove a single aquatic rodent or those aquatic rodents responsible for causing damage or posing threats to human safety. Therefore, the use of lethal methods could result in local population reductions in the area where damage or threats were occurring. The number of individual animals from a target species that WS could remove from the population using lethal methods would be dependent on the number of requests for assistance received, the number of individual aquatic rodents involved with the associated damage or threat, and the efficacy of methods employed.

The analysis will measure the number of individual animals lethally removed in relation to that species abundance to determine the magnitude of impact to the populations of those species from the use of lethal methods. Magnitude may be determined either quantitatively or qualitatively. Determinations based on population estimates, allowable harvest levels, and actual harvest data would be quantitative. Determinations based on population trends and harvest trend data, when available, would be qualitative.

In addition, many of the aquatic rodent species addressed in this EA can be harvested in the State during annual hunting and/or trapping seasons and can be addressed using available methods by other entities in the State when those species cause damage or pose threats of damage when permitted by the ODWC, when required. Therefore, any damage management activities conducted by WS under the alternatives addressed would be occurring along with other natural processes and human-induced events, such as natural mortality, human-induced mortality from private damage management activities, damage management activities from other agencies, counties, or municipal governments, mortality from regulated harvest, and human-induced alterations of wildlife habitat.

Under certain alternatives, WS could employ methods available to resolve damage and reduce threats to human safety that target an individual animal of an aquatic rodent species or a group of animals after applying the WS Decision Model (Slate et al. 1992; see WS Directive 2.201) to identify possible techniques. Chapter 4 analyzes the effects on the populations of target aquatic rodent populations in the State from implementation of the alternatives addressed in detail, including the proposed action. Information on aquatic rodent populations and trends are often available from several sources including the fur harvest reports, damage complaints, ground surveys, aerial surveys, and published literature.

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

The issue of non-target species effects, including effects on T&E species, arises from the use of non-lethal and lethal methods identified in the alternatives. The use of non-lethal and lethal methods has the potential to inadvertently disperse, capture, or kill non-target wildlife. Appendix B describes the methods available for use under the alternatives.

There are also concerns about the potential for adverse effects to occur to non-target wildlife from the use of chemical methods. Chemical methods that would be available for use to manage damage or threats associated with those aquatic rodent species addressed in this EA include immobilizing drugs, euthanasia chemicals, and taste repellents. Chapter 4 and Appendix B further discuss those chemical methods available for use to manage damage and threats associated with aquatic rodents in Oklahoma.

The ESA states that all federal agencies *"...shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the Act"* [Sec. 7(a)(1)]. WS conducts consultations with the USFWS pursuant to Section 7 of the Act to ensure compliance with the ESA. Consultations are also conducted to ensure that *"any action authorized, funded or carried out by such an agency...is not likely to jeopardize the continued existence of any endangered or threatened species…Each agency shall use the best scientific and commercial data available"* [Sec. 7(a)(2)]. Chapter 4 discusses the potential effects of the alternatives on T&E species and interagency cooperation between WS and the USFWS concerning the ESA.

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

An additional issue often raised is the potential risks to human safety associated with employing methods to manage damage caused by target species. Both chemical and non-chemical methods have the potential to have adverse effects on human safety. WS' employees could use and recommend only those methods that were legally available under each of the alternatives. Still, some concerns exist regarding the safety

of methods available despite their legality and selectivity. As a result, this EA will analyze the potential for proposed methods to pose a risk to members of the public. In addition to the potential risks to the public associated with the methods available under each of the alternatives, risks to WS' employees would also be an issue. Injuries to WS' employees could occur during the use of methods, as well as subject to workplace accidents. Selection of methods, under the alternatives, would include consideration for public and employee safety.

The issue of using chemical methods as part of managing damage associated with wildlife relates to the potential for human exposure either through direct contact with the chemical or exposure to the chemical from wildlife that have been exposed. Under the alternatives identified, the use or recommendation of chemical methods could include immobilizing drugs, euthanasia chemicals, and repellents. The EPA through the FIFRA and the ODAFF would regulate pesticide use. The United States Drug Enforcement Administration and the United States Food and Drug Administration would regulate immobilizing drugs and euthanasia chemicals. In addition, the use of all chemical methods by WS would be subject to Oklahoma laws and WS' Directives.

Immobilizing drugs that could be available include ketamine and Telazol, which are anesthetics (*i.e.*, general loss of pain and sensation) used during the capture of wildlife to eliminate pain, calm fear, and reduce anxiety in wildlife when handling and transporting wildlife. Xylazine is a sedative that wildlife professionals often use in combination with ketamine to calm nervousness, irritability, and excitement in wildlife during the handling and transporting of wildlife. Euthanasia chemicals could include sodium pentobarbital, and potassium chloride, all of which WS would administer after anesthetizing an animal.

Currently, there are no chemical repellents registered specifically for aquatic rodents in the State. Repellents often contain different active ingredients with most ingredients occurring naturally in the environment. The most common ingredients of repellents are coyote urine, putrescent whole egg solids, capsaicin, or sand (Silica) mixed with a non-toxic carrier for application to surfaces. Repellents for aquatic rodents are not generally restricted-use products; therefore, a person does not need a pesticide applicators license to purchase or apply those products. People generally apply repellents directly to affected resources, which elicits an adverse taste or texture response when the target animal ingests the treated resource or the ingestion of the repellent causes temporary sickness (*e.g.*, nausea). Products containing coyote urine or other odors associated with predatory wildlife are intended to elicit a fright response in target wildlife by imitating the presence of a predatory animal (*i.e.*, wildlife tend to avoid areas where predators are known to be present). If repellents were registered for use in the State to reduce damage caused by aquatic rodents, WS could employ or recommend for use those repellents that were available (*i.e.*, registered with the EPA pursuant to the FIFRA and registered with the ODAFF).

Another concern would be the potential for immobilizing drugs used in animal capture and handling to cause adverse health effects in people that hunt or trap and consume the species involved. Among the species that WS could capture and handle under the proposed action, this issue would be a primary concern for wildlife species that people hunt and consume as food.

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

Most methods available to alleviate damage and threats associated with aquatic rodents would be non-chemical methods. Non-chemical methods may include cultural methods, limited habitat modification, animal behavior modification, and other mechanical methods. Changes in cultural methods could include

changes in crop rotations or conducting structural repairs. Limited habitat modification would be practices that alter specific characteristics of a localized area, such as removing bushes to eliminate food or shelter locations or planting vegetation that was less palatable to certain aquatic rodent species. Animal behavior modification methods would include those methods designed to disperse aquatic rodents from an area through harassment or exclusion. Behavior modification methods could include pyrotechnics, propane cannons, barriers, electronic distress calls, effigies, Mylar tape, and lasers. Exclusion or barriers may be the wrapping the trunks of desirable trees with woven wire or other material, barrier fencing, or electric fencing. Other mechanical methods could include cage traps, foothold traps, body-gripping traps, cable restraints, shooting, or the recommendation that hunters and/or trappers reduce a local population of aquatic rodents during the hunting and/or trapping seasons.

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

Another concern is the threat to human safety from not employing methods or not employing the most effective methods to reduce the threats that aquatic rodents can pose. The need for action in Chapter 1 addresses the risks to human safety from diseases associated with certain aquatic rodent populations. The low risk of disease transmission from aquatic rodents does not lessen the concerns of cooperators requesting assistance to reduce threats from zoonotic diseases. Increased public awareness of zoonotic events has only heightened the concern of direct or indirect exposure to zoonoses. Not adequately addressing the threats associated with potential zoonoses could lead to an increase in incidences of injury, illness, or loss of human life.

Additional concerns occur when inadequately addressing threats to human safety associated with aircraft striking aquatic rodents at airports in the State. Between 1990 and 2013, civil aircraft have at least struck 2 beaver and 25 muskrats at airports in the United States (Dolbeer et al. 2014). Although aircraft strikes involving aquatic rodents occur rarely, aquatic rodents have the potential to cause damage to aircraft, which can threaten the safety of passengers. Limiting or preventing the use of certain methods to address the potential for aircraft striking aquatic rodents could lead to higher risks to passenger safety. Chapter 4 further evaluates those concerns in relationship to the alternatives.

Issue 4 - Effects on the Aesthetic Values of Aquatic Rodents

One issue is the concern that the proposed action or the other alternatives would result in the loss of aesthetic benefits of target aquatic rodents to the public, resource owners, or neighboring residents. People generally regard wildlife 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. Aesthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics is truly subjective in nature, dependent on what an observer regards as beautiful.

The human attraction to animals likely started when people began domesticating animals. The public today share a similar bond with animals and/or wildlife in general and in modern societies, a large percentage of households have indoor or outdoor pets. However, some people may consider individual wild animals and aquatic rodents as "*pets*" or exhibit affection toward those animals, especially people who enjoy viewing wildlife. Therefore, the public reaction can be variable and mixed to wildlife damage

management because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to manage conflicts/problems between people and wildlife.

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

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

Public attitudes toward wildlife vary considerably. Some people believe that WS should capture and translocate all animals to another area to alleviate damage or threats those animals pose. In some cases, people directly affected by wildlife strongly support removal. Individuals not directly affected by the harm or damage may be supportive, neutral, or totally opposed to any removal of wildlife from specific locations or sites. Some people totally opposed to wildlife damage management want WS to teach tolerance for damage and threats caused by wildlife, and that people should never kill wildlife. Some of the people who oppose removal of wildlife do so because of human-affectionate bonds with individual wildlife. Those human-affectionate bonds are similar to attitudes of a pet owner and result in aesthetic enjoyment.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

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

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

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

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

Pain and suffering, as it relates to methods available for use to manage aquatic rodents has both a professional and lay point of arbitration. Wildlife managers and the public must recognize the complexity of defining suffering, since "*…neither medical nor veterinary curricula explicitly address suffering or its relief*" (California Department of Fish and Game 1991). Research suggests that with some methods (*e.g.*, foothold trap) changes in the blood chemistry of trapped animals indicate the existence of some level of "*stress*" (Kreeger et al. 1988). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness (Bateson 1991, Sharp and Saunders 2008, Sharp and Saunders 2011).

The decision-making process involves tradeoffs between the above aspects of pain and humaneness. Therefore, humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently. The challenge in coping with this issue is how to achieve the least amount of animal suffering. Chapter 4 further discusses the issue of humaneness and animal welfare. Chapter 3 discusses SOPs intended to alleviate pain and suffering.

Issue 6 - Effects of Damage Management Activities on the Regulated Harvest of Aquatic Rodents

Another issue commonly identified is a concern that damage management activities conducted by WS would affect the ability of persons to harvest those species during the regulated hunting and trapping seasons either by reducing local populations through the lethal removal of aquatic rodents or by reducing the number of aquatic rodents present in an area through dispersal techniques.

Potential impacts could arise from the use of non-lethal or lethal damage management methods. Non-lethal methods used to alleviate damage caused by those aquatic rodent species could reduce aquatic rodent densities through dispersal in areas where damage or the threat of damage was occurring. Similarly, lethal methods used to reduce damage associated with those aquatic rodents could lower densities in areas where damage was occurring resulting in a reduction in the availability of those species during the regulated harvest season. The use of non-lethal or lethal methods often disperses aquatic rodents from areas where damage was occurring to areas outside the damage area, which could serve to move those aquatic rodent species from those less accessible areas to places accessible to hunters.

Issue 7 – Effects of Beaver Removal and Dam Manipulation on the Status of Wetlands in the State

Wetlands are a valuable component of land-based ecosystems that provide numerous direct and indirect benefits to people and wildlife (*e.g.*, see Costanza et al. 1997, Millennium Ecosystem Assessment 2005). Between the 1780s and the 1980s, Dahl (1990) estimated 53% of the original wetland acres in the lower 48 states were lost, primarily from human development. Over that 200-year time span, Dahl (1990) estimated the wetland acres in Oklahoma decreased from 2,842,600 acres to 949,700 acres, which represents a 67% decline. Beaver, through their building of dams and impounding water can have a unique role in establishing wetlands that not only provide benefit to the beaver, but to people and other wildlife. Wildlife professionals often consider beaver a "*keystone*" species for their ability to manipulate

and create their own habitats, which can also provide benefits to other wildlife and people. Beaver may also be an inexpensive way of restoring wetlands or creating new wetlands (*e.g.*, see Hey 1995, Muller-Schwarze and Sun 2003, Buckley et al. 2011).

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

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

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

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

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

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

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

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

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

The appropriateness of preparing an EA instead of an EIS was a concern WS identified during the scoping process. Wildlife damage management falls within the category of actions in which the exact timing or location of individual activities can be difficult to predict well enough ahead of time to describe accurately such locations or times in an EA or even an EIS. Although WS could predict some of the possible locations or types of situations and sites where some kinds of wildlife damage would occur, the program cannot predict the specific locations or times at which affected resource owners would determine a damage problem had become intolerable to the point that they request assistance from WS. In addition, the WS program would not be able to prevent such damage in all areas where it might occur without resorting to destruction of wild animal populations over broad areas at a much more intensive level than would be desired by most people, including WS and other agencies. Such broad scale population management would also be impractical or impossible to achieve within WS' policies and professional philosophies.

Lead agencies have the discretion to determine the geographic scope of their analyses under the NEPA (Kleppe v Sierra Club, 427 U.S. 390, 414 (1976), CEQ 1508.25). Ordinarily, according to the APHIS procedures implementing the NEPA, WS' individual wildlife damage management actions could be categorically excluded (7 CFR 372.5(c)). The intent in developing this EA has been to determine if the proposed action or the other alternatives could potentially have significant individual and/or cumulative impacts on the quality of the human environment that would warrant the preparation of an EIS. This EA addresses impacts for managing damage and threats to human safety associated with aquatic rodents in the State to analyze individual and cumulative impacts and to provide a thorough analysis.

In terms of considering cumulative effects, one EA analyzing impacts for the entire State would provide a more comprehensive and less redundant analysis than multiple EAs covering smaller areas. If WS made a determination through this EA that the proposed action or the other alternatives could have a significant impact on the quality of the human environment, then WS would publish a notice of intent to prepare an EIS and this EA would be the foundation for developing the EIS. Based on previous requests for assistance, the WS program in Oklahoma would continue to conduct damage management in a very small area of the State where damage was occurring or likely to occur.

WS' Impact on Biodiversity

The WS program does not attempt to eradicate any species of native wildlife in the State. WS operates in accordance with federal and state laws and regulations enacted to ensure species viability. WS would use available methods to target individual aquatic rodents or groups of aquatic rodents identified as causing damage or posing a threat of damage. Any reduction of a local population or group is frequently temporary because immigration from adjacent areas or reproduction replaces the animals removed. As stated previously, WS would only provide assistance under the appropriate alternatives after receiving a request to manage damage or threats. Therefore, if WS provided direct operational assistance under the alternatives, WS would provide assistance on a small percentage of the land area of Oklahoma. In addition, WS would only target those aquatic rodents identified as causing damage or posing a threat. WS would not attempt to suppress wildlife populations across broad geographical areas at such intensity levels for prolonged durations that significant ecological effects would occur. The goal of WS would not

be to manage wildlife populations but to manage damage caused by specific individuals of a species. The management of wildlife populations in the State is the responsibility of the ODWC and activities associated with many of the aquatic rodent species addressed in the EA require authorization from the ODWC. Therefore, those factors would constrain the scope, duration, and intensity of WS' actions under the alternatives.

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

Chapter 4 evaluates the environmental consequences of the alternatives on the populations of target and non-target species based on available quantitative and qualitative parameters. The permitting of lethal removal by the ODWC would ensure cumulative removal levels would occur within allowable levels to maintain species' populations and meet population objectives for each species. Therefore, activities conducted pursuant to any of the alternatives would not adversely affect biodiversity in the State.

A Loss Threshold Should Be Established Before Allowing Lethal Methods

One issue identified through WS' implementation of the NEPA processes is a concern that WS or other entities should establish a threshold of loss before employing lethal methods to resolve damage and that wildlife damage should be a cost of doing business. In some cases, cooperators likely tolerate some damage and economic loss until the damage reaches a threshold where the damage becomes an economic burden. The appropriate level of allowed tolerance or threshold before employing lethal methods would differ among cooperators and damage situations. In addition, establishing a threshold would be difficult or inappropriate to apply to human health and safety situations. For example, aircraft striking aquatic rodents could lead to property damage and could threaten passenger safety if a catastrophic failure of the aircraft occurred because of the strike. Therefore, addressing the threats of wildlife strikes prior to an actual strike occurring would be appropriate.

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 determined that a forest supervisor could establish a need for wildlife damage management if the supervisor could show that damage from wildlife was threatened (Civil No. 92-C-0052A January 20, 1993). Thus, there is judicial precedence indicating that it is not necessary to establish a criterion such as a percentage of loss of a particular resource to justify the need for damage management actions.

Aquatic Rodent Damage Management Should Not Occur at Taxpayer Expense

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

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

Cost Effectiveness of Management Methods

The CEQ does not require a formal, monetized cost benefit analysis to comply with the NEPA. Consideration of this issue is not essential to making a reasoned choice among the alternatives WS is considering. However, the methods determined to be most effective to reduce damage and threats to human safety caused by aquatic rodents and that prove to be the most cost effective would likely receive the greatest application. As part of an integrated approach and as part of the WS Decision Model, evaluation of methods would continually occur to allow for those methods that were most effective at resolving damage or threats to be employed under similar circumstance where aquatic rodents were causing damage or posing a threat. Additionally, management operations may be constrained by cooperator funding and/or objectives and needs. Therefore, the cost of methods can often influence the availability of methods to resolve damage, which can influence the effectiveness of methods. Discussion of cost effectiveness as it relates to the effectiveness of methods occurs in Chapter 4.

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

People experiencing damage caused by aquatic rodents could contact wildlife control agents and private trappers to reduce aquatic rodent damage when deemed appropriate by the resource owner. The ODWC certifies and regulates private individuals who manage wildlife for commercial purposes. People could also requests assistance from the Wildlife Services Division of the ODAFF. In addition, WS could refer persons requesting assistance to agents and/or private individuals under all of the alternatives fully evaluated in the EA.

WS Directive 3.101 provides guidance on establishing cooperative projects and interfacing with private businesses. WS would only respond to requests for assistance received and would not respond to public bid notices. When responding to requests for assistance, WS would inform requesters that other service providers, including private entities, might be available to provide assistance.

Effects from the Use of Lead Ammunition in Firearms

Questions have arisen about the deposition of lead into the environment from ammunition used in firearms to remove aquatic rodents. As described in Appendix B, the lethal removal of aquatic rodents with firearms by WS to alleviate damage or threats could occur using a handgun, rifle, or shotgun. In an ecological risk assessment of lead shot exposure in non-waterfowl birds, ingestion of lead shot was identified as the concern rather than just contact with lead shot or lead leaching from shot in the environment (Kendall et al. 1996).

The removal of aquatic rodents by WS using firearms in the State would occur primarily from the use of rifles. However, WS could employ the use of shotguns or handguns to remove some species. To reduce risks to human safety and property damage from bullets passing through aquatic rodents, the use of firearms would be applied in such a way (*e.g.*, caliber, bullet weight, distance) to ensure the bullet does not pass through aquatic rodents. Aquatic rodents that were removed using firearms would occur within

areas where retrieval of aquatic rodent carcasses for proper disposal is highly likely (*e.g*., at an airport). With risks of lead exposure occurring primarily from ingestion of bullet fragments, the retrieval and proper disposal of aquatic rodent carcasses would greatly reduce the risk of scavengers ingesting lead that carcasses may contain.

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

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

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

A Site Specific Analysis Should be made for Every Location Where Damage Management Would Occur

The underlying intent for preparing an EA is to determine if a proposed action might have a significant impact on the human environment. WS' EA development process is issue driven, meaning issues that were raised during the interdisciplinary process and through public involvement that were substantive,

would be used to drive the analysis and determine the significance of the environmental impacts of the proposed action and the alternatives. Therefore, the level of site specificity must be appropriate to the issues listed.

The issues raised during the scoping process of this EA drove the analysis. In addition to the analysis contained in this EA, WS' personnel use the WS Decision Model (Slate et al. 1992) described in Chapter 3 as a site-specific tool to develop the most appropriate strategy at each location. The WS Decision Model is an analytical thought process used by WS' personnel for evaluating and responding to requests for assistance.

As discussed previously, one EA analyzing impacts for the entire State would provide a more comprehensive and less redundant analysis that allows for a better cumulative impact analysis. If a determination were made through this EA that the alternatives developed to meet the need for action could result in a significant impact on the quality of the human environment, then an EIS would be prepared.

CHAPTER 3: ALTERNATIVES

Chapter 3 contains a discussion of the alternatives that WS and the ODAFF developed to meet the need for action discussed in Chapter 1 and to address the identified issues discussed in Chapter 2. WS and the ODAFF developed the alternatives based on the need for action and issues using the WS Decision model (Slate et al. 1992). The alternatives will receive detailed environmental impacts analysis in Chapter 4 (Environmental Consequences). Chapter 3 also discusses alternatives considered but not analyzed in detail, with rationale. Chapter 3 also discusses the SOPs that WS would incorporate into the relevant alternatives.

3.1 DESCRIPTION OF THE ALTERNATIVES

WS and the ODAFF developed the following alternatives to meet the need for action and address the identified issues associated with managing damage caused by aquatic rodents in the State:

Alternative 1 - Continue the Current Adaptive Integrated Aquatic Rodent Damage Management Program (No Action/Proposed Action)

The proposed action/no action alternative would continue the current implementation of an adaptive integrated approach utilizing non-lethal and lethal techniques, when requested, as deemed appropriate using the WS Decision Model, to reduce damage and threats caused by aquatic rodents in Oklahoma. A major goal of the program would be to resolve and prevent damage caused by aquatic rodents and to reduce threats to human safety. To meet this goal, WS would continue to respond to requests for assistance with, at a minimum, technical assistance, or when funding was available, operational damage management. Funding could occur through federal appropriations or from cooperative funding. The adaptive approach to managing damage associated with aquatic rodents would integrate the use of the most practical and effective methods to resolve a request for damage management as determined by a site-specific evaluation to reduce damage or threats to human safety for each request. WS would provide city/town managers, agricultural producers, property owners, and others requesting assistance with information regarding the use of appropriate non-lethal and lethal techniques.

Under this alternative, WS could respond to requests for assistance by: 1) taking no action, if warranted, 2) providing only technical assistance to property owners or managers on actions they could take to reduce damages caused by aquatic rodents, or 3) providing technical assistance and direct operational assistance to a property owner or manager experiencing damage. The take of the aquatic rodent species

addressed in this EA would occur with consultation with the ODWC to monitor cumulative impacts to meet mutual wildlife management objectives. To meet the need for action, the objectives of this alternative would be to assist all of the people requesting WS' assistance, within the constraints of available funding and workforce.

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

WS would work with those persons experiencing aquatic rodent damage to address those aquatic rodents responsible for causing damage as expeditiously as possible. To be most effective, damage management activities should occur as soon as aquatic rodents begin to cause damage. Once aquatic rodents become familiar with a particular location (*i.e.*, conditioned to an area), dispersing those aquatic rodents or making the area unattractive can be difficult. WS would work closely with those entities requesting assistance to identify situations where damage could occur and begin to implement damage management activities under this alternative as early as possible to increase the likelihood of those methods achieving the level of damage reduction requested by the cooperating entity.

The WS Decision Model would be the implementing mechanism for a damage management program under the proposed action alternative that could be adapted to an individual damage situation. This alternative would allow WS to use the broadest range of methods to address damage or the threat of damage. When WS received a request for direct operational assistance, WS would conduct site visits to assess the damage or threats, would identify the cause of the damage, and would apply the Decision Model described by Slate et al. (1992) and WS Directive 2.201 to determine the appropriate methods to resolve or prevent damage. Discussion of the Decision Model and WS' use of the Model under the proposed action occurs below. In addition, WS would give preference to non-lethal methods when practical and effective (see WS Directive 2.101).

Non-lethal methods that would be available for use by WS under this alternative include, but are not limited to minor habitat modification, behavior modification, lure crops, visual deterrents, live traps, translocation, exclusionary devices, frightening devices, immobilizing drugs, reproductive inhibitors, and chemical repellents (see Appendix B for a complete list and description of potential methods). In addition, WS could remove or breach beaver dams using binary explosives and hand tools. Once the determination was made that removing or breaching a beaver dam was appropriate and the beaver dam could be removed in accordance with the Clean Water Act (see Appendix E), the breaching or removal of the dam could be conducted manually using hand tools or when safe and appropriate, with use of binary explosives. Lethal methods that would be available to WS under this alternative include body-gripping traps, cable restraints, the recommendation of harvest during hunting and/or trapping seasons, euthanasia chemicals, and shooting. Target aquatic rodent species live-captured using non-lethal methods (*e.g.*, live-traps, immobilizing drugs) could be euthanized. In addition, WS could use foothold traps and submersion rods or cables in drowning sets[7]. The lethal control of target aquatic rodents would comply with WS Directive 2.505.

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

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

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

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

Under the proposed action alternative, WS could employ only non-lethal methods when determined to be appropriate for each request for assistance to alleviate damage or reduce threats of damage using the WS Decision Model. In some situations, a cooperating entity has tried to employ non-lethal methods to resolve damage prior to contacting WS for assistance. In those cases, the methods employed by the requester were either unsuccessful or the reduction in damage or threats had not reached a level that was tolerable to the requesting entity. In those situations, WS could employ other non-lethal methods, attempt to apply the same non-lethal methods, or employ lethal methods. In many situations, the implementation of non-lethal methods, such as exclusion-type barriers, would be the responsibility of the requester, which means that, in those situations, the only function of WS would be to implement lethal methods, if determined to be appropriate using the WS Decision Model.

WS could employ lethal methods to resolve damage associated with those aquatic rodents identified by WS as responsible for causing damage or threats to human safety under this alternative[8]; however, WS would only employ lethal methods after receiving a request for the use of those methods. Surveys in North Carolina and Alabama indicated the majority of landowners with beaver damage on their property

[8]The take of some of the aquatic rodent species addressed in this EA could only legally occur under authorization by the ODWC and only at levels authorized, unless those aquatic rodent species are afforded no protection, in which case, no authorization for lethal removal would be required.

that were surveyed desired 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 that occur between property owners and beaver can result in negative effects that often outweigh the benefits of having beaver on an owner's property (Miller and Yarrow 1994). The use of lethal methods could result in local population reductions in the area where damage or threats were occurring since people could remove individual aquatic rodents from the population. WS and other entities often employ lethal methods to reinforce non-lethal methods and to remove aquatic rodents that WS or other entities identify as causing damage or posing a threat to human safety. The number of aquatic rodents removed from the population using lethal methods under the proposed action would be dependent on the number of requests for assistance received, the number of aquatic rodents involved with the associated damage or threat, and the efficacy of methods employed.

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

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

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

Technical Assistance Recommendations

Under the proposed action, WS would provide technical assistance to those persons requesting assistance with managing damage as part of an integrated approach. Technical assistance would occur as described in Alternative 2 of this EA. From FY 2009 through FY 2013, WS provided technical assistance to 11,282 people that involved aquatic rodent damage to agricultural resources, property, natural resources, and threats to human safety statewide (see Table 1.1).

Direct Operational Assistance

Operational damage management assistance would include damage management activities that WS' personnel conducted directly or activities that WS' employees supervised. Initiation of operational damage management assistance could occur when the problem could not be effectively resolved through technical assistance alone and there was a written MOU, work initiation document, or other comparable document signed between WS and the entity requesting assistance. The initial investigation by WS'

personnel would define the nature, history, and extent of the problem; species responsible for the damage; and methods available to resolve the problem. The professional skills of WS' personnel could be required to resolve problems effectively, especially if chemical methods were necessary or if the problems were complex. To meet the need for action, the objective of WS would be to provide direct operational assistance within two weeks of WS receiving a request for such assistance.

Examples of Assistance Provided by WS

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

WS was contacted by a Nowata County landowner with beaver damage concerns. The landowner reported that beaver were responsible for burrowing several large holes into a pond dam on their property. A WS employee responded to the request and verified that beaver were responsible for causing $1,500 worth of damage to the structure. The WS employee used body-gripping traps to remove two beaver causing the damage. The WS employee then provided the landowner with technical assistance on cultural changes that the landowner should employ to prevent future damages to the pond.

WS met with several property owners from a small town in Oklahoma who reported flooding to their homes and storage buildings by beaver. The damage associated with the flooding was estimated at $70,000. One property owner had tried to dig out the beaver dam on several occasions with no success, as the beaver built it back across the drainage ditch each night. A WS employee verified the damage and utilized body-gripping traps to remove several beaver to prevent further flooding.

Educational Efforts

Education is an important element of activities because wildlife damage management is about finding balance and coexistence between the needs of people and needs of wildlife. This is extremely challenging as nature has no balance, but rather is in continual flux. In addition to the routine dissemination of recommendations and information to individuals or organizations, WS provides lectures, courses, and demonstrations to producers, homeowners, state and county agents, colleges and universities, and other interested groups. WS frequently cooperates with other entities in education and public information efforts. Additionally, WS' employees would continue to write technical papers and provide presentations at professional meetings and conferences so that other wildlife professionals and the public are made aware of recent developments in damage management technology, programs, laws and regulations, and agency policies.

Research and Development

The National Wildlife Research Center (NWRC) functions as the research unit of WS by providing scientific information and the development of methods for wildlife damage management, which are effective and environmentally responsible. Research biologists with the NWRC work closely with wildlife managers, researchers, and others to develop and evaluate methods and techniques for managing wildlife damage. Research biologists with the NWRC have authored hundreds of scientific publications and reports based on research conducted involving wildlife and methods.

WS' Decision Making Procedures

The WS Decision Model (see WS Directive 2.201) described by Slate et al. (1992) depicts how WS' personnel would use a thought process for evaluating and responding to damage complaints. WS'

personnel would assess the problem and then evaluate the appropriateness and availability (legal and administrative) of strategies and methods based on biological, economic, and social considerations. Following this evaluation, WS' employees would incorporate methods deemed practical for the situation into a damage management strategy. After WS' employees implemented this strategy, employees would continue to monitor and evaluate the strategy to assess effectiveness. If the strategy were effective, the need for further management would end. In terms of the WS Decision Model, most efforts to resolve wildlife damage consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions, including WS.

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

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

Community-based Decision Making

WS could receive requests for assistance from community leaders and/or representatives. In those situations, the WS program in Oklahoma under this alternative would follow the "*co-managerial*

approach" to solve wildlife damage or conflicts as described by Decker and Chase (1997). Within this management model, WS could provide technical assistance regarding the biology and ecology of aquatic rodents and effective, practical, and reasonable methods available to the local decision-maker(s) to reduce damage or threats. This could include non-lethal and lethal methods. WS and other state and federal wildlife management agencies may facilitate discussions at local community meetings when resources were available. Under this approach, resource owners and others directly affected by aquatic rodent damage or conflicts would have direct input into the resolution of such problems. They may implement management recommendations provided by WS or others, or may request direct operational assistance from WS, other wildlife management agencies, local animal control agencies, or private businesses or organizations.

The community representative(s) and/or decision-maker(s) for the local community would be elected officials or representatives of the communities. The community representative(s) and/or decision-maker(s) who oversee the interests and business of the local community would generally be residents of the local community or appointees that other members of the community popularly elected. This person or persons would represent the local community's interest and make decisions for the local community or bring information back to a higher authority or the community for discussion and decision-making. Identifying the decision-maker for local business communities can be more complex because building owners may not indicate whether the business must manage wildlife damage themselves, or seek approval to manage wildlife from the property owner or manager, or from a governing Board.

Under a community based decision-making process, WS could provide information, demonstration, and discussion on available methods to the appropriate representative(s) of the community and/or community decision-maker(s) that requested assistance, which would help ensure that decisions made by representatives of the community and/or the decision-makers were based on community-based input. WS would only provide direct operational assistance if the local community representative(s) and/or decision-maker(s) requested such assistance and only if the assistance requested was compatible with WS' recommendations.

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

Decision-makers on Private Property

In the case of private property owners, the decision-maker is the individual that owns or manages the affected property. The decision-maker has the discretion to involve others as to what occurs or does not occur on property they own or manage. Therefore, in the case of an individual property owner or manager, the involvement of others and to what degree others were involved in the decision-making process would be a decision made by that individual. WS could provide direct operational assistance

when requested; however, WS would only provide assistance if the requested management actions were in accordance with WS' recommendations.

Decision-makers on Public Property

The decision-maker for local, state, or federal property would be the official responsible for or authorized to manage the public land to meet interests, goals, and legal mandates for the property. WS could provide technical assistance to this person and make recommendations to reduce damage. WS could provide direct operational assistance when requested; however, WS would only provide assistance if the requested management actions were in accordance with WS' recommendations.

Alternative 2 – Aquatic Rodent Damage Management by WS through Technical Assistance Only

Under this alternative, WS would provide those cooperators requesting assistance with technical assistance only. Similar to Alternative 1, WS could receive requests for assistance from community representatives, private individuals/businesses, or from public entities. Technical assistance would provide those cooperators experiencing damage or threats associated with aquatic rodents with information, demonstrations, and recommendations on available and appropriate methods. The implementation of methods and techniques to resolve or prevent damage would be the responsibility of the requester with no direct involvement by WS. In some cases, WS may provide supplies or materials that were of limited availability for use by private entities (*e.g.*, loaning of propane cannons). Technical assistance may be provided through a personal or telephone consultation, or during an on-site visit with the requester. Generally, WS would describe several management strategies to the requester for short and long-term solutions to managing damage. WS would base those strategies on the level of risk, need, and the practicality of their application. WS would use the Decision Model to recommend those methods and techniques available to the requester to manage damage and threats of damage. Those persons receiving technical assistance from WS could implement those methods recommended by WS, could employ other methods not recommended by WS, could seek assistance from other entities, or take no further action.

Under a technical assistance only alternative, WS would recommend an integrated approach similar to the proposed action alternative (Alternative 1) when receiving a request for assistance; however, WS would not provide direct operational assistance under this alternative. WS would give preference to non-lethal methods when practical and effective under this alternative (see WS Directive 2.101). WS would base method and technique recommendations on information provided by the individual(s) seeking assistance using the WS Decision Model. In some instances, wildlife-related information provided to the requester by WS would result in tolerance/acceptance of the situation. In other instances, WS would discuss and recommend damage management options. WS would only recommend or loan those methods legally available for use by the appropriate individual. Similar to Alternative 1, those methods described in Appendix B would be available to those persons experiencing damage or threats associated with aquatic rodents in the State; however, immobilizing drugs and euthanasia chemicals would have limited availability to the public and other entities under this alternative and Alternative 3. Under this alternative, appropriately licensed veterinarians or people under their supervision would be the only entities that could use immobilizing drugs and euthanasia chemicals. Any direct operational assistance would be conducted solely by individuals certified by ODWC for use of body-grip traps, snares, and shooting, harvest by licensed hunters and trappers, and agents with the Wildlife Services Division of the ODAFF under the direction of the State Board of Agriculture.

The WS program in the State regularly provides technical assistance to individuals, organizations, and other federal, state, and local government agencies for managing aquatic rodent damage. Technical assistance would include collecting information about the species involved, the extent of the damage, and previous methods that the cooperator had attempted to resolve the problem. WS would then provide

information on appropriate methods that the cooperator could consider to resolve the damage themselves. Types of technical assistance projects may include a visit to the affected property, written communication, telephone conversations, or presentations to groups such as homeowner associations or civic leagues. Between FY 2009 and FY 2013, WS provided technical assistance to 11,282 people that involved aquatic rodent damage to agricultural resources, property, natural resources, and threats to human safety.

This alternative would place the immediate burden of operational damage management work on the resource owner, other governmental agencies, and/or private businesses. Those persons experiencing damage or were concerned with threats posed by aquatic rodents could seek assistance from other governmental agencies, private entities, or conduct damage management on their own. Those persons experiencing damage or threats could take action using those methods legally available to resolve or prevent aquatic rodent damage as permitted by federal, state, and local laws and regulations or those persons could take no action.

Alternative 3 – No Aquatic Rodent Damage Management Conducted by WS

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

Despite no involvement by WS in resolving damage and threats associated with aquatic rodents in the State, those persons experiencing damage caused by aquatic rodents could continue to resolve damage by employing those methods legally available since the removal of aquatic rodents to alleviate damage or threats could occur despite the lack of involvement by WS. The removal of aquatic rodents by other entities could continue to occur under this alternative. The ODWC could issue permits to individual landowners/managers and their designees to remove aquatic rodents. In addition, a property owner or manager could seek the assistance of a Nuisance Wildlife Control Officer, which the ODWC certifies for the use of body-grip traps, snares, and night shooting. A property owner or manager could also seek the assistance of agents with the Wildlife Services Division of the ODAFF under the direction of the State Board of Agriculture. Licensed hunters and trappers could harvest aquatic rodents during the annual harvest seasons in the State to alleviate damage. Only methods approved by the ODWC or the ODAFF described in Appendix B could be available for use by those persons experiencing damage or threats under this alternative.

Similar to Alternative 2, those methods described in Appendix B would generally be available to those people experiencing damage or threats associated with aquatic rodents in the State; however, immobilizing drugs and euthanasia chemicals would have limited availability to the public and other entities under this alternative. Under this alternative, appropriately licensed veterinarians or people under their supervision would be the only entities that could use immobilizing drugs and euthanasia chemicals.

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

3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

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

Non-lethal Methods Implemented Before Lethal Methods

This alternative would require that WS apply non-lethal methods or techniques described in Appendix B to all requests for assistance to reduce damage and threats to safety from aquatic rodents in the State. If the use of non-lethal methods failed to resolve the damage situation or reduce threats to human safety at each damage situation, WS could employ lethal methods to resolve the request. WS would apply non-lethal methods to every request for assistance regardless of severity or intensity of the damage or threat until deemed inadequate to resolve the request. This alternative would not prevent the use of lethal methods by other entities or by those persons experiencing aquatic rodent damage but would only prevent the use of those methods by WS until WS had employed non-lethal methods.

Those people experiencing damage often employ non-lethal methods to reduce damage or threats prior to contacting WS. Verification of the methods used would be the responsibility of WS. No standard exists to determine requester diligence in applying those methods, nor are there any standards to determine how many non-lethal applications are necessary before the initiation of lethal methods. Thus, WS could only evaluate the presence or absence of non-lethal methods. The proposed action (Alternative 1) and the technical assistance only alternative (Alternative 2) would be similar to a non-lethal before lethal alternative because WS would give preference to the use of non-lethal methods before lethal methods (see WS Directive 2.101). Adding a non-lethal before lethal alternative and the associated analysis would not contribute additional information to the analyses in the EA.

Use of Non-lethal Methods Only by WS

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

In situations where non-lethal methods were impractical or ineffective to alleviate damages, WS could refer requests for information regarding lethal methods to the ODAFF, the ODWC, other agencies, or private businesses or organizations.

Property owners or managers could conduct management using any method that was legal. Property owners or managers might choose to implement WS' non-lethal recommendations, implement lethal methods, or request assistance from the ODAFF, the ODWC, or a private or public entity other than WS. Property owners/managers frustrated by the lack of WS' assistance with the full range of aquatic rodent damage management techniques may try methods not recommended by WS or use illegal methods (*e.g.*, poisons). In some cases, property owners or managers may misuse some methods or use some methods in excess of what was necessary, which could then become hazardous and pose threats to the safety of people and non-target species.

The proposed action, using an integrated damage management approach, incorporates the use of non-lethal methods when addressing requests for assistance. In those instances where non-lethal methods

would effectively resolve damage from aquatic rodents, WS would use or recommend those methods under the proposed action. Since non-lethal methods would be available for use under the alternatives analyzed in detail, this alternative would not add to the analyses. Those persons experiencing damage or threats of damage could lethally remove aquatic rodents under any of the alternatives even if WS was limited to using non-lethal methods only.

Use of Lethal Methods Only by WS

This alternative would require the use of lethal methods only to reduce threats and damage associated with aquatic rodents. However, non-lethal methods can be effective in preventing damage in certain instances. Under WS Directive 2.101, WS must consider the use of non-lethal methods before lethal methods. Non-lethal methods have been effective in alleviating aquatic rodent damage in some cases. For example, exclusion methods can be effective at preventing beaver from chewing on and felling trees. In those situations where damage could be alleviated effectively using non-lethal methods, WS would employ or recommend those methods as determined by the WS Decision Model. Therefore, WS did not consider this alternative in detail.

Live-capture and Translocate Aquatic Rodents Only

Under this alternative, WS would address all requests for assistance using live-capture methods or the recommendation of live-capture methods and WS would translocate all aquatic rodents live-captured. The success of translocation efforts would depend on efficiently capturing the target aquatic rodents causing damage and the existence of an appropriate release site (Nielsen 1988). Aquatic rodents would be live-captured using live-traps to alleviate damage. All aquatic rodents live-captured through direct operational assistance by WS would be translocated. Translocation sites would be identified and have to be approved by the ODWC and/or the property owner where the translocated aquatic rodents would be placed prior to live-capture and translocation. Live-capture and translocation of aquatic rodents could be conducted as part of the alternatives analyzed in detail. However, the translocation of aquatic rodents could only occur under the authority of the ODWC. Therefore, the translocation of aquatic rodents by WS would only occur as directed by the ODWC. When requested by the ODWC, WS could translocate aquatic rodents or recommend translocation under any of the alternatives analyzed in detail, except under the no involvement by WS alternative (Alternative 3). However, other entities could translocate aquatic rodents under Alternative 3, if authorized by the ODWC.

Translocation may be appropriate in some situations when a species population is low. However, aquatic rodents are abundant in much of the suitable habitat in Oklahoma, and translocation is not necessary for the maintenance of viable populations in the State. Because aquatic rodents are abundant in Oklahoma, the aquatic rodents that WS translocated and released into suitable habitat would likely encounter other aquatic rodents with established territories. For example, if WS could translocate beaver, the release of beaver into suitable habitat would likely occur in areas where other beaver already occur. Beaver are territorial, and introducing translocated beaver into new areas often disorientates the beaver because they are unfamiliar with their surroundings. Therefore, translocated beaver are often at a disadvantage. Territorial beaver often viciously attack other beaver that people release or that wander into their territories and those injuries sustained during those attacks oftentimes causes the death of translocated beaver (McNeely 1995). Survival of translocated animals is generally very poor due to the stress of translocation, and in many cases, released animals suffer mortality in a new environment (Craven et al. 1998). Courcelles and Nault (1983) found that 50% (n=10) of radio-collared, relocated beaver died, probably from stress or predation resulting from the relocation.

Relocated beaver also may disperse long distances from the release site (Novak 1987). Hibbard (1958) recorded an average dispersal distance by 17 relocated beaver to be approximately 9 miles in North

Dakota, and Denney (1952) reported an average dispersal of 10.4 miles and a maximum dispersal of 30 miles for 26 beaver transplanted in Colorado. Beaver relocated on streams and later recaptured (n=200) moved an average distance of 4.6 miles, and in lake and pothole relocations (n=272) moved an average of 2 miles (Knudsen and Hale 1965). Only 12% of beaver relocated on streams and 33% of beaver relocated on lake and pothole areas remained at the release site (Knudsen and Hale 1965).

Generally, translocating aquatic rodents that have caused damage to other areas following live-capture would not be effective or cost-effective. Translocation is generally ineffective because problem aquatic rodents are highly mobile and can easily return to damage sites from long distances, aquatic rodents generally already occupy habitats in other areas, and translocation could result in damage problems at the new location. Translocation of wildlife is also discouraged by WS policy (see WS Directive 2.501) because of the stress to the translocated animal, poor survival rates, threat of spreading diseases, and the difficulties that translocated wildlife have with adapting to new locations or habitats (Nielsen 1988).

In addition, nutria are an invasive species; therefore, translocation of nutria would be inappropriate. Lastly, WS, the ODWC, and the property owner where the original capture took place could be liable for any property damage caused by a translocated beaver. Therefore, WS and the ODAFF did not consider this alternative in detail.

Use of Non-lethal Methods and Approved Euthanasia Only

Under this alternative, WS would continue to employ an integrated approach but would only employ non-lethal methods to exclude, harass, or live-capture target aquatic rodents. When deemed appropriate, WS could continue to remove aquatic rodents lethally; however, under this alternative, WS would only use methods that captured target aquatic rodents alive. Once live-captured, target aquatic rodents would be euthanized using methods that meet the definition of euthanasia as defined by the American Veterinary Medical Association. Under this alternative, the only methods that would be available to live-capture beaver would be cable restraints, foothold traps, suitcase traps, and cage traps. For muskrats and nutria, the only live-capture methods that would be available would be floating colony traps, foothold traps, and cage traps. Other non-lethal methods would also be available to resolve damage or threats of damage under this alternative and those methods would be similar to those non-lethal methods described under the proposed action alternative. The methods that would not be available under this alternative would be the use of foothold traps for drowning sets, the use of body-grip traps, and the use of firearms (except firearms could be used once target animals were live-captured).

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

Reducing Damage by Managing Aquatic Rodent Populations through the Use of Reproductive Inhibitors

Under this alternative, the only method that would be available to resolve requests for assistance by WS would be the recommendation and the use of reproductive inhibitors to reduce or prevent reproduction in aquatic rodents responsible for causing damage. Wildlife professionals often consider reproductive inhibitors for use where wildlife populations are overabundant and where traditional hunting or lethal

control programs are not publicly acceptable (Muller et al. 1997). Population dynamic characteristics (*e.g.*, longevity, age at onset of reproduction, population size, and biological/cultural carrying capacity), habitat and environmental factors (*e.g.*, isolation of target population, cover types, and access to target individuals), socioeconomic, and other factors often limit the use and effectiveness of reproductive control as a tool for wildlife population management.

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

Population modeling indicates that reproductive control is more efficient than lethal control only for some rodent and small bird species with high reproductive rates and low survival rates (Dolbeer 1998). Additionally, the need to treat a sufficiently large number of target animals, multiple treatments, and population dynamics of free-ranging populations place considerable logistic and economic constraints on the adoption of reproduction control technologies as a wildlife management tool for some species.

Novak (1987) conducted a review of research evaluating chemically induced and surgically induced reproductive inhibition as a method for controlling beaver populations. Research on several reproductive inhibitors proposed for use in beaver population reduction has occurred, including research on quinestrol (17-alpha-ethynyl-estradiol-3-cyclopentylether) and mestranol (Gordon and Arner 1976, Wesley 1978). The use of chemosterilants as a means of managing the reproductive output of beaver has been successful in controlled experiments (Davis 1961, Arner 1964). However, while evidence suggests chemosterilants could reduce beaver reproduction in controlled experiments, no practical and effective method for distributing chemosterilants in a consistent way to wild, free ranging beaver populations has been developed or proven (Hill et al. 1977, Wesley 1978). Although those methods were effective in reducing beaver reproduction by up to 50%, those methods were not practical or too expensive for large-scale application. Inhibition of reproduction also may affect behavior, physiological mechanisms, and colony integrity (Brooks et al. 1980). Additionally, reproductive control does not alleviate current damage problems (Organ et al. 1996).

Currently, chemical reproductive inhibitors are not available for use to manage aquatic rodent populations. Given the costs associated with live-capturing and performing sterilization procedures on aquatic rodents and the lack of availability of chemical reproductive inhibitors for the management of most aquatic rodent populations, this alternative was not evaluated in detail. If reproductive inhibitors become available to manage aquatic rodent populations and are effective in reducing localized aquatic rodent populations, WS could evaluate use of the inhibitor as a method available to manage damage. The use of reproductive inhibitors would require the approval of the ODWC.

Compensation for Aquatic Rodent Damage

The compensation alternative would require WS to establish a system to reimburse persons impacted by aquatic rodent damage and to seek funding for the program. Under such an alternative, WS would continue to provide technical assistance to those persons seeking assistance with managing damage. In addition, WS would conduct site visits to verify damage. Evaluation of this alternative indicates that a compensation only alternative has many drawbacks. Compensation would require large expenditures of money and labor to investigate and validate all damage claims, and to determine and administer appropriate compensation. Compensation most likely would be below full market value and would give little incentive to resource owners to limit damage through improved cultural or other practices and

management strategies. In addition, providing compensation would not be practical for reducing threats to human health and safety.

Short Term Eradication and Long Term Population Suppression

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

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

Bounties

Most wildlife professionals have not supported payment of funds (bounties) for removing animals suspected of causing damage, or posing threats of damage, for many years (Latham 1960, Hoagland 1993). WS concurs because of several inherent drawbacks and inadequacies in the payment of bounties. Bounties are often ineffective at controlling damage over a wide area, such as across the entire State. The circumstances surrounding the removal of animals are typically arbitrary and completely unregulated because it is difficult or impossible to assure animals claimed for bounty were not lethally removed from outside the area where damage was occurring. In addition, WS does not have the authority to establish a bounty program.

3.3 STANDARD OPERATING PROCEDURES FOR DAMAGE MANAGEMENT

SOPs improve the safety, selectivity, and efficacy of activities intended to resolve wildlife damage. The WS program in Oklahoma uses many such SOPs. Those SOPs would be incorporated into activities conducted by WS under the appropriate alternatives when addressing aquatic rodent damage and threats in the State.

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

- The WS Decision Model, which is designed to identify effective strategies to managing wildlife damage and their potential impacts, would be consistently used and applied when addressing aquatic rodent damage.

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

- Immobilizing drugs and euthanasia chemicals would be used according to the United States Drug Enforcement Administration, United States Food and Drug Administration, and WS' directives

and procedures.

- All controlled substances would be registered with the United States Drug Enforcement Administration or the United States Food and Drug Administration.

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

- WS' employees that use controlled substances would be trained to use each material and would be certified to use controlled substances.

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

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

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

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

- The use of non-lethal methods would be considered prior to the use of lethal methods when managing aquatic rodent damage.

- The removal of aquatic rodents by WS under the proposed action alternative would be monitored and the results and objectives would be discussed with the ODWC to meet mutual management goals.

- Management actions would be directed toward localized populations, individuals, or groups of target species. Generalized population suppression across Oklahoma or even across major portions of Oklahoma would not be conducted.

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

3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES

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

Issue 1 - Effects of Damage Management Activities on Target Aquatic Rodent Populations

- Lethal removal of aquatic rodents by WS would be reported and monitored by WS and the ODWC to evaluate population trends and the magnitude of WS' removal of aquatic rodents in the State.

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

- The WS Decision Model, designed to identify the most appropriate damage management

strategies and their impacts, would be used to determine strategies for resolving aquatic rodent damage.

- WS would monitor activities to ensure those activities do not adversely affect aquatic rodent populations in the State.

- Preference would be given to non-lethal methods when practical and effective.

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

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

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

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

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

- Personnel would monitor live-capture methods and would check traps in accordance with WS policy. This would help ensure non-target species were released in a timely manner or were prevented from being captured.

- Carcasses of aquatic rodents retrieved after damage management activities were conducted would be disposed of in accordance with WS Directive 2.515.

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

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

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

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

- Shooting would be conducted during times when public activity and access to the control areas were restricted. Personnel involved in shooting operations would be fully trained in the proper and safe application of this method.

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

- All personnel employing chemical methods would be properly trained and certified in the use of

those chemicals. All chemicals used by WS would be securely stored and properly monitored to ensure the safety of the public. WS' use of chemicals and training requirements to use those chemicals are outlined in WS Directive 2.401 and WS Directive 2.430.

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

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

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

Issue 4 - Effects on the Aesthetic Values of Aquatic Rodents

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

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

- Preference would be given to non-lethal methods when practical and effective.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

- Personnel would be well trained in the latest and most humane devices/methods for removing target aquatic rodents causing damage.

- WS' personnel would check methods frequently to ensure aquatic rodents captured would be addressed in a timely manner to minimize the stress of being restrained.

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

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

- The use of non-lethal methods would be considered prior to the use of lethal methods when managing aquatic rodent damage.

Issue 6 - Effects of Damage Management Activities on the Regulated Harvest of Aquatic Rodents

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

- WS' activities to manage damage and threats caused by aquatic rodents would be coordinated with the ODWC.

- WS would monitor activities to ensure those activities do not adversely affect aquatic rodent populations in the State and confer with ODWC to meet management objectives for those aquatic rodent species in the State.

Issue 7 – Effects of Beaver Removal and Dam Manipulation on the Status of Wetlands in the State

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

- Upon receiving a request to remove beaver dams, WS would visually inspect the dam and the associated water impoundment to determine if characteristics exist at the site that would meet the definition of a wetland under section 404 of the CWA (40 CFR 232.2; see Issue 7 in Section 2.2 of this EA). If wetland conditions were present at the site, the entities requesting assistance from WS would be notified that a permit might be required to remove the dam and to seek guidance from the Oklahoma Conservation Commission, the Oklahoma Department of Environmental Quality, and the United States Army Corps of Engineers pursuant to Oklahoma State Law and the CWA.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions when selecting the appropriate alternative to address the need for action described in Chapter 1 and the issues described in Chapter 2. This chapter analyzes the environmental consequences of each alternative as that alternative relates to the issues identified. The following resource values in the State are not expected to be significantly impacted by any of the alternatives analyzed: soils, geology, minerals, water quality/quantity, flood plains, wetlands, critical habitats (areas listed in T&E species recovery plans), visual resources, air quality, prime and unique farmlands, aquatic resources, timber, and range. Those resources will not be analyzed further.

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

4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

This section analyzes the environmental consequences of each alternative in comparison to determine the extent of actual or potential impacts on the issues. Therefore, the proposed action/no action alternative (Alternative 1) serves as the baseline for the analysis and the comparison of expected impacts among the

alternatives. The analysis also takes into consideration mandates, directives, and the procedures of WS and the ODWC.

Issue 1 - Effects of Damage Management Activities on Target Aquatic Rodent Populations

Methods available to address aquatic rodent damage or threats of damage in the State that would be available for use or recommendation under Alternative 1 (proposed action/no action alternative) and Alternative 2 (technical assistance only alternative) would either be lethal methods or non-lethal methods. Many of the methods would also be available to other entities under Alternative 3, if approved by ODWC or exempt by law (no involvement by WS alternative). The only methods that would not likely be widely available for use by other entities under Alternative 2 and Alternative 3 would be immobilizing drugs and euthanasia chemicals. Under Alternative 2, WS could recommend lethal and non-lethal methods as part of an integrated approach to resolving requests for assistance. Alternative 1 would address requests for assistance received by WS through technical and/or operational assistance where an integrated approach to methods would be employed and/or recommended. Non-lethal methods that would be available to WS under Alternative 1 would include, but would not be limited to, habitat/behavior modification, pyrotechnics, visual deterrents, live traps, translocation, cable restraints, exclusionary devices, frightening devices, nets, immobilizing drugs, reproductive inhibitors, and chemical repellents (see Appendix B for a complete list and description of potential methods).

Non-lethal methods that would be available under all of the alternatives could disperse or otherwise make an area unattractive to aquatic rodents causing damage; thereby, reducing the presence of aquatic rodents at the site and potentially the immediate area around the site where non-lethal methods were employed. Non-lethal methods would be given priority by WS when addressing requests for assistance under Alternative 1 and Alternative 2 (see WS Directive 2.101). However, non-lethal methods would not necessarily be employed or recommended to resolve every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model. For example, if a cooperator requesting assistance had already used non-lethal methods, WS would not likely recommend or continue to employ those particular methods since their use had already been proven ineffective in adequately resolving the damage or threat.

The continued use of many non-lethal methods can often lead to the habituation of aquatic rodents to those methods, which can decrease the effectiveness of those methods. For any management methods employed, the proper timing would be essential in effectively dispersing those aquatic rodents causing damage. Employing methods soon after damage begins or soon after threats were identified would increase the likelihood that those damage management activities would achieve success in addressing damage. Therefore, the coordination and timing of methods would be necessary to be effective in achieving expedient resolution of aquatic rodent damage.

Many non-lethal methods exclude, harass, and disperse target wildlife from areas where damage or threats were occurring. Harassment methods have generally proven ineffective in reducing beaver damage (Jackson and Decker 1993). When effective, non-lethal methods would disperse aquatic rodents from the area resulting in a reduction in the presence of those aquatic rodents at the site where those methods were employed. However, aquatic rodents responsible for causing damage or threats would be dispersed to other areas with minimal impact on those species' populations. Non-lethal methods would not be employed over large geographical areas or applied at such intensity that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal methods would generally be regarded as having minimal impacts on overall populations of wildlife since individuals of those species were unharmed. The use of non-lethal methods would not have adverse impacts on aquatic rodent populations in the State under any of the alternatives.

A common issue is whether damage management actions would adversely affect the populations of target aquatic rodent species, especially when lethal methods were employed. WS would maintain ongoing contact with the ODWC to ensure activities occurred within management objectives for those species. Therefore, the ODWC would have the opportunity to monitor the total removal of aquatic rodents from all sources and would factor in survival rates from predation, disease, and other mortality data. Ongoing contact with the ODWC would assure the ODWC has the opportunity to consider local, state, and regional knowledge of wildlife population trends. As discussed previously, the analysis for magnitude of impact from lethal removal can be determined either quantitatively or qualitatively. Quantitative determinations are based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations are based on population trends and harvest trend data. Information on aquatic rodent populations and trends are often derived from several sources, including published literature and harvest data.

Lethal methods would also be available for use under all the alternatives by WS and/or by other entities. Lethal methods that would be available to address aquatic rodent damage include live-capture followed by euthanasia, shooting, body gripping traps, cable restraints, and the recommendation of harvest during the hunting and/or trapping seasons, where appropriate. In addition, WS could use foothold traps and submersion rods or cables for drowning sets. All of those methods would be available for use by WS or for recommendation by WS under Alternative 1. Lethal methods could be employed by WS under Alternative 1 to resolve damage only after receiving a request for the use of those methods. Those same methods would also be available for WS to recommend and for other entities to use under Alternative 2. Under Alternative 3, those same lethal methods would continue to be available for use by other entities despite the lack of involvement by WS in damage management activities.

When live-captured target animals were to be lethally removed under Alternative 1, removal would occur pursuant to WS Directive 2.505 and WS Directive 2.430. Under alternative 2, WS could recommend the use of methods to lethally remove live-captured or restrained target animals in accordance with WS Directive 2.505. No assistance would be provided by WS under Alternative 3; however, many of those methods available to lethally remove live-captured or restrained animals would continue to be available for use by other entities under Alternative 3.

The use of lethal methods by any entity could result in local population reductions in the area where damage or threats were occurring since target individuals would be removed from the population. Lethal methods could be employed or recommended to remove aquatic rodents that have been identified as causing damage or posing a threat to human safety. Therefore, the use of lethal methods could result in local reductions of aquatic rodents in the area where damage or threats were occurring. The number of aquatic rodents removed from the population annually by WS using lethal methods under Alternative 1 would be dependent on the number of requests for assistance received, the number of aquatic rodents involved with the associated damage or threat, and the efficacy of methods employed. The number of aquatic rodents removed by other entities under Alternative 2 and Alternative 3 would be unknown but would likely be similar to the removal that could occur under Alternative 1.

Most lethal methods would be employed to reduce the number of aquatic rodents present at a location since a reduction in the number of aquatic rodents at a location could lead to a reduction in damage, which would be applicable whether using lethal or non-lethal methods. The intent of non-lethal methods would be to harass, exclude, or otherwise make an area unattractive to aquatic rodents, which may disperse or dissuade those aquatic rodents to other areas leading to a reduction in damage at the location. Similarly, the use of a reproductive inhibitor would be to reduce a local population of target aquatic rodents, which could reduce the damage occurring over a length of time, since fewer individuals in a localized population could lead to more tolerable damage levels. The intent of using lethal methods would be similar to the objective trying to be achieved when using non-lethal methods, which would be to

reduce the number of aquatic rodents in the area where damage was occurring; thereby, reducing the damage occurring at that location.

The use of firearms could reduce the number of aquatic rodents using a location (similar to dispersing aquatic rodents) by lethally removing those target animals causing damage or posing a threat of damage. The capture of aquatic rodents using live-traps and subsequently euthanizing those aquatic rodents would be employed to reduce the number of aquatic rodents using a particular area where damage was occurring. Similarly, the recommendation that aquatic rodents be harvested during the regulated hunting and/or trapping season for those species in the State would be intended to manage those populations in the area where damage was occurring.

Often of concern with the use of lethal methods is that aquatic rodents that were lethally removed would only be replaced by other aquatic rodents either during the application of those methods (*e.g.*, aquatic rodents that relocate into the area) or by aquatic rodents the following year (*e.g.*, increase in reproduction and survivability that could result from less competition). As stated previously, WS would not use lethal methods during direct operational assistance as population management tools over broad areas. Lethal methods would be employed under Alternative 1 to reduce the number of target animals present at a location where damage was occurring by targeting those animals causing damage or posing threats. The return of aquatic rodents to areas where methods were previously employed does not indicate previous use of those methods were ineffective since the intent of those methods were to reduce the number of aquatic rodents present at a site where damage was occurring or could occur at the time those methods were employed.

The use of most lethal methods would be intended to reduce the number of aquatic rodents present at a location since a reduction in the number of aquatic rodents at a location could lead to a reduction in damage, which is applicable whether using lethal or non-lethal methods. The intent of non-lethal methods would be to harass, exclude, or otherwise make an area unattractive to aquatic rodents, which could potentially dissuade or disperse those aquatic rodents to other areas potentially leading to a reduction in damage at the location where those aquatic rodents were dispersed. The intent of using lethal methods would be similar to the objective trying to be achieved when using non-lethal methods, which would be to reduce the number of aquatic rodents in the area where damage was occurring leading to a reduction in the damage occurring at that location.

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

WS may recommend under Alternative 1 and Alternative 2 that property owners or managers, that request assistance, allow aquatic rodents to be harvested during the regulated hunting and/or trapping season for those species in an attempt to reduce the number of aquatic rodents causing damage on their properties. Managing localized aquatic rodent populations by allowing hunting and/or trapping could lead to a

decrease in the number of aquatic rodents causing damage. Establishing hunting and trapping seasons and the allowed harvest during those seasons is the responsibility of the ODWC. WS does not have the authority to establish hunting or trapping seasons or to set allowed harvest numbers during those seasons. However, the harvest of those aquatic rodents during hunting and/or trapping seasons in the State would be occurring in addition to any removal that could occur by WS under the alternatives or recommended by WS. In addition, aquatic rodents could also be lethally removed by other entities, such as individuals permitted by ODWC and the Wildlife Services Division of the ODAFF directed by the State Board of Agriculture to alleviate damage or threats of damage under all the alternatives. The total number of individuals from each species that were lethally removed by other entities to alleviate damage or threats of damage is currently not available.

The issue of the potential impacts of conducting the alternatives on the populations of those aquatic rodent species addressed in this assessment is analyzed for each alternative below.

Alternative 1 - Continue the Current Adaptive Integrated Aquatic Rodent Damage Management Program (No Action/Proposed Action)

Under the proposed action, WS would continue to provide both technical assistance and direct operational assistance to those persons requesting assistance with managing damage and threats associated with aquatic rodents in the State. WS could employ those methods described in Appendix B in an adaptive approach that would integrate methods to reduce damage and threats associated with aquatic rodents in the State.

The analysis for each of the species includes an estimate of annual removal by WS as compared to statewide population estimates of the species. The statewide population has been estimated using the most current reliable information possible. Frequently, there is no current reliable information available for a species and conservative estimates are calculated based upon habitat availability and species use of those habitats.

As discussed previously, the analysis to determine the magnitude of impact from lethal removal can be determined either quantitatively or qualitatively. Quantitative determinations are based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations are based on population trends and harvest trend data. WS' removal that could occur to alleviate damage or threats of damage under the proposed action would be monitored by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of removal was maintained below the level that would cause undesired adverse effects to the viability of native species' populations. The potential impacts on the populations of target aquatic rodent species from the implementation of the proposed action are analyzed for each species below.

BEAVER POPULATION INFORMATION AND EFFECTS ANALYSIS

The North American beaver is a semi-aquatic mammal occurring in rivers, streams, lakes, reservoirs, and wetlands across North America. Beaver are large, bulky rodents whose most prominent features include a large scaly, paddle-shaped tail and nearly orange colored incisors (Hill 1982). Most adults weigh from 15.8 to 38.3 kg (35 to 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 throughout most of Canada and the United States, with the exception of portions of Florida and the desert southwest. Beaver are active throughout most of the year and are primarily nocturnal, but they can be active during daylight hours. Beaver living along a river or large stream generally make bank burrows with multiple underwater entrances. Those in quiet streams, lakes, and ponds usually build dams and a lodge (National Audubon Society 2000). Signs that beaver are present in an area include gnawing around the bases of trees and

trees that have fallen because of the gnawing. Beaver strip bark, which is a primary source of food for beaver. Beaver are unique in their ability to create and modify their habitat by building dams (Boyles and Owens 2007).

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

Beaver often occur in family groups that consist of two adult parents with two to six offspring from the current or previous breeding season. The average family group ranges from 3.0 to 9.2 individuals (Novak 1987). Reports of beaver abundance often occur in terms of families per kilometer of stream or per square kilometer of habitat. Densities in terms of families per square kilometer have been reported to range from 0.15 to 4.6 beaver (Novak 1987), which is the same as 0.4 to 11.9 beaver per square mile. In streams, Novak (1987) summarized beaver abundance as ranging from 0.31 to 1.5 families per kilometer of stream, which converts to 0.8 to 3.9 families per mile of stream. Novak (1987) stated the beaver population is density dependent, which means that rates of increase generally occur as a population is reduced and become less as a population increases toward its carrying capacity[9]. This natural function of most wildlife populations helps to mitigate population reductions. Logan et al. (1996) indicated that wildlife populations being held at a level below carrying capacity could sustain a higher level of harvest because of the compensatory mechanisms that cause higher rates of increase in such populations.

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

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

The current population of beaver in the State is unknown; however, beaver are present in all Oklahoma counties, and their population is considered stable. Beaver population estimates are often derived from density estimates for beaver that are based on the number of beaver colonies per a linear unit of measure (*e.g.*, stream miles) or per unit of area (*e.g.*, habitat type) (Baker and Hill 2003). In addition, population estimates depend on the number of beaver colonies per unit of measure and on the average number of individual beaver per family (Novak 1987). Beaver densities specific to Oklahoma are currently not available.

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

Beaver densities per unit of area calculated from other studies in the United States and Canada have ranged from 0.4 beaver colonies per square mile to a high of 11.9 beaver colonies per square mile (Novak 1987). Density estimates in the United States and Canada based on stream miles (*i.e.*, per a linear unit of measure) have ranged from 0.8 beaver colonies per stream mile to 3.9 beaver colonies per stream mile (Novak 1987). There are approximately 950,000 acres of wetlands in Oklahoma (United States Geological Survey 1996, Association of State Wetland Managers 2013) along with 78,778 miles of rivers and streams in the State (EPA 2012, Oklahoma Department of Environmental Quality 2014). To evaluate a worst-case scenario, the statewide beaver population will be estimated using the lowest beaver colony density per linear measure derived from other studies of 0.8 beaver colonies per stream mile. If all of the stream and river miles in Oklahoma were suitable beaver habitat and if beaver colonies occupied all of those miles, approximately 63,000 beaver colonies would occur along the 78,778 miles of river and streams in the State, which would not include beaver colonies that inhabit wetlands, lakes, ponds, and other aquatic habitats.

To derive a population estimate, the number of beaver per colony must also be known. In Alabama, Wilkinson (1962) estimated the average number of beaver per colony at 4.6 beaver, which is similar to the average of 5.3 beaver per colony in Georgia that Parrish (1960) estimated. From other studies, the average size of beaver colonies has ranged from 3.2 beaver to 9.2 beaver per colony (Novak 1987). Therefore, if there were 63,000 beaver colonies along the rivers and streams of the State and if there were 4.6 beaver per colony, a statewide population of beaver inhabiting rivers and streams could be estimated at 289,800 beaver. The actual statewide population of beaver is likely much larger than 289,800 beaver since the population estimate was only based on river and stream miles using the lowest density information. In addition, the population estimate did not include beaver that could inhabit other aquatic habitats or create their own habitats by impounding water in areas associated with water runoff or storage (*e.g.*, drainage ditches, irrigation canals, storm water storage facilities).

The authority for management of resident aquatic rodent species in Oklahoma, including beaver, is the responsibility of the ODWC. The State considers beaver to be a furbearer that people can harvest annually during hunting and trapping seasons. The hunting season for beaver occurs year round, and the trapping season in the State is open from December 1- February 28 with no harvest limit for either season (ODWC 2014). When beaver are causing damage on private property, the landowner or their designee can remove beaver without authorization during anytime of the year.

Between FY 2009 and FY 2013, WS received requests for assistance to manage damage or threats of damage caused by beaver in the State. Requests for assistance associated with beaver were primarily associated with flooding and burrowing damage, along with damage from beaver felling and girdling trees. Based on those requests for assistance to manage damage or threats of damage associated with beaver, WS employed multiple methods to remove those beaver identified as causing damage or posing a threat of damage (see Table 4.1). On average, WS has lethally removed 4,100 beaver per year between FY 2009 and FY 2013.

Table 4.1 – Number of beaver WS removed by method in Oklahoma, FY 2009 – FY 2013

	Method				
Fiscal Year	**Body Gripping**	**Foothold Trap**	**Cable Restraint**	**Firearm**	**TOTAL**
2009	3,657	21	400	933	**5,011**
2010	3,772	31	384	1,014	**5,201**
2011	3,173	10	287	1,097	**4,567**
2012	2,070	13	147	907	**3,137**
2013	1,774	14	139	659	**2,586**

The number of beaver harvested in the State and lethally removed to alleviate damage is currently unknown. The ODWC allowing beaver to be lethally removed at any time throughout the year with no limit on the number of beaver that can be harvested or removed to alleviate damage provides an indication that population levels in the State are sufficient to sustain the level of harvest occurring and that overharvest is not likely to occur. An allowable harvest level for beaver has been estimated at 30% of the population (Novak 1987).

Based on previous requests for assistance and in anticipation of receiving additional requests for assistance with managing damage caused by beaver in Oklahoma, WS could lethally remove up to 5,000 beaver annually. The annual lethal removal by WS of up to 5,000 beaver would represent 1.7% of a statewide population estimated at 289,800 beaver. As indicated previously, the actual statewide population of beaver is likely much larger than 289,800 beaver since the population estimate was only based on river and stream miles using the lowest density information. Therefore, the proposed removal of up to 5,000 beaver annually by WS would likely be a much lower percentage of the actual statewide population.

Under the proposed action alternative, people could also request WS breach or remove beaver dams to alleviate or prevent flooding damage. While generally cooperator or landowner employed methods, WS could at times be requested to install devices to control the water flow through dams to alleviate flooding or install exclusion devices to prevent damming. WS would primarily utilize manual methods (*e.g.*, hands and hand tools) to breach dams. To remove dams, WS could also use manual methods but could employ explosives in some cases. Based on anticipated requests for assistance with beaver damage management in Oklahoma, WS could remove or install flow control devices in 800 beaver dams as part of an integrated damage management program. When dams were breached or removed, the building material used to create the dam (*e.g.*, sticks, logs, and other vegetative matter) would be discarded on the bank or would be released to flow downstream. Mud and small materials, such as bark and other plant debris, could also escape downstream and would tend to settle out within a short distance of the dam. Small to medium limbs, along with sediments, may drift further distances downstream. Dam breaching and removal would generally be conducted in conjunction with the removal of beaver responsible for constructing the dam since beaver would likely repair and/or rebuild dams quickly if dams were breached or removed prior to the beaver being removed. Therefore, the removal or breaching of beaver dams would not adversely affect beaver populations in the State since those activities would be conducted in association with removing beaver from the site; therefore, the removal would be included in the estimated annual removal levels of beaver addressed previously.

MUSKRAT POPULATION INFORMATION AND EFFECTS ANALYSIS

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

Muskrats build houses, or lodges of aquatic plants, especially cattails, up to 2.4 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. They also burrow in stream or pond banks with entrances often above the water line. Another sign of the presence of muskrat includes the presence of feeding platforms that muskrats build out of cut vegetation in water or on ice. These feeding platforms are marked by discarded or uneaten grasses or reed cuttings and floating blades of cattails, sedges, and

similar vegetation located near the banks. This species is most active at dusk, dawn, and at night, but may be seen at any time of the day in all seasons, especially spring. Muskrat are excellent swimmers and spend much of their time in the water. They inhabit fresh, salt, and brackish waters throughout most of Canada and the United States; except for the Arctic regions (National Audubon Society 2000). They can be found in marshes, ponds, sloughs, lakes, ditches, streams, and rivers (Boutin and Birkenholz 1997).

Muskrat are prolific and produce three to four litters per year that average five to eight young per litter (Wade and Ramsey 1986), which makes them relatively immune to overharvest (Boutin and Birkenholz 1997). Gestation period varies between 25 and 30 days. Young muskrats can reproduce the spring after their birth. Harvest rates of three to eight animals per acre have been reported to be sustainable in muskrat populations (Boutin and Birkenholz 1997). Muskrat home ranges have been shown to vary from 529 square feet to 11,970 square feet (0.1 to 0.25 acres), with the size of home ranges occupied by muskrats dependent upon habitat quality and population density (Boutin and Birkenholz 1997).

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

No population estimates are available in Oklahoma for muskrats; however, muskrats can be found statewide in suitable habitat. As stated previously, the wetland estimates in Oklahoma are approximately 950,000 acres (United States Geological Survey 1996, Association of State Wetland Managers 2013) including an estimated 78,778 miles of rivers and streams (EPA 2012, Oklahoma Department of Environmental Quality 2014).

Since population estimates are not currently available, a population estimate will be derived based on the best available information for muskrats to provide an indication of the magnitude of removal proposed by WS to alleviate damage and threats of damage. Using the acreage of wetlands in Oklahoma of 950,000 acres and using a single muskrat home range of 0.25 acres and assuming only one muskrat occupies a home range with no overlap of ranges, a statewide population could be estimated at 3.8 million muskrats. However, not all wetlands likely provide suitable habitat for muskrats. If only 25% of the wetland acreage in the State were suitable habitat for muskrats, the population would be estimated at 950,000 muskrats.

Muskrats are classified as regulated furbearers in Oklahoma, and seasons and limits for harvest are set by the ODWC. Muskrats can be harvested during annual hunting and trappings seasons in the State with no limit on the number of muskrats that can be harvested. The number of muskrats harvested annually during the hunting and trapping season is currently unknown.

To alleviate damage at the request of a cooperator, WS lethally removed 94 muskrats in the State between FY 2009 through FY 2013, which is an average of 19 muskrats lethally removed annually. Those persons requesting assistance reported or WS verified damages associated with muskrats totaling $2,700. Damages occurred to earthen dams, golf courses, gardens, and turf. In addition, WS lethally removed 11 muskrats unintentionally during damage management activities targeting other animals, primarily activities targeting beaver. Based on the number of muskrats lethally removed by WS previously, and a reasonable anticipation of an increase in the number of requests for assistance, WS could lethally remove up to 100 muskrats per year as part of an integrated damage management program.

Using a population estimated at 950,000 muskrats, the lethal removal of up to 100 muskrats annually would represent 0.01% of the statewide population. Although the number of muskrats harvested annually in the State during the hunting and trapping season is unknown, the cumulative removal is not likely to reach a magnitude where adverse effects would occur to the muskrat population. The unlimited removal allowed by the ODWC provides an indication that the statewide densities of muskrats are sufficient that overharvest is not likely to occur. In addition, most muskrats would probably be removed in habitats where little or no trapping by fur harvesters is done. Damage management activities associated with muskrats would target single animals or localized populations at sites where their presence was causing unacceptable damage to agriculture, human health and safety, natural resources, or property.

NUTRIA POPULATION INFORMATION AND EFFECTS ANALYSIS

The nutria is a large, dark colored, semi-aquatic rodent that is native to South America. It was introduced to the United States in the late 1930s (Whitaker, Jr. and Hamilton, Jr., 1998). The nutria is somewhat similar to the native muskrat in appearance. Nutria have small eyes and ears with a tail that is long, scaly, sparsely haired, and round (National Audubon Society 2000). Nutria weigh on average about 12 pounds (Whitaker, Jr. and Hamilton, Jr., 1998).

Nutria primarily inhabit brackish or freshwater marshes, but are also found in swamps, rivers, ponds, and lakes. They live in dense vegetation, in abandoned burrows, or in burrows they dig along stream banks or shorelines (Wade and Ramsey 1986). The burrowing activity of nutria can severely damage levees, dikes, earthen dams, and other structures. Nutria feed on terrestrial or aquatic green plants, but also feed on crops adjacent to their habitat. Nutria will consume approximately 25% of their own weight in food each day (Whitaker, Jr. and Hamilton, Jr. 1998).

Nutria females begin breeding in their first year. Breeding can occur at any time during the year. In the right conditions, nutria can produce up to 15 young per year (Whitaker, Jr. and Hamilton, Jr. 1998). In the wild, the life expectancy of nutria is approximately two years. Home ranges for nutria are estimated to be from 12 to 445 acres, and densities range up to 10 nutria per acre (Whitaker, Jr. and Hamilton, Jr. 1998).

Nutria are known to have established extensive populations within the United States. Pursuant to Executive Order 13112, the National Invasive Species Council has designated the nutria as meeting the definition of an invasive species. Nutria can cause extensive damage to native vegetation and often competes with native wildlife species for resources. Nutria are not considered a native wildlife species in Oklahoma; however, ODWC considers nutria to be a furbearer that can be harvested annually during hunting and trapping seasons; the hunting season for nutria occurs year round, and the trapping season in the State is open from December 1- February 28, with no harvest limit for either season. The first reported sighting of nutria in Oklahoma occurred in 1970, as populations began expanding from introduced populations in nearby States (Carter and Leonard 2002). A small population has become established in the State and appears to be expanding (Bounds 2000, Carter and Leonard 2002). The current population of nutria in the State is unknown, but appears to be sporadic based on reported sightings.

Between FY 2009 and FY 2013, the WS program in Oklahoma has lethally removed six nutria to alleviate damage at the request of a cooperator. Based on the presence of established populations within the United States and the expanding population occurring within the State, WS could receive additional requests for assistance to manage damage associated with nutria. The number of nutria addressed by WS each year would be dependent on the number of requests received, the number of nutria associated with causing damage or the threat of damage, and the efficacy of methods employed to resolve the damage. WS anticipates that few, if any, nutria would be lethally removed annually to resolve requests for

assistance, based on current trends. Activities would only be conducted when requested by a property owner or property manager. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, WS could remove up to 200 nutria in Oklahoma per year. In addition, nutria could be lethally removed as non-targets during damage management activities conducted targeting other aquatic rodent species, primarily beaver damage management activities. From FY 2009 through FY 2013, no nutria were lethally removed as unintentional non-targets by WS. The number of nutria lethally removed by other entities in the State is unknown.

Executive Order 13112 states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law; 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations, provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education on invasive species. WS' activities would be conducted pursuant to Executive Order 13112. The nutria management objective of the ODWC is to limit the range expansion of nutria and eradication in Oklahoma (Tackett 2009).

WILDLIFE DISEASE SURVEILLANCE AND MONITORING

The ability to efficiently conduct surveillance for and detect diseases is dependent upon rapid detection of the pathogen if it is introduced. Effective implementation of a surveillance system would facilitate planning and execution at regional and state levels, and coordination of surveillance data for risk assessment. It would also facilitate partnerships between public and private interests, including efforts by federal, state, and local governments as well as non-governmental organizations, universities, and other interest groups.

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

Alternative 2 – Aquatic Rodent Damage Management by WS through Technical Assistance Only

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

Under a technical assistance only alternative, those persons experiencing threats or damage associated with aquatic rodents in the State could lethally remove aquatic rodents or request assistance from other

entities despite WS' lack of direct involvement in the management action. Therefore, under this alternative, the number of aquatic rodents lethally removed annually would likely be similar to the other alternatives. Removal of aquatic rodents by other entities would likely be similar since removal could occur through the ODAFF, the issuance of a permit by the ODWC, and removal would continue to occur during the harvest season for those species. People can lethally remove beaver and nutria during a continuous open harvest season in the State. WS' participation in a management action would not be additive to an action that would occur in the absence of WS' participation.

With the oversight of the ODWC, it is unlikely that aquatic rodent populations would be adversely impacted by implementation of this alternative. Under this alternative, WS would not be directly involved with damage management actions and therefore, direct operational assistance could be provided by other entities, such as the ODAFF, approved private entities, and/or municipal authorities. If direct operational assistance was not available from WS or other entities, it is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal removal, which could lead to real but unknown effects on other wildlife populations. People have resorted to the illegal use of chemicals and methods to resolve wildlife damage issues (*e.g.*, see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003).

Alternative 3 – No Aquatic Rodent Damage Management Conducted by WS

Under this alternative, WS would not conduct damage management activities in the State. WS would have no direct involvement with any aspect of addressing damage caused by aquatic rodents and would provide no technical assistance. No removal of aquatic rodents by WS would occur under this alternative. Aquatic rodents could continue to be lethally removed to resolve damage and/or threats occurring by ODAFF, through permits issued by the ODWC, during the regulated hunting or trapping seasons, or in the case of non-regulated species, removal could occur anytime using legally available methods. Management actions taken by non-federal entities would be considered the *environmental status quo*.

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

Since aquatic rodents could still be removed under this alternative, the potential effects on the populations of those aquatic rodent species in the State would be similar to the other alternatives for this issue. WS' involvement would not be additive to removal that could occur since the cooperator requesting WS' assistance could conduct aquatic rodent damage management activities without WS' direct involvement. Therefore, any actions to resolve damage or reduce threats associated with aquatic rodents could occur by other entities despite WS' lack of involvement under this alternative.

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

As discussed previously, a concern is often raised about the potential impacts to non-target species, including T&E species, from the use of methods to resolve damage caused by aquatic rodents. The potential effects on the populations of non-target wildlife species, including T&E species, are analyzed below.

Alternative 1 - Continue the Current Adaptive Integrated Aquatic Rodent Damage Management Program (No Action/Proposed Action)

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

Personnel from WS would be experienced with managing wildlife damage and would be trained in the employment of methods, which would allow WS' employees to use the WS Decision Model to select the most appropriate methods to address damage caused by targeted animals and excluding non-target species. To reduce the likelihood of capturing non-target wildlife, WS would employ the most selective methods for the target species, would employ the use of attractants that were as specific to target species as possible, and determine placement of methods to avoid exposure to non-targets. SOPs to prevent and reduce any potential adverse effects on non-targets are discussed in Chapter 3 of this EA. Despite the best efforts to minimize non-target exposure to methods during program activities, the potential for WS to disperse or lethally remove non-targets exists when applying both non-lethal and lethal methods to manage damage or reduce threats to safety.

Non-lethal methods have the potential to cause adverse effects to non-targets primarily through exclusion, harassment, and dispersal. Any exclusionary device erected to prevent access of target species also potentially excludes species that were not the primary reason the exclusion was erected; therefore, non-target species excluded from areas may potentially be adversely affected if the area excluded was large enough. The use of auditory and visual dispersal methods to reduce damage or threats caused by aquatic rodents would also likely disperse non-targets in the immediate area the methods were employed. Therefore, non-targets may be permanently dispersed from an area while employing non-lethal dispersal techniques. However, like target species, the potential impacts on non-target species would likely be temporary with target and non-target species often returning after the cessation of dispersal methods.

Non-lethal methods that use auditory and visual stimuli to reduce or prevent damage would be intended to elicit fright responses in wildlife. When employing those methods to disperse or harass target species, any non-targets nearby when the methods were employed would also likely be dispersed from the area. Similarly, any exclusionary device constructed to prevent access by target species could also exclude access to some non-target species. The persistent use of non-lethal methods would likely result in the dispersal or abandonment of those areas where non-lethal methods were employed of both target and non-target species. Therefore, any use of non-lethal methods would likely elicit a similar response from both non-target and target species. Although non-lethal methods do not result in the lethal removal of non-targets, the use of non-lethal methods could restrict or prevent access of non-targets to beneficial resources. However, long-term adverse effects would not occur to a species' population since non-lethal methods would not be employed over large geographical areas and those methods would not be applied at such intensity levels that resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope. Non-lethal methods would generally be regarded as having minimal impacts on overall populations of wildlife since individuals of those species were unharmed. Overall, the use of non-lethal methods would not adversely affect populations of wildlife since those methods would often be temporary.

Other non-lethal methods available for use under this alternative would include live traps, nets, repellents, immobilizing drugs, and reproductive inhibitors. Live traps and nets restrain wildlife once captured; therefore, those methods would be considered live-capture methods. Live traps would have the potential to capture non-target species. Trap and net placement in areas where target species were active and the

use of target-specific attractants would likely minimize the capture of non-targets. If traps and nets were attended to appropriately, any non-targets captured could be released on site unharmed.

Chemical repellents would also be available to reduce aquatic rodent damage. Since FY 2009, WS has not used repellents to reduce aquatic rodent damage in the State. However, WS may recommend or employ commercially available repellents when providing technical assistance and direct operational assistance. Only those repellents registered with the EPA pursuant to the FIFRA and registered with the ODAFF would be recommended or used by WS under this alternative. The active ingredients in many commercially available repellents are naturally occurring substances (*e.g.*, capsaicin, whole egg solids), which are often used in food preparation (EPA 2001). When used according to label instructions, most repellents would be regarded as safe since 1) they are not toxic to animals, if ingested; 2) there is normally little to no contact between animals and the active ingredient, and 3) the active ingredients are found in the environment and degrade quickly (EPA 2001). Therefore, the use and recommendation of repellents would not have negative impacts on non-target species when used according to label requirements. Most repellents for aquatic rodents pose a very low risk to non-targets when there is exposure or ingestion.

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

Potential impacts to non-targets from the use of non-lethal methods would be similar to the use of non-lethal methods under any of the alternatives. Non-targets would generally be unharmed from the use of non-lethal methods under any of the alternatives since no lethal removal would occur. Non-lethal methods would be available under all the alternatives analyzed. WS' involvement in the use of or recommendation of non-lethal methods would ensure the potential impacts to non-targets were considered under the WS Decision Model. Potential impacts to non-targets under this alternative from the use of and/or the recommendation of non-lethal methods are likely to be low.

WS could also employ and/or recommend lethal methods under the proposed action alternative to alleviate damage, when those methods were deemed appropriate for use using the WS Decision Model. Lethal methods available for use to manage damage caused by aquatic rodents under this alternative would include the recommendation of harvest during hunting and/or trapping seasons, shooting, body-gripping traps, cable restraints, and euthanasia chemicals, including euthanasia after live-capture. In addition, WS could use foothold traps and submersion cables or rods as a drowning set. Available methods and the application of those methods to resolve aquatic rodent damage is further discussed in Appendix B.

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

While every precaution would be taken to safeguard against taking non-targets during operational use of methods and techniques for resolving damage and reducing threats caused by aquatic rodents, the use of

such methods could result in the incidental lethal removal of unintended species. The unintentional removal and capture of wildlife species during damage management activities conducted under the proposed action alternative would primarily be associated with the use of body-gripping traps and in some situations, with live-capture methods, such as foothold traps, cage traps, and cable restraints.

The unintentional removal of non-targets by WS could occur during activities targeting those aquatic rodent species addressed in this EA; however, the unintentional removal of non-targets would likely be minimal. Although non-targets could be lethally removed by WS, removal of individuals from any species is not likely to increase substantively. In addition, the level of removal analyzed for each species under Issue 1 includes non-target removal that could occur by WS. Therefore, the removal of those species addressed in this EA has been evaluated cumulatively under Issue 1, including removal that could occur when a species was considered a target or non-target. WS would continue to monitor activities, including non-target removal, to ensure the annual removal of non-targets would not result in adverse effects to a species' population. No T&E species have been captured or adversely affected by WS' activities conducted previously in Oklahoma.

Methods available to resolve and prevent aquatic rodent damage or threats when employed by trained, knowledgeable personnel would be selective for target species. WS would monitor and confer with ODWC on non-target removal issues to ensure removal by WS was considered as part of management objectives established for those species by the ODWC. The potential for adverse effects to occur with non-targets would be similar to the other alternatives and would be considered minimal to non-existent based on previous non-target removal.

As discussed previously, the use of non-lethal methods to address damage or threats would generally be regarded as having no effect on a species' population since those individuals addressed using non-lethal methods would be unharmed and no actual reduction in the number of individuals in a species' population occurs. Similarly, the live-capture and release of non-targets would generally be regarded as having no adverse effects on a species' population since those individuals would be released unharmed and no actual reduction in the number of individuals in a population occurs. Therefore, the live-capture and subsequent releasing of non-targets during damage management activities conducted under the proposed action alternative would not result in declines in the number of individuals in a species' population.

T&E Species Effects

Special efforts would be made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or minimization measures. SOPs to avoid effects to T&E species are described in Chapter 3 of this EA.

Federal and State Listed Species - The list of species designated as threatened and endangered in the State of Oklahoma as determined by the USFWS was obtained and reviewed during the development of this EA. Appendix C lists those T&E species listed by the USFWS and the potential effects of methods and feral swine removal on those species. Based on the use patterns of the methods and the removal activities, the proposed action alternative would have no effect on many T&E species listed in the State.

In 1999, the WS program in Oklahoma entered into an informal consultation with the USFWS to address T&E species in Oklahoma. At that time, a Biological Assessment was prepared by WS to evaluate potential impacts to red-cockaded woodpeckers, Arkansas river shiners, American burying beetles, and the scaleshell mussels. The USFWS concurred with WS' determination that the current program is "*…not likely to adversely affect any of the listed or proposed species*."

As part of the development process associated with this EA, the USFWS concurred with WS' determination that activities conducted pursuant to the proposed action would not likely adversely affect those species currently listed in the State or their critical habitats (J. Aldrich, Field Supervisor, USFWS pers. comm. 2015). The ODWC has also concurred with WS' determination that proposed activities would not adversely affect threatened or endangered species in Oklahoma (J. Davis, Furbearer Biologist, ODWC, pers. comm. 2015). If any conditions warrant, WS would immediately initiate consultation with the USFWS pursuant to Section 7 of the ESA. WS would abide by the outcome associated with the consultation process. WS would continue to consult with the USFWS to evaluate activities to resolve aquatic rodent damage to ensure the protection of T&E species and to comply with the ESA.

Alternative 2 – Aquatic Rodent Damage Management by WS through Technical Assistance Only

Under a technical assistance alternative, WS would have no direct impact on non-target species, including T&E species. Methods recommended or provided through loaning of equipment could be employed by those persons requesting assistance. Recommendations would be based on the WS Decision Model using information provided by the person requesting assistance or through site visits. Recommendations would include methods or techniques to minimize non-target impacts associated with the methods being recommended or loaned. Methods recommended could include non-lethal and lethal methods as deemed appropriate by the WS Decision Model and as permitted by laws and regulations.

The potential impacts to non-targets under this alternative would be variable and based on several factors. If methods were employed, as recommended by WS, the potential impacts to non-targets would likely be similar to the proposed action. If recommended methods and techniques were not followed or if other methods were employed that were not recommended, the potential impacts on non-target species, including T&E species would likely be higher compared to the proposed action.

The potential impacts of harassment and exclusion methods on non-target species would be similar to those described under the proposed action. Harassment and exclusion methods would be easily obtainable and simple to employ. Since identification of targets would occur when employing shooting as a method, the potential impacts to non-target species would likely be low under this alternative but would be based on the knowledge and experience of the person to identify the target species correctly.

Those persons experiencing damage from aquatic rodents may implement methods and techniques based on the recommendations of WS. The potential for impacts would be based on the knowledge and skill of those persons implementing recommended methods. If those persons experiencing damage do not implement methods or techniques correctly, the potential impacts from providing only technical assistance could be greater than the proposed action. The incorrect implementation of methods or techniques recommended by WS could lead to an increase in non-target removal when compared to the non-target removal that could occur by WS under the proposed action alternative.

If requesters were provided technical assistance but do not implement any of the recommended actions and conducted no further action, the potential to remove non-targets would be lower when compared to the proposed action. If those persons requesting assistance implement recommended methods appropriately and as instructed or demonstrated, the potential impacts to non-targets would be similar to the proposed action. If WS made recommendations on the use of methods to alleviate damage but those methods were not implemented as recommended by WS or if those methods recommended by WS were used inappropriately, the potential for lethal removal of non-targets would likely increase under a technical assistance only alternative. Therefore, the potential impacts to non-targets, including T&E species would be variable under a technical assistance only alternative.

If non-lethal methods recommended by WS under this alternative were deemed ineffective by those people requesting assistance, lethal methods could be employed by those people experiencing damage. Those people requesting assistance would likely be those persons that would use lethal methods since a damage threshold had been met for that individual requester that triggered seeking assistance to reduce damage. The potential impacts on non-targets by those people experiencing damage would be highly variable. People whose aquatic rodent damage problems were not effectively resolved by non-lethal control methods would likely resort to other means of legal or illegal lethal control. This could result in less experienced persons implementing control methods and could lead to greater removal of non-target wildlife than the proposed action. When those persons experiencing damage caused by wildlife reach a level where assistance does not adequately reduce damage or where no assistance is available, people have resorted to using chemical toxicants that are illegal for use on the intended target species. The illegal use of methods often results in loss of both target and non-target wildlife (*e.g.*, see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003). The use of illegal toxicants by those persons frustrated with the lack of assistance or assistance that inadequately reduces damage to an acceptable level can often result in the indiscriminate removal of wildlife species.

The ability to reduce negative effects caused by aquatic rodents to wildlife species and their habitats, including T&E species, would be variable under this alternative. The ability to reduce risks would be based upon the skills and abilities of the person implementing damage management actions. It would be expected that this alternative would have a greater chance of reducing damage than Alternative 3 since WS would be available to provide information and advice on appropriately employing methods and reducing the risk of non-target removal.

Alternative 3 – No Aquatic Rodent Damage Management Conducted by WS

Under this alternative, WS would not be directly involved with damage management activities in the State. Therefore, no direct impacts to non-targets or T&E species would occur by WS under this alternative. Aquatic rodents could continue to be lethally removed by the ODAFF or under permits issued by the ODWC. In addition, removal could continue to occur during the regulated harvest seasons and non-game aquatic rodent species could continue to be removed at any time without the need for a permit. Risks to non-targets and T&E species would continue to occur from those people who implement damage management activities on their own or through recommendations by other federal, state, and private entities. Although some risks could occur from those people that implement aquatic rodent damage management in the absence of any involvement by WS, those risks would likely be low and would be similar to those risks under the other alternatives.

The ability to reduce negative effects caused by aquatic rodents to other wildlife species and their habitats, including T&E species, would be variable based upon the skills and abilities of the person implementing damage management actions under this alternative.

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

A common concern is the potential adverse effects that methods available could have on human health and safety. The threats to human safety of methods available under the alternatives are evaluated below by each of the alternatives.

Alternative 1 - Continue the Current Adaptive Integrated Aquatic Rodent Damage Management Program (No Action/Proposed Action)

The cooperator requesting assistance would be made aware through a MOU, work initiation document, or a similar document that those methods agreed upon could potentially be used on property owned or

managed by the cooperator. Therefore, the cooperator would be made aware of the possible use of those methods on property they own or manage to identify any risks to human safety associated with the use of those methods. Cooperators would be made aware by signing a MOU, work initiation document, or another similar document, which would assist WS and the cooperating entity with identifying any risks to human safety associated with methods at a particular location.

Under the proposed action, WS could use or recommend those methods discussed in Appendix B singularly or in combination to resolve and prevent damage associated with aquatic rodents in the State. WS would use the Decision Model to determine the appropriate method or methods that would effectively resolve the request for assistance. Those methods would be continually evaluated for effectiveness and if necessary, additional methods could be employed. Non-lethal and lethal methods could be used under the proposed action. WS would continue to provide technical assistance and/or direct operational assistance to those persons seeking assistance with managing damage or threats from aquatic rodents. Risks to human safety from technical assistance conducted by WS would be similar to those risks addressed under Alternative 2. Those non-lethal methods that could be used as part of an integrated approach to managing damage, that would be available for use by WS as part of direct operational assistance, would be similar to those risks associated with the use of those methods under the other alternatives.

Lethal methods available under the proposed action would include the use of body-gripping traps, cable restraints, the recommendation of harvest during hunting and/or trapping seasons, shooting, and euthanasia chemicals. In addition, target aquatic rodent species live-captured using non-lethal methods (*e.g.*, live-traps, immobilizing drugs) could be euthanized. In addition, WS could use foothold traps and submersion rods or cables for drowning sets. Those lethal methods available under the proposed action alternative or similar products would also be available under the other alternatives. None of the lethal methods available would be restricted to use by WS only. Euthanasia chemicals would not be available to the public but those aquatic rodents live-captured could be killed using other methods.

WS' employees who conduct activities to manage damage caused by aquatic rodents would be knowledgeable in the use of those methods available, the wildlife species responsible for causing damage or threats, and WS' directives. That knowledge would be incorporated into the decision-making process inherent with the WS Decision Model that would be applied when addressing threats and damage caused by aquatic rodents. When employing lethal methods, WS' employees would consider risks to human safety when employing those methods based on location and method. For example, risks to human safety from the use of methods would likely be lower in rural areas that are less densely populated. Consideration would also be given to the location where damage management activities would be conducted based on property ownership. If locations where methods would be employed occur on private property in rural areas where access to the property could be controlled and monitored, the risks to human safety from the use of methods would likely be less. If damage management activities occurred at public parks or near other public use areas, then risks of the public encountering damage management methods and the corresponding risk to human safety would increase. Activities would generally be conducted when human activity was minimal (*e.g.*, early mornings, at night) or in areas where human activities was minimal (*e.g.*, in areas closed to the public).

The use of live-capture traps, restraining devices (*e.g.*, foothold traps, some cable restraints), and body-gripping traps have been identified as a potential issue. Live-capture traps available for aquatic rodents would typically be walk-in style traps where aquatic rodents enter but are unable to exit. Live-traps, restraining devices, and body-gripping traps would typically be set in situations where human activity was minimal to ensure public safety. Those methods rarely cause serious injury and would only be triggered through direct activation of the device. Therefore, human safety concerns associated with live-traps, restraining devices, and body-gripping traps used to capture wildlife, including aquatic rodents, would require direct contact to cause bodily harm. Therefore, if left undisturbed, risks to human safety would be

minimal. Signs warning of the use of those tools in the area could be posted for public view at access points to increase awareness that those devices were being used and to avoid the area, especially pet owners.

Other live-capture devices, such as cannon nets, pose minor safety hazards to the public since activation of the device would occur by trained personnel after target species were observed in the capture area of the net. Lasers also pose minimal risks to the public since application would occur directly to target species by trained personnel, which would limit the exposure of the public to misuse of the method.

Safety issues related to the misuse of firearms and the potential human hazards associated with the use of firearms were issues identified. To help ensure the safe use of firearms and to increase awareness of those risks, WS' employees who use firearms during official duties would be required to attend an approved firearm safety-training course and to remain certified for firearm use must attend a safety-training course in accordance with WS Directive 2.615. As a condition of employment, WS' employees who carry and use firearms are subject to the Lautenberg Domestic Confiscation Law, which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence (18 USC § 922(g)(9)). A safety assessment based on site evaluations, coordination with cooperating and local agencies (if applicable), and consultation with cooperators would be conducted before firearms were deemed appropriate to alleviate or reduce damage and threats to human safety when conducting activities. WS would work closely with cooperators requesting assistance to ensure all safety issues were considered before firearms would be deemed appropriate for use. The use of all methods, including firearms, would be agreed upon with the cooperator to ensure the safe use of those methods. The security of firearms would also occur pursuant to WS Directive 2.615.

The recommendation by WS that aquatic rodents be harvested during the regulated hunting and/or trapping season that are established by the ODWC would not increase risks to human safety above those risks already inherent with hunting or trapping those species. Recommendations of allowing hunting and/or trapping on property owned or managed by a cooperator to reduce aquatic rodent populations, which could then reduce damage or threats, would not increase risks to human safety. Safety requirements established by the ODWC for the regulated hunting and trapping season would further minimize risks associated with hunting and trapping. Although hunting and trapping accidents do occur, the recommendation of allowing hunting or trapping to reduce localized populations of aquatic rodents would not increase those risks.

The issue of using chemical methods as part of managing damage associated with wildlife relates to the potential for human exposure either through direct contact with the chemical or exposure to the chemical from wildlife that have been exposed. Under the alternatives identified, the use of chemical methods could include immobilizing drugs, euthanasia chemicals, binary explosives, and repellents.

The use of immobilizing drugs would only be administered to aquatic rodents that have been live-captured using other methods or administered through injection using a projectile (*e.g.*, dart gun). Immobilizing drugs used to sedate wildlife would be used to temporarily handle and transport animals to lessen the distress of the animal from the experience. Drug delivery would likely occur on site with close monitoring of the animal to ensure proper care of the animal. Immobilizing drugs would be reversible with a full recovery of sedated animals occurring. Drugs used in capturing and handling wildlife that would be available include ketamine, a mixture of ketamine/xylazine, and telazol. A list and description of immobilizing drugs available for use under the identified alternatives can be found in Appendix B.

If aquatic rodents were immobilized for sampling or translocation and released, risks could occur to human safety if harvest and consumption occurred. SOPs employed by WS to reduce risks are discussed in Chapter 3 and in Appendix B. SOPs that would be part of the activities conducted include:

- All immobilizing drugs used in capturing and handling 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. This practice would avoid release of animals that may be consumed by hunters and/or trappers prior to the end of established withdrawal periods for the particular drugs used. Ear tagging or other marking of animals drugged and released to alert hunters and trappers that they should contact state officials before consuming the animal.
- Most animals administered immobilizing drugs would be released well before hunting/trapping seasons, which would give the drug time to metabolize completely out of the animals' systems before they might be harvested and consumed by people. In some instances, animals collected for control purposes would be euthanized when they were captured within a certain specified time period prior to the legal hunting or trapping season to avoid the chance that they would be consumed as food while still potentially having immobilizing drugs in their systems.

Meeting the requirements of the AMDUCA should prevent any adverse effects to human health with regard to this issue.

Euthanizing chemicals would be administered under similar circumstances to immobilizing drugs and would be administered to animals live-captured using other methods. Euthanasia chemicals would include sodium pentobarbital and potassium chloride. Euthanized animals would be disposed of in accordance with WS Directive 2.515; therefore, would not be available for harvest and consumption. Euthanasia of target animals would occur in the absence of the public to minimize risks, whenever possible.

The recommendation of repellents or the use of those repellents registered for use to disperse aquatic rodents in the State could occur under the proposed action as part of an integrated approach to managing aquatic rodent damage. Those chemical repellents that would be available to recommend for use or that could be directly used by WS under this alternative would also likely be available under any of the alternatives. Therefore, risks to human safety from the recommendation of repellents or the direct use of repellents would be similar across all the alternatives. Risks to human safety associated with the use of repellents by WS or the recommendation of repellents by WS is addressed under the technical assistance only alternative (Alternative 2). Risks to human safety would be similar across all the alternatives. WS' involvement, either through recommending the use of repellents or the direct use of repellents, would ensure that label requirements of those repellents were discussed with those persons requesting assistance when recommended through technical assistance or would be specifically adhered to by WS' personnel when using those chemical methods. Therefore, the risks to human safety associated with the recommendation of or direct use of repellents could be lessened through WS' participation.

When WS received a request to remove a beaver dam, WS' employees would assess the potential for downstream flooding to determine the appropriate removal method. WS would generally breach or remove beaver dams by hand with a rake or power tools (*e.g.*, a winch). WS would normally breach or remove dams through incremental stages of debris removal from the dam that allows water levels to be gradually lowered. Breaching of dams would normally occur to limit the potential for flooding downstream by gradually allowing water levels to lower as more of the dam was breached over time. Depending on the size of the impoundment, water levels could be slowly lowered over several hours or days when breaching dams. When breaching dams, only that portion of the dam blocking the stream or ditch channel would be altered or breached, with the intent of returning water levels and flow rates to

historical levels or to a level that eliminates damage threats that would be acceptable to the property owner or resource manager. Similar to breaching dams, the removal of the dam removes the debris impounding water and restores the normal flow of water. WS could also use explosives to breach or remove beaver dams. Explosives would generally be used to remove beaver dams that were too large to remove by hand.

WS' personnel responsible for the use of explosives would be required to complete in-depth training and must demonstrate competence and safety with use of explosives pursuant to the WS Explosives Safety Manual (see WS Directive 2.435). Employees would adhere to WS' policies as well as regulations promulgated by the Bureau of Alcohol, Tobacco, and Firearms, the Occupational Safety and Health Administration, the United States Department of Transportation, and the Oklahoma State Police concerning explosives use, storage, safety, and transportation. WS would use binary explosives that require the mixing of two components for activation. Binary explosives reduce the hazard of accidental detonation during storage and transportation since the two components are stored separately. Storage and transportation of mixed binary explosives is prohibited. When explosives were being used by WS, warning signs would be posted to restrict public entry. WS would also contact the appropriate utility resources to identify and mark underground utilities before removing dams with explosives. When beaver dams were near roads or highways, police or other road officials would be used to help stop traffic and restrict public entry.

No adverse effects to human safety have occurred from WS' use of methods to alleviate aquatic rodent damage in the State from FY 2009 through FY 2013. The risks to human safety from the use of non-lethal and lethal methods, when used appropriately and by trained personnel, would be considered low. Based on the use patterns of methods available to address damage caused by aquatic rodents, this alternative would comply with Executive Order 12898 and Executive Order 13045.

Alternative 2 – Aquatic Rodent Damage Management by WS through Technical Assistance Only

Under this alternative, WS would be restricted to making recommendations on the use of methods and the demonstration of methods to resolve damage. WS would only provide technical assistance to those people requesting assistance with aquatic rodent damage and threats. Although hazards to human safety from non-lethal methods exist, those methods are generally regarded as safe when used by trained individuals who are experienced in their use. Risks to human safety associated with non-chemical methods such as resource management methods (*e.g.*, crop selection, limited habitat modification, modification of human behavior), exclusion devices, frightening devices, and cage traps could be considered low based on their use profile for alleviating damage associated with wildlife. Although some risk of fire and bodily harm exists from the use of pyrotechnics and propane cannons, when used appropriately and in consideration of those risks, those methods could be used with a high degree of safety.

Under a technical assistance only alternative, the availability of immobilizing drugs and euthanasia chemicals would be limited. Immobilizing drugs used in capturing and handling wildlife could be administered under the direction and authority of veterinary authorities, either directly or through procedures agreed upon between those authorities and other entities, such as the ODWC. Without access to immobilizing drugs or euthanizing chemicals, those persons capturing aquatic rodents using live-traps or other live-capture methods would be responsible for euthanizing or handling live-captured captive animals. Since the availability of immobilizing drugs and euthanizing chemicals would be limited under this alternative, a gunshot would likely be the primary method of euthanasia.

The use of chemical methods that are considered non-lethal could be available under this alternative. Chemical methods available would include repellents. There are few chemical repellents registered for

use to manage damage caused by aquatic rodents in the State. Most repellents require ingestion of the chemical to achieve the desired effects on target species. Repellents that require ingestion are intended to discourage foraging on vulnerable resources and to disperse aquatic rodents from areas where the repellents were applied. Repellents, when used according to label directions, are generally regarded as safe especially when the ingredients are considered naturally occurring. Some risk of exposure to the chemical would occur to the applicator, as well as others, as the product was applied due to the potential for drift. Some repellents also have restrictions on whether application can occur on edible plants with some restricting harvest for a designated period after application. All restrictions on harvest and required personal protective equipment would be included on the label and if followed, would minimize risks to human safety associated with the use of those products.

The recommendation by WS that aquatic rodents be harvested during the regulated hunting and/or trapping season, which would be established by the ODWC would not increase risks to human safety above those risks already inherent with hunting and trapping aquatic rodents. Recommendations of allowing hunting or trapping on property owned or managed by a cooperator to reduce local aquatic rodent populations that could then reduce aquatic rodent damage or threats would not increase risks to human safety. Safety requirements established by the ODWC for the regulated hunting and trapping season would further minimize risks associated with those activities. Although hunting and trapping accidents do occur, the recommendation of allowing hunting or trapping to reduce localized aquatic rodent populations would not increase those risks.

The recommendation of shooting with firearms as a method of direct lethal removal could occur under this alternative. Safety issues do arise related to misusing firearms and the potential human hazards associated with firearms use when employed to reduce damage and threats. When used appropriately and with consideration for human safety, risks associated with firearms would be minimal. If firearms were employed inappropriately or without regard to human safety, serious injuries could occur. Under this alternative, recommendations of the use of firearms by WS would include human safety considerations. Since the use of firearms to alleviate aquatic rodent damage would be available under any of the alternatives and the use of firearms by those persons experiencing aquatic rodent damage could occur whether WS was consulted or contacted, the risks to human safety from the use of firearms would be similar among all the alternatives.

If non-chemical methods were employed according to recommendations and as demonstrated by WS, the potential risks to human safety would be similar to the proposed action. If methods were employed without guidance from WS or applied inappropriately, the risks to human safety could increase. The extent of the increased risk would be unknown and variable. Non-chemical methods inherently pose minimal risks to human safety given the design and the extent of the use of those methods.

The cooperator requesting assistance would also be made aware of threats to human safety associated with the use of those methods. SOPs for methods are discussed in Chapter 3 of this EA. Risks to human safety from activities and methods recommended under this alternative would be similar to the other alternatives since the same methods would be available. If misused or applied inappropriately, any of the methods available to alleviate aquatic rodent damage could threaten human safety. However, when used appropriately, methods available to alleviate damage would not threaten human safety. The recommendation of methods by WS to people requesting assistance and the pattern of use recommended by WS would comply with Executive Order 12898 and Executive Order 13045.

Alternative 3 – No Aquatic Rodent Damage Management Conducted by WS

Under the no involvement by WS alternative, WS would not be involved with any aspect of managing damage associated with aquatic rodents in the State, including technical assistance. Due to the lack of

involvement in managing damage caused by aquatic rodents, no impacts to human safety would occur directly from WS. This alternative would not prevent those entities experiencing threats or damage from aquatic rodents from conducting damage management activities in the absence of WS' assistance. The direct burden of implementing permitted methods would be placed on those people experiencing damage or would require those people to seek assistance from other entities.

Similar to the technical assistance only alternative, immobilizing drugs and euthanasia chemicals would have limited availability under this alternative to the public. However, repellents would continue to be available to those persons with the appropriate pesticide applicators license, when required. Since most methods available to resolve or prevent aquatic rodent damage or threats would be available to anyone, the threats to human safety from the use of those methods would be similar between the alternatives. However, methods employed by those persons not experienced in the use of methods or were not trained in their proper use, could increase threats to human safety. Overall, the methods available to the public, when applied correctly and appropriately, would pose minimal risks to human safety.

Issue 4 - Effects on the Aesthetic Values of Aquatic Rodents

Another concern often raised is the potential impact the alternatives could have on the aesthetic value that people often regard for aquatic rodents. The effects of the alternatives on this issue are analyzed below by alternative.

Alternative 1 - Continue the Current Adaptive Integrated Aquatic Rodent Damage Management Program (No Action/Proposed Action)

Under the proposed action, methods would be employed that would result in the dispersal, exclusion, or removal of individuals or small groups of aquatic rodents to resolve damage and threats. In some instances where aquatic rodents were dispersed or removed, the ability of interested persons to observe and enjoy those aquatic rodents would likely temporarily decline.

Even the use of exclusionary devices can lead to the dispersal of wildlife if the resource being damaged was acting as an attractant. Thus, once the attractant was removed or made unavailable, the wildlife would likely disperse to other areas where resources would be more vulnerable.

The use of lethal methods would result in temporary declines in local populations resulting from the removal of aquatic rodents to address or prevent damage and threats. The goal under the proposed action would be to respond to requests for assistance and to manage those aquatic rodents responsible for the resulting damage. Therefore, the ability to view and enjoy aquatic rodents would remain if a reasonable effort were made to locate aquatic rodents outside the area in which damage management activities were occurring. In most cases, the aquatic rodents removed by WS could be removed by the person experiencing damage or removed by other entities if no assistance was provided by WS.

All activities would be conducted where a request for assistance was received and only after the cooperator and WS had signed a MOU, work initiation document, or a similar document. Some aesthetic value would be gained by the removal of aquatic rodents and the return of a more natural environment, including the return of native wildlife and plant species that may be suppressed or displaced by high aquatic rodent densities.

Since those aquatic rodents that could be removed by WS under this alternative could be removed by other entities, WS' involvement in removing those aquatic rodents would not likely be additive to the number of aquatic rodents that could be removed in the absence of WS' involvement. Other entities could remove aquatic rodents when a permit had been issued by the ODWC, without the need for a permit

if the species was unregulated, or during the regulated hunting or trapping seasons. In addition, entities could request the assistance of the ODAFF or seek assistance from private entities to manage damage.

WS' removal of aquatic rodents from FY 2009 through FY 2013 has been of low magnitude compared to the total mortality and populations of those species. WS' activities would not likely be additive to the aquatic rodents that could be lethally removed in the absence of WS' involvement. Although aquatic rodents removed by WS would no longer be present for viewing or enjoying, those aquatic rodents would likely be removed by the property owner or manager if WS were not involved in the action. Removal by the property owner or manager could occur under a permit, during the regulated hunting and trapping seasons, or if the aquatic rodents were unregulated, removal could occur without the need for a permit. Given the limited removal proposed by WS under this alternative when compared to the known sources of mortality of aquatic rodents and the population estimates of those species, WS' aquatic rodent damage management activities conducted pursuant to the proposed action would not adversely affect the aesthetic value of aquatic rodents. The impact on the aesthetic value of aquatic rodents and the ability of the public to view and enjoy aquatic rodents under the proposed action would be similar to the other alternatives and would likely be low.

Alternative 2 – Aquatic Rodent Damage Management by WS through Technical Assistance Only

If those persons seeking assistance from WS were those persons likely to conduct damage management activities in the absence of WS' involvement, then technical assistance provided by WS would not adversely affect the aesthetic value of aquatic rodents in the State similar to Alternative 1. Aquatic rodents could be lethally removed under this alternative by those entities experiencing aquatic rodent damage or threats, which could result in localized reductions in the presence of aquatic rodents at the location where damage was occurring. The presence of aquatic rodents where damage was occurring could be reduced where damage management activities were conducted under any of the alternatives. Even the recommendation of non-lethal methods would likely result in the dispersal of aquatic rodents from the area if those non-lethal methods recommended by WS were employed by those persons receiving technical assistance. Therefore, technical assistance provided by WS would not prevent the aesthetic enjoyment of aquatic rodents since any activities conducted to alleviate aquatic rodent damage could occur in the absence of WS' participation in the action, either directly or indirectly.

Under this alternative, the effects on the aesthetic values of aquatic rodents would be similar to those addressed in the proposed action. When people seek assistance with managing damage from either WS or another entity, the damage level has often reached an unacceptable threshold for that particular person. Therefore, in the case of aquatic rodent damage, the social acceptance level of those aquatic rodents causing damage has reached a level where assistance has been requested and those persons would likely apply methods or seek those entities that would apply those methods based on recommendations provided by WS or by other entities. Based on those recommendations, methods could be employed by the requester that could result in the dispersal and/or removal of aquatic rodents responsible for damage or threatening safety. If those aquatic rodents causing damage were dispersed or removed by those persons experiencing damage based on recommendations by WS or other entities, the potential effects on the aesthetic value of those aquatic rodents would be similar to the proposed action alternative. In addition, those persons could contact other entities to provide direct assistance with dispersing or removing those aquatic rodents causing damage.

The potential impacts on aesthetics from a technical assistance program would only be lower than the proposed action if those individuals experiencing damage were not as diligent in employing those methods as WS would be if conducting an operational program or if no further action was taken by the requester. If those persons experiencing damage abandoned the use of those methods or conducted no further actions, then aquatic rodents would likely remain in the area and available for viewing and

enjoying for those persons interested in doing so. Similar to the other alternatives, the geographical area in which damage management activities could occur would not be such that aquatic rodents would be dispersed or removed from such large areas that opportunities to view and enjoy aquatic rodents would be severely limited.

Alternative 3 – No Aquatic Rodent Damage Management Conducted by WS

Under the no aquatic rodent damage management by WS alternative, the actions of WS would have no impact on the aesthetic value of aquatic rodents in the State. Those people experiencing damage or threats from aquatic rodents would be responsible for researching, obtaining, and using all methods as permitted by federal, state, and local laws and regulations. Aquatic rodents could continue to be dispersed and lethally removed under this alternative in the State. Lethal removal could continue to occur by ODAFF, or when permitted by the ODWC through the issuance of permits, removal could occur during the regulated harvest season, and in the case of non-regulated species, removal could occur any time without the need for a permit.

Since aquatic rodents would continue to be lethally removed under this alternative, despite WS' lack of involvement, the ability to view and enjoy aquatic rodents would likely be similar to the other alternatives. The lack of WS' involvement would not lead to a reduction in the number of aquatic rodents dispersed or removed since WS' has no authority to regulate removal or the harassment of aquatic rodents in the State. The ODWC with management authority over aquatic rodents could continue to adjust all removal levels based on population objectives for those aquatic rodent species in the State. Therefore, the number of aquatic rodents lethally removed annually through harvest and under permits would be regulated and adjusted by the ODWC.

Those people experiencing damage or threats could continue to use those methods they feel appropriate to resolve aquatic rodent damage or threats, including lethal removal or could seek the direct assistance of other entities. Therefore, WS' involvement in managing damage would not be additive to the aquatic rodents that could be dispersed or removed. The impacts to the aesthetic value of aquatic rodents would be similar to the other alternatives.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

As discussed previously, a common issue often raised is concerns about the humaneness of methods available under the alternatives for resolving aquatic rodent damage and threats. The issues of method humaneness relating to the alternatives are discussed below.

Alternative 1 - Continue the Current Adaptive Integrated Aquatic Rodent Damage Management Program (No Action/Proposed Action)

Under the proposed action, WS would integrate methods using the WS Decision Model as part of technical assistance and direct operational assistance. Methods available under the proposed action could include non-lethal and lethal methods integrated into direct operational assistance conducted by WS. Under this alternative, non-lethal methods would be used by WS that were generally regarded as humane. Non-lethal methods that would be available include resource management methods (*e.g.*, crop selection, limited habitat modification, modification of human behavior), translocation, exclusion devices, frightening devices, reproductive inhibitors, cage traps, foothold traps, nets, immobilizing drugs, and repellents.

As discussed previously, humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal. People may perceive the humaneness of an action differently. The challenge in coping with this issue is how to achieve the least amount of animal suffering.

Some individuals believe any use of lethal methods to resolve damage associated with wildlife is inhumane because the resulting fate is the death of the animal. Others believe that certain lethal methods can lead to a humane death. Others believe most non-lethal methods of capturing wildlife to be humane because the animal is generally unharmed and alive. Still others believe that any disruption in the behavior of wildlife is inhumane. With the multitude of attitudes on the meaning of humaneness and the varying perspectives on the most effective way to address damage and threats in a humane manner, agencies are challenged with conducting activities and employing methods that are perceived to be humane while assisting those persons requesting assistance to manage damage and threats associated with wildlife. The goal of WS would be to use methods as humanely as possible to resolve requests for assistance to reduce damage and threats to human safety. WS would continue to evaluate methods and activities to minimize the pain and suffering of methods addressed when attempting to resolve requests for assistance.

Some methods have been stereotyped as "*humane*" or "*inhumane*". However, many "*humane*" methods can be inhumane if not used appropriately. For instance, a cage trap would generally be considered by most members of the public as "*humane*", since the animal would be alive and generally unharmed. Yet, without proper care, live-captured wildlife in a cage trap could be treated inhumanely if not attended to appropriately.

Therefore, the goal would be to address requests for assistance effectively using methods in the most humane way possible that minimizes the stress and pain to the animal. Overall, the use of resource management methods, harassment methods, and exclusion devices would be regarded as humane when used appropriately. Although some concern arises from the use of live-capture methods, the stress of animals is likely temporary.

Although some issues of humaneness could occur from the use of cage traps, foothold traps, reproductive inhibitors, translocation, immobilizing drugs, nets, and repellents, those methods, when used appropriately and by trained personnel, would not result in the inhumane treatment of wildlife. Concerns from the use of those non-lethal methods would be from injuries to animals while those animals were restrained and from the stress of the animal while being restrained or during the application of the method. Pain and physical restraint can cause stress in animals and the inability of animals to effectively deal with those stressors can lead to distress. Suffering occurs when action is not taken to alleviate conditions that cause pain or distress in animals.

If aquatic rodents were to be live-captured by WS, WS' personnel would be present on-site during capture events or capture devices would be checked frequently to ensure aquatic rodents captured were addressed in a timely manner and to prevent injury. Although stress could occur from being restrained, timely attention to live-captured wildlife would alleviate suffering. Stress would likely be temporary.

Under the proposed action, lethal methods could also be employed to alleviate or prevent aquatic rodent damage and threats, when requested. Lethal methods would include shooting, body-gripping traps, cable restraints, euthanasia chemicals, and the recommendation of harvest during hunting and/or trapping seasons. WS could also use foothold traps and submersion cables or rods with drowning sets. In addition, target species live-captured using non-lethal methods could be euthanized by WS. WS' use of lethal control methods under the proposed action would follow those required by WS' directives (see WS Directive 2.505, WS Directive 2.430).

The euthanasia methods being considered for use under the proposed action for live-captured aquatic rodents are carbon dioxide, carbon monoxide, gunshot, and barbiturates or potassium chloride in conjunction with general anesthesia. Those methods are considered acceptable methods by the American Veterinary Medical Association for euthanasia and the use of those methods would meet the definition of euthanasia (American Veterinary Medical Association 2013). The use of carbon dioxide, carbon monoxide, barbiturates, and potassium chloride for euthanasia would occur after the animal had been live-captured and would occur away from public view. Although the American Veterinary Medical Association guideline also lists gunshot as a conditionally acceptable method of euthanasia for free-ranging wildlife, there is greater potential the method may not consistently produce a humane death (American Veterinary Medical Association 2013). WS' personnel that employ firearms to address aquatic rodent damage or threats to human safety would be trained in the proper placement of shots to ensure a timely and quick death.

An issue when dealing with aquatic rodent species is the use of foothold traps to create drowning sets and the humaneness of drowning. There is considerable debate and disagreement among animal interest groups, veterinarians, wildlife professionals, fur trappers, and nuisance wildlife control agents on this issue. The debate centers on an uncertainty as to whether the drowning animals are rapidly rendered unconscious by high levels of carbon dioxide and therefore, insensitive to distress and pain (Ludders et al. 1999). The inhalation of carbon dioxide at concentrations of 7.5% can increase the pain threshold and higher concentrations can have a rapid anesthetic effect on animals (American Veterinary Medical Association 2013). For comparison, room air contains approximately 0.04% carbon dioxide (American Veterinary Medical Association 2007).

The American Veterinary Medical Association identifies drowning as an unacceptable method of euthanasia (Beaver et al. 2001, American Veterinary Medical Association 2007, American Veterinary Medical Association 2013). Ludders et al. (1999) concluded animals that drowned were distressed because of the presence of high levels of the stress related hormones epinephrine and norepinephrine that were present in their bloodstreams. Ludders et al. (1999) showed death during drowning occurred from hypoxia and anoxia; thus, animals experienced hypoxemia. Ludders et al. (1999) reported carbon dioxide narcosis did not occur in drowning animals until the mercury levels in the arterial blood of animals exceeded 95 millimeters. Therefore, Ludders et al. (1999) also concluded drowning did not meet the definition of euthanasia. This conclusion was based on animals not dying rapidly from carbon dioxide narcosis (Ludders et al. 1999).

Death by drowning in the classical sense is caused by the inhalation of fluid into the lungs and is referred to as "*wet*" drowning (Gilbert and Gofton 1982, Noonan 1998). Gilbert and Gofton (1982) reported that all submerged beaver do not die from wet drowning, but die of narcosis induced by carbon dioxide, and the American Veterinary Medical Association has stated the use of carbon dioxide is acceptable (Gilbert and Gofton 1982, Noonan 1998, American Veterinary Medical Association 2013). Gilbert and Gofton (1982) reported that after beaver were trapped and they entered the water, the beaver struggled for two to five minutes, followed by a period of reflexive responses. Andrews et al. (1993) stated that with some techniques that induce hypoxia, some animals have reflex motor activity followed by unconsciousness that is not perceived by the animal. Gilbert and Gofton (1982) stated it is unknown how much conscious control actually existed at this stage and they stated anoxia might have removed much of the sensory perception by five to seven minutes post submersion.

However, Gilbert and Gofton (1982) have been criticized because levels of carbon dioxide in the blood were not reported (Ludders et al. 1999) and there was insufficient evidence that the beaver in their study were under a state of carbon dioxide narcosis when they died (letter from V. Nettles, D.V.M., Ph.D., Southeastern Cooperative Wildlife Disease Study, to W. MacCallum, MDFW, June 15, 1998). Adding to the controversy, Clausen and Ersland (1970) did measure carbon dioxide in the blood for submersed

restrained beaver; yet, none of the beaver in their study died, so Clausen and Ersland (1970) could not determine if beaver died of carbon dioxide narcosis. Clausen and Ersland (1970) demonstrated that carbon dioxide increased in arterial blood while beaver were submersed and carbon dioxide was retained in the tissues. While Clausen and Ersland (1970) did measure the amounts of carbon dioxide in the blood of submersed beaver, they did not attempt to measure the analgesic effect of carbon dioxide buildup to the beaver (letter from V. Nettles, D.V.M., Ph.D., Southeastern Cooperative Wildlife Disease Study, to W. MacCallum, MDFW, June 15, 1998). When beaver were trapped using foothold traps with intent to "*drown*", the beaver exhibit a flight response. Gracely and Sternberg (1999) reported that there is stress-induced analgesia resulting in reduced pain sensitivity during fight or flight responses. Environmental stressors that animals experience during flight or fight activate the same stress-induced analgesia (Gracely and Sternberg 1999).

The use of drowning trap sets has been a traditional wildlife management technique in trapping aquatic rodents, such as beaver and muskrat. Trapper education manuals and other manuals written by wildlife biologists recommend drowning sets for foothold traps set for beaver (Howard et al. 1980, Randolph 1988, Bromley et al. 1994, Dolbeer et al. 1994, Miller and Yarrow 1994). In some situations, drowning trap sets are the most appropriate and efficient method available to capture beaver and muskrat. For example, a drowning set attachment should be used with foothold traps when capturing beaver to prevent the animals from injuring themselves while restrained, or from escaping (Miller and Yarrow 1994). Animals that drown die relatively quickly (*e.g.*, within minutes) versus the possible stress of being restrained and harassed by people, dogs, and other wildlife before being euthanized. Drowning sets make the captured animal, along with the trap, less visible and prevents injury from the trapped animal (*i.e.*, bites and scratches) to people who may otherwise approach a restrained animal. Furthermore, the sight of dead animals may offend some people. Drowning places the dead animal out of public view. Some sites may be unsuitable for body-gripping traps or snares because of unstable banks, deep water, or a marsh with a soft bottom, but those sites would be suitable for foothold traps.

Although rarely used by WS, WS concludes that using drowning trap sets are acceptable and WS recognizes some people disagree. WS based those conclusions on the short time period of a drowning event, the possible analgesic effect of carbon dioxide buildup, the minimal, if any, pain or distress on drowning animals, the American Veterinary Medical Association acceptance of hypoxemia as euthanasia, and the American Veterinary Medical Association acceptance of a minimum of pain and distress during euthanasia. In addition, the best management practice trapping standards for beaver and muskrat allow for the use of submersion sets (Association of Fish and Wildlife Agencies 2014) and the current acceptance of catching and drowning muskrats and beaver approved by International Humane Trapping Standards (Fur Institute of Canada 2009).

Research and development by WS has improved the selectivity and humaneness of management techniques. Research is continuing to bring new findings and products into practical use. Until new findings and products were found practical, a certain amount of animal suffering could occur when some methods were used in situations where non-lethal damage management methods were not practical or effective. As stated previously, research suggests that some methods, such as restraint in foothold traps or changes in the blood chemistry of trapped animals, indicate "*stress*" (Kreeger et al. 1988). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness (Bateson 1991, Sharp and Saunders 2008, Sharp and Saunders 2011).

Personnel from WS would be experienced and professional in their use of management methods. Consequently, management methods would be implemented in the most humane manner possible. Many of the methods discussed in Appendix B to alleviate aquatic rodent damage and/or threats in the State could be used under any of the alternatives by those persons experiencing damage regardless of WS'

direct involvement. The only methods that would not be available to those people experiencing damage associated with aquatic rodents would be reproductive inhibitors, immobilizing drugs, and euthanasia chemicals. Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives since those methods could be employed by other entities in the absence of WS' involvement. Those persons who view a particular method as humane or inhumane would likely continue to view those methods as humane or inhumane under any of the alternatives. SOPs that would be incorporated into WS' activities to ensure methods were used by WS as humanely as possible are listed in Chapter 3.

Alternative 2 – Aquatic Rodent Damage Management by WS through Technical Assistance Only

The issue of humaneness of methods under this alternative would be similar to the humaneness issues discussed under the proposed action. This similarity would be derived from WS' recommendation of methods that some people may consider inhumane. WS would not directly be involved with damage management activities under this alternative. However, the recommendation of the use of methods would likely result in the requester employing those methods. Therefore, by recommending methods and thus a requester employing those methods, the issue of humaneness would be similar to the proposed action. Under Alternative 2, WS would recommend the use of euthanasia methods pursuant to WS Directive 2.505. However, the person requesting assistance would determine what methods to use to euthanize or kill a live-captured animal under Alternative 2.

WS would instruct and demonstrate the proper use and placement of methodologies to increase effectiveness in capturing target aquatic rodent species and to ensure methods were used in such a way as to minimize pain and suffering. However, the efficacy of methods employed by a cooperator would be based on the skill and knowledge of the requester in resolving the threat to safety or damage situation despite WS' demonstration. Therefore, a lack of understanding of the behavior of aquatic rodents or improperly identifying the damage caused by aquatic rodents along with inadequate knowledge and skill in using methodologies to resolve the damage or threat could lead to incidents with a greater probability of being perceived as inhumane. In those situations, the potential for pain and suffering would likely be regarded as greater than discussed in the proposed action.

Alternative 3 – No Aquatic Rodent Damage Management Conducted by WS

Under this alternative, WS would not be involved with any aspect of aquatic rodent damage management in Oklahoma. Those people experiencing damage or threats associated with aquatic rodents could continue to use those methods legally available. Those methods would likely be considered inhumane by those persons who would consider methods proposed under any alternative as inhumane. The issue of humaneness would likely be directly linked to the methods legally available to the public since methods are often labeled as inhumane by segments of society no matter the entity employing those methods.

The humaneness of methods would be based on the skill and knowledge of the person employing those methods. A lack of understanding of the target species or methods used could lead to an increase in situations perceived as being inhumane to wildlife despite the method used. Despite the lack of involvement by WS under this alternative, those methods perceived as inhumane by certain individuals and groups would still be available to the public to use to resolve damage and threats caused by aquatic rodents. Under Alternative 3, euthanasia or killing of live-captured animals would also be determined by those persons employing methods to live-captured wildlife.

Issue 6 - Effects of Damage Management Activities on the Regulated Harvest of Aquatic Rodents

The populations of aquatic rodents addressed in this assessment are sufficient to allow for annual harvest seasons that typically occur during the fall and winter. Hunting and trapping seasons are established by the ODWC. For many aquatic rodent species considered harvestable during hunting and/or trapping seasons, the estimated number of aquatic rodents harvested during the season could be reported by the ODWC in published reports.

Alternative 1 - Continue the Current Adaptive Integrated Aquatic Rodent Damage Management Program (No Action/Proposed Action)

The magnitude of lethal removal addressed in the proposed action would be low when compared to the mortality of those species from all known sources. When WS' proposed removal of aquatic rodents was included as part of the known mortality of those species and compared to the estimated populations, the impact on those species' populations was below the level of removal required to lower population levels.

With oversight of aquatic rodent populations by the ODWC, the number of aquatic rodents that WS could remove annually would not limit the ability of those persons interested to harvest those aquatic rodent species during the regulated season. All data concerning removal by WS is available to the ODWC to ensure the ODWC has the opportunity to incorporate removal by WS into population management objectives established for aquatic rodent populations. Based on the limited removal proposed by WS and the oversight by the ODWC, WS' removal of aquatic rodents annually would have no effect on the ability of those persons interested to harvest aquatic rodents during the regulated harvest season.

Alternative 2 – Aquatic Rodent Damage Management by WS through Technical Assistance Only

Under the technical assistance only alternative, WS would have no direct impact on aquatic rodent populations in the State. If WS recommended the use of non-lethal methods and those non-lethal methods were employed by those persons experiencing damage, aquatic rodents would likely be dispersed from the damage area to areas outside the damage area, which could serve to move those aquatic rodents from those less accessible areas to places accessible to trappers and hunters. Although lethal methods could be recommended by WS under a technical assistance only alternative, the use of those methods could only occur after the property owner or manager received a permit from the ODWC or under certain conditions, could be removed at any time using legally available methods. In addition, a person experiencing damage associated with aquatic rodents could seek the services of the ODAFF or seek assistance from private entities. Lethal removal could also occur during the annual hunting and trapping season in areas where those activities were permitted. WS' recommendation of lethal methods could lead to an increase in the use of those methods. However, the number of animals that people are authorized to remove and the allowed harvest levels during the regulated hunting/trapping seasons would be determined by the ODWC. Therefore, WS' recommendation of the use of lethal methods under this alternative would not limit the ability of those persons interested in harvesting aquatic rodents during the regulated season since the ODWC determines the number of aquatic rodents that may be lethally removed during the hunting/trapping season and under permits.

Alternative 3 – No Aquatic Rodent Damage Management Conducted by WS

WS would have no impact on the ability to harvest aquatic rodents under this alternative. WS would not be involved with any aspect of aquatic rodent damage management. Aquatic rodent damage management could be conducted by the ODAFF cooperating with ODWC. In addition, those persons experiencing damage caused by aquatic rodents could seek the services of private entities, such as licensed nuisance

wildlife control officers. The ODWC would continue to regulate populations through adjustments of the allowed removal during the regulated harvest season and the continued use of permits.

Issue 7 – Effects of Beaver Removal and Dam Manipulation on the Status of Wetlands in the State

Generally, people consider beaver beneficial where their activities do not compete with human land use or human health and safety (Wade and Ramsey 1986). The opinions and attitudes of individuals, organizations, and communities vary greatly and are primarily influenced and formed by the benefits and/or damage directly experienced by each individual (Hill 1982, Baker and Hill 2003). Woodward et al. (1976) found that 24% of landowners who reported beaver activity on their property indicated benefits to having beaver ponds on their land and desired assistance with beaver pond management (Hill 1976, Lewis 1979, Woodward et al. 1985). In some situations, the damage and threats caused by beaver outweigh the benefits (Grasse and Putnam 1955, Woodward et al. 1985, Novak 1987).

Concern has been expressed regarding the potential effects of the proposed action and the alternatives on wetland ecosystems associated with activities that could be conducted to address beaver damage or threats. Concerns have been raised that removing and/or modifying beaver dams in an area would result in the loss of wetland habitat and the plant and animal species associated with those wetlands. In addition, concerns are often raised regarding the use of lethal methods to remove beaver to alleviate damage or threats. If beaver were lethally removed from an area and any associated beaver dam was removed or breached, the manipulation of water levels by removing/breaching the dam could prevent the establishment of wetlands in areas where water has been impounded by beaver dams for an extended period.

Over time, the impounding of water associated with beaver dams can establish new wetlands. Because beaver dams may involve waters of the United States, the removal of a beaver dam is regulated under Section 404 of the CWA. The United States Army Corps Of Engineers and the EPA regulatory definition of a wetland (40 CFR 232.2) is "[t]*hose areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas*."

Although beaver can cause damage to resources, there can be many benefits associated with beaver and beaver activities. Beaver can provide ecological benefits associated with the creation of wetland habitats (*e.g.*, see Munther 1982, Wright et al. 2002, Rosell et al. 2005, Bergman et al. 2007, Pollock et al. 2007, Fouty 2008*a*, Fouty 2008*b*, Hood and Bayley 2008, Pollock et al. 2012, Pollock et al. 2014). Beaver can also provide aesthetic and recreational opportunities for wildlife observation (Wade and Ramsey 1986, Ringleman 1991), improve water quality (Muller-Schwarze and Sun 2003), and provide cultural and economic gains from fur harvest (Hill 1976, McNeely 1995, Lisle 1996, Lisle 2003).

Beaver impoundments can increase surface and groundwater storage, which can help reduce problems with flooding by slowing the downstream movement of water during high-flow events and help to mitigate the adverse effects of drought (Wade and Ramsey 1986, Naiman et al. 1988, Hey and Phillips 1995, Westbrook et al. 2006, Fouty 2008*a*). Hood and Bayley (2008) determined that the presence of beaver could help reduce the loss of open water wetlands during warm, dry years. The presence of beaver impoundments in riverine systems of the Rocky Mountains could affect groundwater recharge and the ability of the water table drought effects (Westbrook et al. 2006). The presence of active beaver lodges accounted for over 80% of the variability in the amount of open water present in the mixed-wood boreal region of east-central Alberta (Hood and Bayley 2008). Hood and Bayley (2008) also found temperature and rainfall influenced the amount of open-water wetlands, but to a much lesser extent than the presence of beaver. During wet and dry years, the presence of beaver was associated with a 9-fold increase in open

water area over the same areas when beaver were absent. Hood and Bayley (2008) noted that beaver could mitigate some of the adverse effects of global warming through their ability to create and maintain areas of open water. Beaver ponds and associated wetlands can provide a potential water source for livestock, serve as basins for the entrapment of streambed silt and eroding soil (Hill 1982), and help to filter nutrients from the water; thereby, maintaining the quality of nearby water systems (Arner and Hepp 1989).

Beaver may increase habitat diversity by opening forest habitats via dam building and tree cutting, which can result in a greater mix of plant species, and different-aged plant communities (Hill 1982, Arner and Hepp 1989). The creation of standing water, edge habitat, and plant diversity, all in close proximity, can result in excellent habitat for many wildlife species (Jenkins and Busher 1979, Arner and DuBose 1982, Hill 1982, Arner and Hepp 1989, Medin and Clary 1990, Medin and Clary 1991). The wetland habitat that can be created by beaver ponds can be beneficial to some fish (primarily warm water species), reptiles, amphibians, waterfowl, shorebirds, and furbearers, such as muskrats, otter, and mink (Arner and DuBose 1982, Naiman et al. 1986, Miller and Yarrow 1994). For example, in Mississippi, beaver ponds over three years in age were found to have developed plant communities valuable as nesting and brood rearing habitat for wood ducks (Arner and DuBose 1982). Reese and Hair (1976) found that beaver pond habitats were highly attractive to a large number of birds throughout the year and that the value of beaver pond habitat to waterfowl was minor when compared to other species of birds (Novak 1987). Beaver ponds can be beneficial to some T&E species. The USFWS estimates that up to 43% of T&E species rely directly or indirectly on wetlands for their survival (EPA 1995).

Under the proposed action alternative, WS could recommend and/or implement methods to manipulate water levels associated with water impounded by beaver dams to alleviate flooding damage. If the technical assistance alternative was selected, WS could recommend methods to people requesting assistance that could result in the manipulation of water levels associated with water impounded by beaver dams. WS would not be involved with any aspect of activities associated with beaver dams under the no involvement by WS alternative. Methods that would generally be available under all the alternatives would include exclusion devices, explosives, and water flow devices (see Appendix B for additional information). However, the availability to breach or remove beaver dams using explosives would be limited under Alternative 2 and Alternative 3, since the property owner or manager seeking to remove or breach a dam would be required to locate a person certified to use explosives to conduct the work. In addition, the use of backhoes or other mechanical methods could be employed by property owners or managers to remove or breach beaver dams under any of the alternatives; however, WS would not operationally employ backhoes or other large machinery to remove or breach dams.

Exclusion devices and water control systems have been used for many years to manipulate the level of water impounded by beaver dams with varying degrees of success (United States General Accounting Office 2001, Taylor and Singleton 2014). Taylor and Singleton (2014) provide a comprehensive summary of the evolution of flow devices to reduce flooding by beaver. Landowner management objectives play a role in how the efficacy of a level system is perceived (Nolte et al. 2001). Nolte et al. (2001) found that survey respondents classified pond levelers installed to manage wetlands for waterfowl habitat more successful than levelers installed to provide relief from flooding. Langlois and Decker (2004) reported that "*...very few beaver problems...can actually be solved with a water level control device*" with a 4.5% success rate in Massachusetts and a 3% success rate in New York. Nolte et al. (2001) reported only 50% of installed pond levelers in Mississippi met landowner objectives and found that pond levelers placed in sites with high beaver activity more frequently failed if installed without implementing population control measures. Taylor and Singleton (2014) recommended, "*…that natural resource managers avoid using fence systems or pipe systems alone, unless they can be used in areas where maintenance requirements and expected damage are extremely low. Flow devices are not intended to replace lethal control*." Taylor and Singleton (2014) also recommended that flow devices be used

"*…as part of integrated management plans where beaver flooding conflicts are expected and where local conditions allow flow-device installation and maintenance*".

Higher success rates have been reported for newer exclusion and water control systems ranging from 87% to 93% (Callahan 2005, Boyles 2006, Simon 2006, Boyles and Owens 2007). Lisle (2003) reported the use of water control devices or a combination of a Beaver Deceiver™ and flow management device virtually eliminated the need for maintenance and beaver removal at 20 sites where clogged culverts and flooded roads had previously been a routine issue.

When using exclusion and water control systems, those methods must be specifically designed to meet the needs of each site (Langlois and Decker 2004). Consequently, devices installed by inexperienced individuals may have a higher failure rate than those installed by a professional (Lisle 1996, Callahan 2003, Boyles 2006, Simon 2006, Spock 2006). Higher success rates reported for newer exclusion and water control devices may be indicative of increased understanding of the kinds of situations where those devices work best. For example, Callahan (2005) noted that exclusion and water control systems installed at culvert sites were more successful than similar systems installed at freestanding dams. Callahan (2003) and Callahan (2005) also provided a list of sites that were not well suited to the use of exclusion or water control devices. Boyles (2006) and Boyles and Owens (2007) reported some of the highest success rates for newer exclusion and water control systems; however, those devices were only tested at culvert sites.

Beaver build dams to raise water levels to meet their needs for security and access to forage. While pond levelers allow for the retention of some water, if the water level does not meet the needs of the beaver, they may move a short distance upstream or downstream and build a new dam, or abandon the area (Callahan 2003, Langlois and Decker 2004, Clemson University 2006). This may merely result in moving the problem to a new landowner or, depending upon site characteristics, the resulting pond may result in new or increased damage problems for the original landowner. McNeely (1995) reported the most common reasons cited for lack of success of water flow devices were clogging caused by debris or silt and beaver construction of additional dams upstream or downstream of the management device. In a study by Callahan (2005), construction of a new dam upstream or downstream of a pond leveler device was the most common cause of failure for free-standing dams (*e.g.*, dams not associated with a culvert or other similar constriction in water flow, 11 of 156 sites). Callahan (2005) also found that insufficient pipe capacity (6 sites), dammed fencing (two sites), and lack of maintenance (2 sites) were causes for pond leveler failures. Nolte et al. (2001) also reported the need to address problems with dams upstream or downstream of a device. At culvert sites, Callahan (2005) found a lack of maintenance was the primary cause of failure with culvert exclusion devices (4 of 227 sites). Callahan (2005) also found vandalism resulted in the failure of a culvert device at one of the sites. At two culvert sites, Callahan (2005) found dammed fencing reduced or completely impeded the operation of exclusion devices.

Most pond levelers and exclusion devices require maintenance. The amount of maintenance required can vary considerably among sites, depending on site conditions and the type of device (Nolte et al. 2001, Callahan 2005, Boyles 2006, Spock 2006). Stream flow, leaf fall, floods, and beaver activity can continuously bring debris to the intake of a water control device. Ice damage and damage from debris washed downstream during high water events may also trigger the need for maintenance (*e.g.*, cleaning out the intake pipe). Although most exclusion and water control devices generally require some level of maintenance, there are reports of devices that have remained effective for a period of years with no maintenance (Nolte et al. 2001). Nolte et al. (2001) reported that post-installation maintenance had been performed by property owners or managers on 70% of the 20 successfully operating Clemson pond levels installed by WS in Mississippi. The most common action was to adjust the riser on the pipe to manipulate water levels. Other maintenance included removal of vegetation and secondary dams built after the installation of the devices. In a survey of individuals who had received assistance with exclusion and water control devices, Simon (2006) found 18 of 36 survey respondents reported maintaining their

devices, while installation program staff monitored an additional 10 devices. Of those survey respondents, Simon (2006) found that 61% reported that routine maintenance took 15 minutes or less while 93% reported that maintenance took a half hour or less. Boyles (2006) reported that time spent on device maintenance ranged from one to 4.75 hours per year.

Installation and upkeep of water control devices vary from site to site. For example, transporting materials over long distances in difficult terrain to install devices in remote locations where road access is not available could increase costs compared to the ability to transport materials for installation at a culvert site along a roadway. Callahan (2005) reported that the average cost for an exclusion fence at a culvert was $750 with an average annual maintenance cost of approximately $200. Flexible leveler pipe systems cost an average of $1,000 to install and $100 per year in maintenance, while the average cost to install a combination fence and leveler was $1,400 with approximately $150 per year in maintenance (Callahan 2005). Over a ten-year period, Callahan (2005) estimated the cost of installation and annual maintenance would range from $200 to $290 per year depending on the device installed. Spock (2006) reported that exclusion and/or water control device installation cost ranged from < $600 to over $3,000 dollars, with slightly more than half the systems (58.2%) ranging between $600 and $1,000 to install. In many cases, Spock (2006) found the cost included the first year of maintenance. The more expensive installations tended to be extensive fence and leveler systems or systems with numerous leveler pipes (Spock 2006). Boyles (2006) reported that device installation cost an average of $1,349 per device and $3,180 per site with subsequent annual maintenance cost averaging $19.75 per site per year (Boyles 2006). However, unlike the study by Callahan (2005) the devices evaluated by Boyles (2006) had only been in place for a relatively short time (average time in place 15 months, range 6 to 22 months versus average time in place 36.6 months, range 3 to 75 months). The cost of maintenance may vary over time as site conditions change.

Alternative 1 - Continue the Current Adaptive Integrated Aquatic Rodent Damage Management Program (No Action/Proposed Action)

Manipulation of water levels associated with water impoundments caused by beaver dams could be addressed by WS under the proposed action using either dam breaching, dam removal, or the installation of water flow devices, including exclusion devices. Those methods allow dams to be breached or removed to maintain the normal flow of water. Heavy equipment, such as backhoes or bulldozers, would not be used by WS to breach, remove, or install water flow devices. However, heavy machinery could be utilized by a cooperator or their agents. WS may utilize small all-terrain or amphibious vehicles and/or watercraft for transporting personnel, equipment, and supplies to worksites. WS would only remove or breach that portion of the beaver dam blocking the stream or ditch channel.

The breaching or removal of dams could be conducted by hand. Breaching would normally be conducted through incremental stages of debris removal from the dam that allows water levels to be gradually lowered. Breaching of dams would normally occur to limit the potential for flooding downstream by gradually allowing water levels to lower as more of the dam was breached over time. Breaching also minimizes the release of debris and sediment downstream by allowing water to move slowly over or through the dam. Depending on the size of the impoundment, water levels could be slowly lowered over several hours or days when breaching dams. When breaching dams, only that portion of the dam blocking the stream or ditch channel would be altered or breached, with the intent of returning water levels and flow rates to historical levels or to a level that eliminates damage threats that would be acceptable to the property owner or resource manager. Similar to breaching dams, the removal of the dam removes the debris impounding water and restores the normal flow of water.

Beaver dams would generally be breached or removed by hand with a rake or power tools (*e.g.*, a winch). However, explosives would also be available to remove beaver dams. Explosives could potentially be

utilized by WS' personnel specially trained and certified to conduct such activities. Explosives are defined as any chemical mixture or device that serves as a blasting agent or detonator. Explosives would generally be used to remove beaver dams that were too large to remove by hand. After a blast, the majority of materials are lifted up and out of the drainage area, away from the water flow. Any remaining fill material still obstructing the channel would normally be washed downstream by water current. The only noticeable side effects from this activity are diluted mud, water, and small amounts of debris from the dam scattered around the blasting site. Considerably less than 10 cubic yards of material would be moved in each of those project activities. Explosives would only be used after beaver were removed from the site.

WS' personnel would only utilize binary explosives (*i.e.*, explosives comprised of two parts that must be mixed at the site before they can be detonated as an explosive material) for beaver dam removal, when requested. Binary explosives consist of ammonium nitrate and nitro-methane; however, those two components separated are not classified as explosives until mixed. Therefore, binary explosives would be subject to fewer regulations and controls. However, once mixed, binary explosives would be considered high explosives and subject to all applicable federal and state regulations. Detonating cord and detonators would also be considered explosives and WS would adhere to all applicable state and federal regulations for storage, transportation, and handling. WS' use of explosives and safety procedures would occur in accordance with WS Directive 2.435.

In addition to dam breaching and removal, water flow devices and exclusion methods would also be available for WS to employ during direct operational assistance or to recommend during technical assistance. Several different designs of water flow devices and exclusion methods would be available; however, the intent of all those methods would be to lower water levels by allowing water to flow through the beaver dam using pipes and wire mesh. After installation, beaver dams would be left intact with water levels maintained at desired levels by adjusting the water flow device. Water flow devices and exclusion methods allow beaver to remain at the site and maintain the beaver dam.

Although dams could be breached/removed manually or with binary explosives, those methods can be ineffective because beaver could quickly repair or replace the dam if the beaver were not removed prior to breaching or removing the dam (McNeely 1995). Damage may be effectively reduced in some situations by installing exclusion and water control devices. Exclusion and water control devices can be designed so that the level of the beaver-created water impoundment can be managed to eliminate or minimize damage from flooding while retaining the ecological and recreational benefits derived from beaver impounding water over time. For example, WS may recommend modifications to site and culvert design (Jensen et al. 1999) as a non-lethal way of reducing problems with beaver dams at culverts.

Manipulating water levels impounded by beaver dams under the proposed action alternative would generally be conducted to maintain existing stream channels and drainage patterns, and to reduce water levels to alleviate flooding. WS could be requested to assist with manipulation of a beaver dam to alleviate flooding to agricultural crops, timber resources, public property, such as roads and bridges, private property, and water management structures, such as culverts. The intent of breaching or removing beaver dams would not be to drain established wetlands. With few exceptions, requests for assistance received by WS from public and private entities would involve breaching or removing dams to return an area to the condition that existed before the dam had been built, or before the impounded water had been affecting the area long enough for wetland characteristics to become established.

Most activities conducted by WS in Oklahoma do not have the potential to affect wetlands, since those activities would not be conducted near or in wetlands. Under this alternative, water levels would be manipulated to return streams, channels, dikes, culverts, and canals to their original function. Most requests to alleviate flooding from impounded water would be associated roads, crops, merchantable

timber, pastures, and other types of property or resources that were not previously flooded. Most dams removed would have been created because of recent beaver activity. WS' personnel receive most requests for assistance associated with beaver dams soon after affected resource owners discover damage.

As stated previously, WS could install water control devices or remove up to 800 beaver dams annually under the proposed action alternative. Upon receiving a request to manipulate the water levels in impoundments caused by beaver dams, WS would visually inspect the dam and the associated water impoundment to determine if characteristics exist at the site that would meet the definition of a wetland under section 404 of the CWA (see 40 CFR 232.2). If wetland conditions were present at the site, the entities requesting assistance from WS would be notified that a permit might be required to manipulate the water levels impounded by the dam and to seek guidance from the Oklahoma Conservation Commission, the Oklahoma Department of Environmental Quality, the EPA, and/or the United States Army Corps of Engineers pursuant to State laws and the CWA. If the area does not already have hydric soils, it usually takes several years for them to develop and a wetland to become established. This process often takes more than 5 years as indicated by the Swampbuster provision of the Food Security Act. Most beaver dam removal by WS would occur under exemptions stated in 33 CFR parts 323 and 330 of Section 404 of the CWA or parts 3821 and 3822 of the Food Security Act. However, manipulating water levels associated with some beaver dams could trigger certain portions of Section 404 that require landowners to obtain permits from the United States Army Corps of Engineers prior to removing a blockage. WS' personnel would determine the proper course of action upon inspecting a beaver dam impoundment. Appendix E describes the procedures used by WS to assure compliance with the pertinent laws and regulations.

The manipulation of water impoundment levels by WS through dam breaching, dam removal, or installation of water flow devices would typically be associated with dams constructed from recent beaver activity and would not have occurred long enough to take on the qualities of a true wetland (*i.e.* hydric soils, hydrophytic vegetation, and hydrological function). WS' activities associated with beaver dam breaching, beaver dam removal, or the installation of flow control device would only be conducted to restore the normal flow of water through drainages, streams, creeks, canals, and other watercourses where flooding damage was occurring or would occur. Activities most often take place on small watershed streams, tributary drainages, and ditches and those activities can best be described as small, one-time projects conducted to restore water flow through previously existing channels. Beaver dam breaching or removal would not affect substrate or the natural course of streams since only the dam would be breached or removed.

In the majority of instances, beaver dam removal would be accomplished by manual methods (*i.e.*, hand tools). WS' personnel would not utilize heavy equipment, such as trackhoes or backhoes, for beaver dam removal. In some cases, small explosive charges may be used by certified, trained personnel. These explosives are placed in a manner to remove only that portion of the dam necessary to alleviate flooding. In addition, explosives are placed to lift and remove debris out from the drainage, stream or creek flow to prevent unnecessary sediment or debris downstream. In all cases, only the portion of the dam blocking the stream or ditch channel would be breached or removed. In some instances, WS would install water flow devices to manage water levels at the site of a breached beaver dam. WS would use hand tools to breach or remove dams. Dams could be breached or removed in accordance with exemptions from Section 404 permit requirements established by regulation or as allowed under nationwide permits (NWPs) granted under Section 404 of the CWA (see Appendix E). The majority of impoundments that WS would remove would only be in existence for a few months. Therefore, those impoundments would generally not be considered wetlands as defined by 40 CFR 232.2 and those impoundments would not possess the same wildlife habitat values as established wetlands.

In those situations where a non-federal cooperator had already made the decision to breach or remove a beaver damage to manipulate water levels with or without WS' assistance, WS' participation in carrying out the action would not affect the environmental status quo.

Additional concern has been raised relating to the lethal removal of beaver by WS or the recommendation of lethal methods to alleviate damage or threats of damage under the proposed action alternative. Beaver lethally removed could be replaced by other beaver requiring additional assistance later. Houston (1995) indicated that beaver tend to reoccupy vacant habitats. The likelihood that a site would be recolonized by beaver varies depending on many factors. For example, removal of beaver and a beaver dam from a relatively uniform section of irrigation canal may resolve the problem for an extended period because the relatively uniform nature of the canal does not predispose a site to repeat problems. Recolonization would also depend on the proximity and density of the beaver population in the surrounding area. Isolated areas or areas with a lower density of beaver would normally take longer for beaver to recolonize than areas with higher beaver densities. Activities conducted under the proposed action would be directed at specific beaver and/or beaver colonies and would not be conducted to suppress the overall beaver population in the State.

In accordance with WS Directive 2.101, preference would be given to non-lethal methods where practical and effective. Although use of exclusion and water control devices could greatly reduce the need for lethal beaver removal, beaver removal may still be needed in some situations even though a flow device or water control system had been installed (Wood et al. 1994, Nolte et al. 2001, Simon 2006, Spock 2006). Callahan (2005) states the trapping of beaver to alleviate damage should occur "*...where a flow device is either not feasible or fails, the water level needs to be drastically lowered, or the landowner wants no beavers or ponds on their property*". Spock (2006) reported that beaver had to be trapped out of one site when an exclusion system was augmented by the installation of a water control device. Lisle (1996) noted that it might be necessary to remove beaver that have learned to dam around exclusion and water control devices. In some instances, trapping during the annual trapping season for beaver continued to occur at or near the area where water control devices were installed but was not prompted by the failure of the devices (Lisle 1996, Simon 2006, Spock 2006).

Exclusion and water control devices may not be the most effective method in specific types of terrain and are not suitable for every site (Wood et al. 1994, Nolte et al. 2001, Langlois and Decker 2004, Callahan 2005). Exclusion devices and water control devices may not be suitable for man-made, uniform channels, such as agricultural drainage ditches and irrigation canals. In addition, exclusion devices and water control devices may not be suitable for reservoirs, areas where human health, property or safety would be threatened with even minor elevation in water level, and areas where the landowner has expressed zero tolerance for beaver activity on their property (Callahan 2003, Callahan 2005, Simon 2006). Water control devices may be ineffective in beaver ponds in broad, low-lying areas because even a slight increase in water depth can result in a substantial increase in the area flooded (Organ et al. 1996). Exclusion and water control systems would not resolve problems related to beaver construction of bank dens. Depending upon site characteristics, beaver may build bank dens instead of lodges by burrowing into banks, levees, and other earthen impoundments. When bank dens are built in earthen levees or in banks supporting roadways or railroad tracks, they can greatly weaken the earthen structure. Burrowing into embankments can weaken the integrity of impoundments. Burrows allow water to infiltrate embankments, which can allow water to seep through the embankments causing erosion and weakening water impoundments. In those situations, removal of the beaver (either by translocation or by lethal methods) could be the only practical solution to resolve the potential for damage.

Water control devices may also be inappropriate in areas that are managed for aquatic species that need free-flowing water conditions and gravel substrate to survive. The still water and silt that accumulates behind beaver dams can be detrimental to some species. In addition, beaver dams could impede the

movement of fish upstream. Avery (2004) found the removal of beaver dams resulted in substantial increases in the stream area where trout could be found. For example, a 9.8-mile treatment zone on the North Branch of the Pemebonwon River in Wisconsin and an additional 17.9 miles of seven tributaries to the treatment section of the river were maintained free of beaver dams since 1986. In 1982, prior to dam removal, wild brook trout were found in only four of the seven tributaries within the treatment zone and at only four of the 12 survey stations. In the spring of 2000, wild brook trout were present in all seven tributaries and at all 12 survey stations (Avery 2004). In some cases, water control devices could be modified to improve fish passage (Close 2003). Although the presence of beaver dams could be detrimental to some species of fish, some fish species may benefit from the presence of a beaver dam (Rosell et al. 2005, Bergman et al. 2007, Pollock et al. 2007, Pollock et al. 2012, Pollock et al. 2014).

Although beaver can serve a valuable role in wetland ecology, the presence of beaver dams in existing wetlands that property owners or managers manage intensively could be a concern to those entities. In those wetlands, property owners or managers often use man-made water control structures to manage the water level in the wetland area in order to maximize habitat value for waterfowl and specific types of wetland-dependent wildlife. Therefore, the presence of beaver dams can impede the use of those structures or cause elevated water levels that are contrary to the objectives of the wetland. While general elevations or reductions in water levels might conceivably be achieved by installing pipe systems through beaver dams in managed wetlands, the devices tend to be more difficult to adjust than man-made water control structures. More importantly, the primary difficulty associated with pipe systems in those situations comes when property owners or managers use drawdowns to achieve wetland management objectives. Drawdowns generally involve reducing the water level until large sections of mudflat are exposed. Many plant species valuable to waterfowl and other wetland bird species need exposed mudflats to sprout. Shorebirds can also use the mudflats to forage for invertebrates. The extent of the water level reduction conflicts with the beaver's desire for water deep enough to provide protection, and water area of sufficient extent to provide relatively easy access to foraging sites. The extent of the water level reduction during a drawdown would likely increase the risk of new dam creation in other locations that may cause new problems (Callahan 2003).

Alternative 2 – Aquatic Rodent Damage Management by WS through Technical Assistance Only

The issues regarding the effects on wetlands under this alternative would likely be similar to those issues discussed under the proposed action. This similarity would be based on WS' recommendation of methods to manage damage caused by beaver and the recommendation of methods to manage the water impounded by beaver dams. Based on information provided by the person requesting assistance or based on site visits, WS could recommend that a landowner or manager manipulate beaver dams to reduce flooding damage or threats of damage. WS would not be directly involved with conducting activities associated with the manipulation of beaver dams under this alternative. However, the recommendation of the use of methods would likely result in the requester employing those methods or employing an agent to employ them. Therefore, by recommending methods and thus a requester employing those methods, the potential for those methods to reduce the presence of impounded water would be similar to the proposed action.

WS could instruct and demonstrate the proper use and placement of flow control and exclusionary devices, as well as recommend the breaching or removal of beaver dams, when appropriate. WS would also assist requesters by providing information on permit requirements and which state and/or federal agencies need to be contacted by the requester to obtain appropriate permits to manipulate the levels of water impounded by beaver dams.

The efficacy of methods employed by a cooperator would be based on the skill and knowledge of the requester or their agent despite WS' recommendations or demonstration. Therefore, a lack of

understanding of the behavior of beaver along with inadequate knowledge and skill in using methodologies to resolve flooding could lead to incidents with a greater probability of unforeseen impacts to wetlands. In those situations, the potential for dam manipulation to affect the status of wetlands adversely would likely be regarded as greater than those affects discussed under the proposed action alternative.

WS would recommend the landowner or manager seek and obtain the proper permits to manipulate water levels impounded by beaver dams under this alternative; however, WS would not be responsible for ensuring that appropriate permits were obtained, proper methods were implemented for manipulating water levels, or for reviewing sites for the presence of T&E species. Those responsibilities would be incurred by the property owner/manager and/or their designated agent who may or may not properly follow WS' recommendations.

Alternative 3 – No Aquatic Rodent Damage Management Conducted by WS

Under this alternative, WS would not be involved with any aspect of managing water levels associated with beaver dam impoundments. Under the no involvement by WS alternative, WS would not be involved with any aspect of managing damage associated with beaver in the State, including technical assistance. Due to the lack of involvement in managing damage caused by beaver, no impacts to wetlands would occur directly from WS. This alternative would not prevent those entities experiencing threats or damage due to flooding from manipulating water levels associated with beaver dams in the absence of WS' assistance. Those methods described previously would be available to other entities to breach or remove dams, including explosives and water flow devices. However, the use of explosives to remove dams under this alternative would be limited to those persons trained and licensed to use explosives. A property owner or manager could seek the services of an entity trained and licensed to use explosives to remove beaver dams under this alternative. The direct burden of implementing permitted methods would be placed on those persons experiencing damage.

Since the same methods would be available to resolve or prevent beaver damage or threats related to beaver dams, effects on the status of wetlands in the State from the use of those methods would be similar between the alternatives. However, manipulating water levels by those persons not experienced in identifying wetland characteristics or unaware of the requirement to seek appropriate permits to alter areas considered as a wetland, could increase threats to wetlands and the associated flora and fauna.

4.2 CUMULATIVE IMPACTS OF THE PROPOSED ACTION BY ISSUE

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

Under Alternative 1 and Alternative 2, WS would address damage associated with aquatic rodents either by providing technical assistance only (Alternative 2) or by providing technical assistance and direct operational assistance (Alternative 1) in the State. WS would be the primary federal agency conducting direct operational aquatic rodent damage management in the State under Alternative 1 and Alternative 2. However, other federal, state, and private entities could also be conducting aquatic rodent damage management in the State.

The potential cumulative impacts could occur from either WS' damage management program activities over time or from the aggregate effects of those activities combined with the activities of other agencies

and private entities. Through ongoing coordination and collaboration between WS, the ODAFF, and the ODWC, activities of each agency and the removal of aquatic rodents would be available. Damage management activities in the State would be monitored to evaluate and analyze activities to ensure they were within the scope of analysis of this EA.

WS does not normally conduct direct damage management activities concurrently with other outside entities in the same area, but may conduct damage management activities at adjacent sites within the same period. In addition, commercial companies may conduct damage management activities in the same area. The activities proposed in the alternatives would have a negligible effect on atmospheric conditions including the global climate. Meaningful direct or indirect emissions of greenhouse gases would not occur because of any of the proposed alternatives. Those alternatives would meet the requirements of applicable laws, regulations, and Executive Orders including the Clean Air Act and Executive Order 13514.

Issue 1 - Effects of Damage Management Activities on Target Aquatic Rodent Populations

The issue of the effects on target aquatic rodent species arises from the use of non-lethal and lethal methods to address the need for reducing damage and threats. As part of an integrated methods approach to managing damage and threats, WS could apply both lethal and non-lethal methods when requested by those persons experiencing damage.

Non-lethal methods could dissuade, disperse or otherwise make an area unattractive to aquatic rodents causing damage; thereby, reducing the presence of aquatic rodents at the site and potentially the immediate area around the site where non-lethal methods were employed. WS' employees would give non-lethal methods priority when addressing requests for assistance (see WS Directive 2.101). However, WS would not necessarily employ non-lethal methods to resolve every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model. For example, if a cooperator requesting assistance, had already attempted to disperse aquatic rodents using non-lethal harassment methods, WS would not necessarily employ those methods again during direct operational assistance since those methods had already been proven to be ineffective in that particular situation. WS and other entities could use non-lethal methods to exclude, harass, and disperse target wildlife from areas where damage or threats were occurring. When effective, non-lethal methods would disperse aquatic rodents from an area resulting in a reduction in the presence of those aquatic rodents at the site where WS or other entities employed those methods. However, aquatic rodents responsible for causing damage or threats would likely disperse to other areas with minimal impacts occurring to those species' populations. WS would not employ non-lethal methods over large geographical areas or apply those methods at such intensity that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. WS and most people generally regard non-lethal methods as having minimal impacts on overall populations of wildlife since individuals of those species would be unharmed. Therefore, the use of non-lethal methods would not have cumulative effects on aquatic rodent populations in the State.

WS' employees could employ lethal methods to resolve damage associated with those target aquatic rodent species identified by WS as responsible for causing damage or threats to human safety. However, lethal removal by WS would only occur after receiving a request for such assistance and only after the ODWC authorized WS to remove the species, when required. Therefore, the use of lethal methods could result in local reductions in the number of target animals in the area where damage or threats were occurring since WS would remove those target individuals from the population. WS would often employ lethal methods to reinforce non-lethal methods and to remove aquatic rodents that have been identified as causing damage or posing a threat to human safety. The use of lethal methods could therefore result in local reductions of aquatic rodents in the area where damage or threats were occurring. The number of

aquatic rodents removed from a species' population using lethal methods under the proposed action would be dependent on the number of requests for assistance received, the number of aquatic rodents involved with the associated damage or threat, and the efficacy of methods employed.

WS would maintain ongoing contact with the ODWC to ensure activities were within management objectives for those species. Therefore, the ODWC would have the opportunity to monitor the total removal of aquatic rodents from all sources and could factor in survival rates from predation, disease, and other mortality data.

WS would monitor removal by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of removal was below the level that would cause undesired adverse effects to the viability of native species populations. This EA analyzed the potential cumulative impacts on the populations of target aquatic rodent species from the implementation of the proposed action alternative in Section 4.1.

Evaluation of activities relative to target species indicated that program activities would likely have no cumulative adverse effects on aquatic rodent populations when targeting those species responsible for damage at the levels addressed in this EA. WS' actions would be occurring simultaneously, over time, with other natural processes and human generated changes that are currently taking place. These activities include, but would not be limited to:

- Natural mortality of aquatic rodents
- Mortality through vehicle strikes, aircraft strikes, and illegal harvest
- Human-induced mortality of aquatic rodents through annual hunting and trapping seasons
- Human-induced mortality of aquatic rodents through private damage management activities
- Human and naturally induced alterations of wildlife habitat
- Annual and perennial cycles in wildlife population densities
- Precipitation levels

All those factors play a role in the dynamics of aquatic rodent populations. In many circumstances, requests for assistance arise when some or all of those elements have contrived to elevate target species populations or place target species at a juncture to cause damage to resources. The actions taken to minimize or eliminate damage would be constrained as to scope, duration, and intensity for the purpose of minimizing or avoiding impacts to the environment. WS would use the Decision Model to evaluate the damage occurring, including other affected elements and the dynamics of the damaging species, to determine appropriate strategies to minimize effects on environmental elements. The Model would allow WS to implement damage management actions and to monitor those actions to adjust/cease damage management actions, which would allow WS to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative effects on target species (Slate et al. 1992).

With management authority over aquatic rodent populations in the State, the ODWC could adjust removal levels, including the removal of WS, to ensure population objectives for aquatic rodents were achieved. Consultation and reporting of removal by WS would ensure the ODWC had the opportunity to consider any activities WS conducts.

WS' removal of aquatic rodents in Oklahoma from FY 2009 through FY 2013 was of a low magnitude when compared to the total known removal of those species and the populations of those species. The ODWC could consider all known removal when determining population objectives for aquatic rodents and could adjust the number of aquatic rodents that could be harvested during the regulated harvest

season and the number of aquatic rodents removed for damage management purposes to achieve the population objectives. Any removal of regulated aquatic rodent species by WS would occur with concurrence of the ODWC. Any aquatic rodent population declines or increases would be the collective objective for aquatic rodent populations established by the ODWC through the regulation of lethal removal. Therefore, the cumulative removal of aquatic rodents annually or over time by WS would occur of the as part of ODWC management objectives for aquatic rodents in the State. No cumulative adverse effects on target and non-target wildlife would be expected from WS' damage management activities based on the following considerations:

Historical outcomes of WS' damage management activities on wildlife

WS would conduct damage management activities associated with aquatic rodents only at the request of a cooperator to reduce damage that was occurring or to prevent damage from occurring and only after methods to be used were agreed upon by all parties involved. WS would monitor activities to ensure any potential impacts were identified and addressed. WS would work closely with resource agencies to ensure damage management activities would not adversely affect aquatic rodent populations and that WS' activities were considered as part of management goals established by those agencies. Historically, WS' activities to manage damage caused by aquatic rodents in Oklahoma have not reached a magnitude that would cause adverse effects to aquatic rodent populations in the State.

SOPs built into the WS program

SOPs are designed to reduce the potential negative effects of WS' actions on aquatic rodents, and have been tailored to respond to changes in wildlife populations that could result from unforeseen environmental changes. This would include those changes occurring from sources other than WS. Alteration of activities would be defined through SOPs, and implementation would be insured through monitoring, in accordance with the WS Decision Model (see WS Directive 2.201; Slate et al. 1992).

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

Potential effects on non-target species from conducting aquatic rodent damage management arise from the use of non-lethal and lethal methods to alleviate or prevent those damages. The use of non-lethal methods during activities to reduce or prevent damage caused by aquatic rodents has the potential to exclude, dissuade, disperse, or capture non-target wildlife. However, the effects of non-lethal methods are often temporary and often do not involve the removal (killing) of non-target wildlife species. When using exclusion devices and/or repellents, both target and non-target wildlife can be prevented from accessing the resource being damaged. Since exclusion and repellents do not involve lethal removal, cumulative impacts on non-target species from the use of exclusionary methods or repellents would not occur but would likely disperse those individuals to other areas. Exclusionary methods and repellents can require constant maintenance to ensure effectiveness. Therefore, the use of exclusionary devices and repellents would be somewhat limited to small, high-value areas and not used to the extent that non-targets would be excluded from large areas that would cumulatively impact populations from the inability to access a resource, such as potential food sources, or shelter. The use of visual and auditory harassment and dispersion methods would generally be temporary with non-target species returning after the cessation of those activities. Dispersal and harassment do not involve the removal (killing) of non-target species and similar to exclusionary methods would not be used to the extent or at a constant level that would prevent non-targets from accessing critical resources that would threaten survival of a population.

The use of lethal methods or those methods used to live-capture target species followed by euthanasia also have the potential to affect non-target wildlife through the removal (killing) or capture of non-target species. Capture methods used are often methods that would be set to confine or restrain target wildlife

after being triggered by a target individual. Capture methods would be employed in such a manner as to minimize the threat to non-target species by placement in those areas frequently used by target wildlife, using baits or lures that are as species specific as possible, and modification of individual methods to exclude non-targets from capture. Most methods described in Appendix B are methods that would be employed to confine or restrain wildlife that would be subsequently euthanized using humane methods. With all live-capture devices, non-target wildlife captured could be released on site if determined to be able to survive following release. SOPs are intended to ensure removal of non-target wildlife is minimal during the use of methods to capture target wildlife.

The use of firearms and euthanasia methods would essentially be selective for target species since identification of an individual would be made prior to the application of the method. Euthanasia methods would be applied through direct application to target wildlife. Therefore, the use of those methods would not affect non-target species.

All chemical methods would be tracked and recorded to ensure proper accounting of used and unused chemicals occurs. All chemicals would be stored and transported according to WS' Directives and relevant federal, state, and local regulations. Chemical methods available for use under the proposed action would include repellents, immobilizing drugs, and euthanasia chemicals, which are described in Appendix B. Except for repellents that would be applied directly to the affected resource and reproductive inhibitors that would be applied directly to target animals, those chemical methods available for use would be employed using baits that were highly attractive to target species, used in known burrow/den sites, and/or used in areas where exposure to non-targets would be minimal. The use of those methods often requires an acclimation period and monitoring of potential bait sites for non-target activity. All chemicals would be used according to product labels, which would ensure that proper use would minimize non-target threats. WS' adherence to Directives and SOPs governing the use of chemicals would also ensure non-target hazards would be minimal.

Repellents may be used or recommended by the WS program in Oklahoma to manage aquatic rodent damage. The active ingredients in numerous commercial repellents are capsaicin, pepper oil, and carnivore urine. Characteristics of these chemicals and potential use patterns indicate that no cumulative impacts related to environmental fate would be expected from their use in WS' programs in Oklahoma when used according to label requirements.

The amount of chemicals used or stored by WS would be minimal to ensure human safety. All label requirements of repellents and toxicants would be followed to minimize non-target hazards. Based on this information, WS' use of chemical methods, as part of the proposed action, would not have cumulative impacts on non-targets.

The methods described in Appendix B have a high level of selectivity and could be employed using SOPs to ensure minimal impacts to non-target species. The unintentional removal of wildlife would likely be limited and would not reach a magnitude where adverse effects would occur. Based on the methods available to resolve aquatic rodent damage and/or threats, WS does not anticipate the number of non-targets lethally removed to reach a magnitude where declines in those species' populations would occur. Therefore, removal under the proposed action of non-targets would not cumulatively affect non-target species. WS' has reviewed the T&E species listed by the ODWC and the USFWS. WS has met with the USFWS and has initiated consultation pursuant to Section 7 of the ESA. WS would abide by the outcome resulting from the consultation process. Cumulative impacts would be minimal on non-targets from any of the alternatives discussed**.**

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

Non-chemical methods described in Appendix B would be used within a limited period, would not be residual, and do not possess properties capable of inducing cumulative effects on human health and safety. Non-chemical methods would be used after careful consideration of the safety of those persons employing methods and to the public. When possible, capture methods would be employed where human activity was minimal to ensure the safety of the public. Capture methods also require direct contact to trigger ensuring that those methods, when left undisturbed, would have no effect on human safety. All methods would be agreed upon by the requesting entities, which would be made aware of the safety issues of those methods when entering into a MOU, work initiation document, or another comparable document between WS and the cooperating entity. SOPs would also ensure the safety of the public from those methods used to capture or remove wildlife. Firearms used to alleviate or prevent damage, though hazards do exist, would be employed to ensure the safety of employees and the public.

Personnel employing non-chemical methods would continue to be trained to be proficient in the use of those methods to ensure the safety of the applicator and to the public. Based on the use patterns of non-chemical methods, those methods would not cumulatively affect human safety.

Repellents to disperse aquatic rodents from areas of application would be available. Repellents must be registered with the EPA according to the FIFRA and registered with the ODAFF. Many of the repellents currently available for use have active ingredients that are naturally occurring and are generally regarded as safe. Although some hazards exist from the use of repellents, hazards occur primarily to the handler and applicator. When repellents were applied according to label requirements, no effects to human safety would be expected. Given the use patterns of repellents, no cumulative effects would occur to human safety.

When using explosives to remove beaver dams, WS would only use binary explosives (see Appendix B). WS' employees who conduct activities using binary explosives would receive training in accordance with WS Directive 2.435. WS personnel who use explosives undergo extensive training and are certified to safely use explosives. WS' employees must adhere to the safe storage, transportation and use policies and regulations of WS, the Bureau of Alcohol, Tobacco and Firearms, the Occupational Safety and Health Administration, and the Department of Transportation.

WS has received no reports or documented any effects to human safety from WS' aquatic rodent damage management activities conducted from FY 2009 through FY 2013. No cumulative effects from the use of those methods discussed in Appendix B would be expected given the use patterns of those methods for resolving aquatic rodent damage in the State.

Issue 4 - Effects on the Aesthetic Values of Aquatic Rodents

The activities of WS would result in the removal of aquatic rodents from those areas where damage or threats were occurring. Therefore, the aesthetic value of aquatic rodents in those areas where damage management activities were being conducted would be reduced. However, for some people, the aesthetic value of a more natural environment would be gained by reducing aquatic rodent densities, including the return of native species that may be suppressed or dispersed by non-native species.

Some people experience a decrease in aesthetic enjoyment of wildlife because they feel that overabundant species are objectionable and interfere with their enjoyment of wildlife in general. Continued increases in numbers of individuals or the continued presence of aquatic rodents may lead to further degradation of some people's enjoyment of any wildlife or the natural environment. The actions of WS could positively

affect the aesthetic enjoyment of wildlife for those people that were being adversely affected by the target species identified in this EA.

Aquatic rodent population objectives would be established and enforced by the ODWC by regulating harvest during the statewide hunting and trapping seasons after consideration of other known mortality factors. Therefore, WS would have no direct impact on the status of aquatic rodent populations since removal by WS would occur at the discretion of the ODWC. Since those persons seeking assistance could remove aquatic rodents from areas where damage was occurring through permits or the services of other entities, WS' involvement would have no effect on the aesthetic value of aquatic rodents in the area where damage was occurring. When damage caused by aquatic rodents has occurred, any removal of aquatic rodents by the property or resource owner would likely occur whether WS was involved with taking the aquatic rodents or not.

In the wild, few animals in the United States have life spans approaching that of people. Mortality is high among wildlife populations and specific individuals among a species may experience death early in life. Mortality in wildlife populations is a natural occurrence and people who form affectionate bonds with animals experience loss of those animals over time in most instances. A number of professionals in the field of psychology have studied human behavior in response to attachment to pet animals (Gerwolls and Labott 1994, Marks and Koepke 1994, Zasloff 1996, Archer 1999, Ross and Baron-Sorensen 1998, Meyers 2000). Similar observations were probably applicable to close bonds that could exist between people and wild animals. As observed by researchers in human behavior, normal human responses to loss of loved ones proceed through phases of shock or emotional numbness, sense of loss, grief, acceptance of the loss or what cannot be changed, healing, and acceptance and rebuilding which leads to resumption of normal lives (Lefrancois 1999). Those who lose companion animals, or animals for which they may have developed a bond and affection, are observed to proceed through the same phases as with the loss of human companions (Gerwolls and Labott 1994, Boyce 1998, Meyers 2000). However, they usually establish a bond with other individual animals after such losses. Although they may lose the sense of enjoyment and meaning from the association with those animals that die or are no longer accessible, they usually find a similar meaningfulness by establishing an association with new individual animals or through other relational activities (Weisman 1991). Through this process of coping with the loss and establishing new affectionate bonds, people may avoid compounding emotional effects resulting from such losses (Parkes 1979, Lefrancois 1999).

Some aquatic rodents with which people have established affectionate bonds may be removed from some project sites by WS. However, other individuals of the same species would likely continue to be present in the affected area and people would tend to establish new bonds with those remaining animals. In addition, human behavior processes usually result in individuals ultimately returning to normalcy after experiencing the loss of association with a wild animal that might be removed from a specific location. WS' activities would not be expected to have any cumulative effects on this element of the human environment.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

WS would continue to seek new methods and ways to improve current technology to improve the humaneness of methods used to manage damage caused by wildlife. Cooperation with individuals and organizations involved in animal welfare continues to be an agency priority for the purpose of evaluating strategies and defining research aimed at developing humane methods.

All methods not requiring direct supervision during employment (*e.g.*, live traps) would be checked in accordance with WS policy to ensure any wildlife confined or restrained were addressed in a timely manner to minimize distress of the animal. All euthanasia methods used for live-captured aquatic rodents

would be applied according to WS' directives. Shooting would occur in some situations and personnel would be trained in the proper use of firearms to minimize pain and suffering of aquatic rodents removed by this method.

WS would employ methods as humanely as possible by applying SOPs to minimize pain and that allow wildlife captured to be addressed in a timely manner to minimize distress. Through the establishment of SOPs that guide WS in the use of methods to address damage and threats associated with aquatic rodents in the State, the cumulative impacts on the issue of method humaneness would be minimal. All methods would be evaluated to ensure SOPs were adequate and that wildlife captured were addressed in a timely manner to minimize distress.

Issue 6 - Effects of Damage Management Activities on the Regulated Harvest of Aquatic Rodents

As discussed in this EA, the magnitude of WS' aquatic rodent removal for damage management purposes from FY 2009 through FY 2013 was low when compared to the total removal of aquatic rodents and when compared to the estimated statewide populations of those species. Since removal of aquatic rodents is regulated by the ODWC, removal by WS that could occur annually and cumulatively would occur pursuant to aquatic rodent population objectives established in the State. WS' removal of aquatic rodents (combined removal) annually to alleviate damage would be a minor component to the known removal that occurs annually by other entities.

The populations of several aquatic rodent species are sufficient to allow for annual harvest seasons that typically occur during the fall and winter. Hunting and trapping seasons are established by the Oklahoma Wildlife Commission and regulated by the ODWC.

With oversight of aquatic rodent removal, the ODWC and WS confer to meet management objectives for aquatic rodents in the State. Therefore, the cumulative removal of aquatic rodents would be considered as part of the ODWC objectives for aquatic rodent populations in the State.

Issue 7 – Effects of Beaver Removal and Dam Manipulation on the Status of Wetlands in the State

Beaver build dams primarily in smaller riverine streams (intermittent and perennial brooks, streams, and small rivers) and in drainage areas with dams consisting of mud, sticks and other vegetative materials. Their dams obstruct the normal flow of water and typically change the pre-existing hydrology from flowing or circulating waters to slower, deeper, more expansive waters that accumulate bottom sediment behind the dam. The depth of bottom sediment depends on the length of time an area is covered by water and the amount of suspended sediment in the water.

The pre-existing habitat and the altered habitat have different ecological values to the fish and wildlife native to an area. Some species would abound by the addition of a beaver dam, while others would diminish. For example, some fish species require fast moving waters over gravel or cobble beds, which beaver dams can eliminate, thus reducing the habitat's value for these species. In general, it has been found that wildlife habitat values decline around bottomland beaver impoundments because trees are killed from flooding and mast production declines. On the other hand, beaver dams can potentially be beneficial to some species of fish and wildlife such as river otter, neotropical birds, and waterfowl.

If a beaver dam is not breached and water is allowed to stand, hydric soils and hydrophytic vegetation eventually form. This process can take anywhere from several months to years depending on pre-existing conditions. Hydric soils are those soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. In general, hydric soils form much easier where wetlands have preexisted. Hydrophytic vegetation includes those plants that grow in water or on a

substrate that is at least periodically deficient in oxygen because of excessive water content. If these conditions are met, then a wetland has developed that would have different wildlife habitat values than an area that has been more recently impounded by beaver dam activity.

The intent of most dam breaching is not to drain established wetlands. With few exceptions, requests from public and private individuals and entities that WS receives involve dam breaching to return an area back to its pre-existing condition within a few years after the dam was created. If the area does not have hydric soils, it usually takes many years for them to develop and a wetland to become established. This often takes greater than five years as recognized by the Swampbuster provisions. Most beaver dam removal by WS is either exempt from regulation under Section 404 of the CWA as stated in 33 CFR Part 323 or may be authorized under the United States Army Corps of Engineers Nationwide Permit System in 33 CFR Part 330.

However, the breaching of some beaver dams can trigger certain portions of Section 404 that require landowners to obtain permits from the United States Army Corps of Engineers. WS' personnel determine the proper course of action upon inspecting a beaver dam impoundment.

It should also be noted that beaver created wetlands are dynamic and do not remain in one state for indefinite periods. Large beaver ponds may eventually fill with sediment and create a beaver meadow. Beaver may be removed from an area due to natural predation or they may abandon an area due to lack of food. Once a dam is abandoned, it is subject to natural decay and damage due to weather. The dam would eventually fail and the wetland would return to a flowing stream or brook. WS' beaver management activities may accelerate or modify these natural processes by removing beaver and restoring or increasing water flow; however, they are generally processes that would occur naturally over time.

Muskrat management would usually be intended to maintain or protect existing wetlands by reducing threats to natural and man-made wetlands and associated floral, faunal and T&E communities. Wetlands are often created by natural or man-made dams, dikes, levees, and berms that contain standing water or control drainage, particularly after precipitation events that could result in flooding. Muskrat burrowing activity can degrade the integrity of these structures by allowing water infiltration or by causing erosion by feeding on vegetation intended to stabilize dirt structures. Muskrats are omnivores and feed on a variety of aquatic and terrestrial plants and aquatic animals. At high population densities, they may disrupt or damage natural wetland floral and faunal communities or they may feed on T&E species. WS activities would be intended to protect existing wetlands from damage caused by muskrats.

Therefore, the activities of WS to manage flooding damage by manipulating beaver dams would not be expected to have any cumulative adverse effects on wetlands in Oklahoma when conducted in accordance with the CWA and the Swampbuster provision of the Food Security Act.

CHAPTER 5: LIST OF PREPARERS AND PERSONS CONSULTED

5.1 LIST OF PREPARERS

Kevin Grant, State Director, USDA-APHIS-Wildlife Services
Ryan Wimberly, Staff Wildlife Biologist, USDA-APHIS-Wildlife Services
Patrick Whitley, Wildlife Disease Biologist, USDA-APHIS-Wildlife Services

5.2 LIST OF PERSONS CONSULTED

Alan Peoples, Wildlife Division Chief, ODWC

Jerrod Davis, Furbearer Biologist, ODWC
Jontie W. Aldrich, Acting Project Leader & State Coordinator, USFWS
John Hendrix, Wildlife Biologist, USFWS
Blayne Arthur, Associate Commissioner of Agriculture, ODAFF

APPENDIX A
LITERATURE CITED

American Veterinary Medical Association. 1987. Panel report on the colloquium on recognition and alleviation of animal pain and distress. Journal of the American Veterinary Medical Association 191:1186-1189.

American Veterinary Medical Association. 2007. American Veterinary Medical Association guidelines on euthanasia. American Veterinary Medical Association. Schaumburg, Illinois.

American Veterinary Medical Association. 2013. American Veterinary Medical Association guidelines on euthanasia. American Veterinary Medical Association. http://www.avma.org/issues/animal_welfare/euthanasia.pdf. Accessed on March 6, 2013.

Andrews, E. J., B. T. Bennett, J. D. Clark, K. A. Houpt, P. J. Pascoe, G. W. Robinson, and J. R. Boyce. 1993. Report on the American Veterinary Medical Association panel on euthanasia. Journal of the American Veterinary Medical Association 202:229-249.

Archer, J. 1999. The nature of grief: The evolution and psychology of reactions to loss. Taylor & Francis/Routledge, Florence, Kentucky.

Arner, D. H. 1964. Research and a practical approach needed in management of beaver and beaver habitat in the Southeastern United States. Transactions of the North American Wildlife Conference 29:150-158.

Arner, D. H., J. Baker, D. Wesley, and B. Herring. 1967*a*. An inventory and study of beaver impounded water in Mississippi. Water Resources Research Institute, Mississippi State University, Mississippi.

Arner, D. H., D. Wesley, and B. Herring. 1967*b*. Possibilities for recreational development in beaver impounded waters. Transactions of the Third Annual Water Resources Conference, San Francisco, California.

Arner, D. H., and J. S. Dubose. 1978*a*. The economic impact of increased forest and farmland beaver damage in Mississippi. Water Resources Research Institute, Mississippi State University, Mississippi State, Mississippi. 41pp.

Arner, D. H., and J. S. Dubose. 1978*b*. Increase in beaver impounded water in Mississippi over a ten year period. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 32:150–153.

Arner, D. H., and J. S. DuBose. 1982. The impact of the beaver on the environment and economics in the southeastern United States. International Congress of Game Biologists 14:241-247.

Arner, D. H., and G. R. Hepp. 1989. Beaver pond wetlands: A southern perspective. Pp 117-128 *in* L. M. Smith, R. L. Pederson, and R. M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Texas Tech University Press, Lubbock, Texas.

Association of Fish and Wildlife Agencies. 2014. Best Management Practices. http://jjcdev.com/~fishwild/?section=best_management_practices. Accessed November 3, 2014.

Association of State Wetland Managers. 2013. Oklahoma and the national wetlands inventory. http://aswm.org/pdf_lib/mapping_2013/oklahoma.pdf. Accessed September 26, 2014.

Avery, E. L. 1992. Effects of removing beaver dams upon a northern Wisconsin brook trout stream. Wisconsin Department of Natural Resources Final D-J Project Report, F-83R. 185 pp.

Avery, E. L. 2004. A compendium of 58 trout stream habitat development evaluations in Wisconsin – 1985-2000. Wisconsin Department of Natural Resources Research Report 187. 96 pp.

Baker, B. W., and E. P. Hill. 2003. Beaver (*Castor canadensis*). Pages 288-310 *in* G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, eds. Wild mammals of North America: Biology, management, and conservation. Second edition. The Johns Hopkins University Press, Baltimore, Maryland.

Bateson, P. 1991. Assessment of pain in animals. Animal Behaviour, 42:827-839.

Beaver, B. V., W. Reed, S. Leary, B. McKiernan, F. Bain, R. Schultz, B. T. Bennett, P. Pascoe, E. Schull, L. C. Cork, R. Francis-Floyd, K. D. Amass, R. Johnson, R. H. Schmidt, W. Underwood, G. W. Thorton, and B. Kohn. 2001. 2000 Report of the AVMA panel on euthanasia. Journal of the American Veterinary Medical Association 218:669-696.

Beach, R., and W. F. McCulloch. 1985. Incidence and significance of *Giardia Lamblia* (Lambl) in Texas beaver populations. Proc. Great Plains Wildl. Damage Cont. Work. 7:152-164.

Bergman, D., D. Nolte, and J. Taylor. (comp.). 2007. Proceedings of the International Beaver Ecology and Management Workshop. USDA, APHIS, WS, Arizona State Office, 8836 North 23rd Ave. Suite 2, Phoenix AZ 85021.

Berryman, J. H. 1991. Animal damage management: Responsibilities of various agencies and the need for coordination and support. Proc. East. Wildl. Damage Control Conf. 5:12-14.

Bishop, R. C. 1987. Economic values defined. Pp. 24-33 *in* D. J. Decker and G. R. Goff, eds. Valuing wildlife: Economic and social perspectives. Westview Press, Boulder, Colorado.

Blanton, J. D., D. Palmer, and C. E. Rupprecht. 2010. Rabies surveillance in the United States during 2009. Journal of the American Veterinary Medical Association 237:646-657.

Blanton, J. D., D. Palmer, J. Dyer, and C. E. Rupprecht. 2011. Rabies surveillance in the United States during 2010. Journal of the American Veterinary Medical Association 239:773-783.

Blanton, J. D., J. Dyer, J. McBrayer, and C. E. Rupprecht. 2012. Rabies surveillance in the United States during 2011. Journal of the American Veterinary Medical Association 241:712-722.

Blanton, J. D., K. Robertson, D. Plamer, and C. E. Rupprecht. 2009. Rabies surveillance in the United States during 2008. Journal of the American Veterinary Medical Association 235:676-689.

Blundell, G. M., J. W. Kern, R. T. Bowyer, and L. K. Duffy. 1999. Capturing river otters: a comparison of Hancock and leg-hold traps. Wildlife Society Bulletin 27:184-192.

Boggess, E. K. 1994. Raccoons. Pp. C101-C107 *in* S. E. Hygnstrom, R. M. Timm and G. E. Larson, eds. Prevention and control of wildlife damage. University of Nebraska-Lincoln, Lincoln, Nebraska.

Bounds, D. L. 2000. Nutria: An invasive species of national concern. Wetland Journal 12:9-16.

Boutin, S., and D. E. Birkenholz. 1997. Muskrat and round-tailed muskrat. Pp. 282-313 *in* M. Novak, J. A. Baker, M. E. Obbard, and B. Mallock, eds. Wild Furbearer management and conservation in North America. The Ontario Trappers Association, Ontario Ministry of Natural Resources, Toronto, Canada.

Boyce, P. S. 1998. The social construction of bereavement: An application to pet loss. Thesis, City University of New York. 154 pp.

Boyles, S. L. 2006. Report on the efficacy and comparative costs of using flow devices to resolve conflicts with North American beavers along roadways in the Coastal Plain of Virginia. M.S. Thesis, Christopher Newport University, Newport News, Virginia. 48 pp.

Boyles, S., and S. Owens. 2007. North American Beaver (*Castor canadensis*): A technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. http://www.fs.fed.us/r2/projects/scp/assessments/northamericanbeaver.pdf. Accessed on November 3, 2014.

Brakhage, G. K., and F. W. Sampson. 1952. Rabies in beaver. Journal of Wildlife Management 16:226.

Bromley, P. T., J. F. Heisterberg, W. T. Sullivan, Jr., P. Sumner, J. C. Turner, R. D. Wickline, and D. K. Woodward. 1994. Wildlife damage management: beavers. North Carolina Cooperative Extension Service.

Brooks, R. P., M. W. Fleming, and J. J. Kennelly. 1980. Beaver colony response to fertility control: Evaluating a concept. Journal of Wildlife Management 44:568-575.

Brown, S. T., and J. W. Brown. 1999. How to control beaver flooding. Beavers Wetlands and Wildlife, Dolgeville, New York 13329.

Brown, S., D. Shafer, and S. Anderson. 2001. Control of beaver flooding at restoration projects. WRAP Technical Notes Collection (ERDC TN-WRAP-01-01), U.S. Army Engineer Research and Development Center, Vicksburg Mississippi. http://www.beaversww.org/assets/PDFs/US-ACE-paper.pdf. Accessed November 3, 2014.

Buckley, M., T. Souhlas, E. Niemi, E. Warren, and S. Reich. 2011. The economic value of beaver ecosystem services: Escalante River Basin, Utah. ECONorthwest, Eugene, Oregon. 66 pp.

California Department of Fish and Game. 1991. Final environmental document - bear hunting. Title 14 Calif. Code of Regs. Calif. Dept. of Fish and Game, State of California, April 25, 1991. 337 pp.

Callahan, M. 2003. Beaver management study. Association of Massachusetts Wetland Scientists Newsletter 44:12-15.

Callahan, M. 2005. Best management practices for beaver problems. Association of Massachusetts Wetland Scientists Newsletter 53:12-14.

Carter, J., and B. P. Leonard. 2002. A review of the literature on the worldwide distribution, spread of, and efforts to eradicate the coypu (*Myocastor coypus*). Wildlife Society Bulletin 30:162-175.

Caudell, J. N. 2008. In the news. Human-Wildlife Interactions 2:141-143.

Caudell, J. N. 2012. In the news. Human-Wildlife Interactions 6:179-180.

CDC. 2000. Notice to Readers: Update: West Nile Virus Isolated from Mosquitoes – New York, 2000. Morbidity and Mortality Weekly Report 49:211.

CDC. 2002. Rabies in a beaver – Florida, 2001. Centers for Disease Control and Prevention. Morbidity and Mortality Weekly Report. 51:481-482.

CDC. 2012. Parasites-Giardia: Epidemiology and risk factors. Centers for Disease Control and Prevention. http://www.cdc.gov/parasites/giardia/epi.html. Accessed January 26, 2015.

Chapman, F. B. 1949. The beaver in Ohio. Journal of Mammalogy 30:174-179.

Clausen, G., and A. Ersland. 1970. Blood O_2 and acid-base changes in the beaver during submersion. Respiration Physiology 11:104-112.

Clemson University. 2006. Clemson beaver pond leveler Version II. DVD. Clemson University Extension, Clemson, South Carolina.

Close, T. L. 2003. Modifications to the Clemson pond leveler to facilitate brook trout passage. Minnesota Department of Natural Resources Special Publication 158. 9 pp.

Conover, M. R. 1982. Comparison of two behavioral techniques to reduce bird damage to blueberries: methiocarb and hawk-kite predator model. Wildlife Society Bulletin 10:211-216.

Cooke, H. A., and S. Zack. 2008. Influence of beaver dam density on riparian areas and riparian birds in shrubsteppe of Wyoming. Western North American Naturalist 68:365-373.

Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K.Limburg, S. Naeem, R. V. O'Neill, J.Paruelo, R G. Raskin, P. Sutton, and M.van den Belt. 1997. The value of the world's ecosystem services and natural capital. Nature 387:253-260.

Courcelles, R., and R. Nault. 1983. Beaver programs in the James Bay area, Quebec, Canada. Acta Zool. Fenn. 174:129-131.

Craig, J. R., J. D. Rimstidt, C. A. Bonnaffon, T. K. Collins, and P. F. Scalon. 1999. Surface water transport of lead at a shooting range. Bulletin of Environmental Contamination and Toxicology 63:312-319.

Craven, S. R., and S. E. Hygnstrom. 1994. Deer. Pp D25–D40 *in* S. E. Hygnstrom, R. M. Timm, and G. E. Larson, eds. Prevention and Control of Wildlife Damage. University of Nebraska Cooperative Extension, Lincoln, Nebraska.

Craven, S.R., T. Barnes, and G. Kania. 1998. Toward a professional position on the translocation of problem wildlife. Wildlife Society Bulletin 26:171-177.

Dahl, T.E. 1990. Wetland losses in the United States, 1780s to 1980s. United States Department of Interior, United States Fish and Wildlife Service, Washington, D.C. 21 pp.

Davis, D. S. 1961. Principles for population control by gametocides. Transactions of the North American Wildlife Conference 26:160-166.

DeAlmeida, M. H. 1987. Nuisance furbearer damage control in urban and suburban areas. Pp. 996-1006 *in* Novak, J. A. Baker, M. E. Obbard, and B. Malloch, Eds., Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada.

Decker, D. J., and G. R. Goff. 1987. Valuing wildlife: economic and social perspectives. Westview Press, Boulder, Colorado.

Decker, D. J., and K. G. Purdy. 1988. Toward a concept of wildlife acceptance capacity in wildlife management. Wildlife Society Bulletin 16:53-57.

Decker, D. J., and L. C. Chase. 1997. Human dimensions of living with wildlife – a management challenge for the 21st century. Wildlife Society Bulletin 28:4-15.

Deems, E. F., and D. Pursley. 1978. North American Furbearers: their management, research, and harvest status in 1976. University of Maryland, College Park, Maryland.

Denney, R. N. 1952. A summary of North American beaver management, 1946-1948. Colorado Game and Fish Dep., Curr. Rep. 28. 58 pp.

Dickson, J. G. 2001. Early History. Pp. 20–30 *in* J. Dickson, ed. Wildlife of the Southern Forests: Habitat and management. Hancock House, Blaine, Washington.

Dolbeer, R. A. 1998. Population dynamics: The foundation of wildlife damage management for the 21st century. Pp. 2-11 *in* Barker, R. O. and Crabb, A. C., Eds. Eighteenth Vertebrate Pest Conference (March 2-5, 1998, Costa Mesa, California). University of California at Davis, Davis, California.

Dolbeer, R. A., N. R. Holler, and D. W. Hawthorne. 1994. Identification and control of wildlife damage. Pp. 474-506 *in* T. A. Bookhout, ed. Research and management techniques for wildlife and habitats. The Wildlife Society, Bethesda, Maryland.

Dolbeer, R. A., S. E. Wright, J. R. Weller, and M. J. Begier. 2014. Wildlife strikes to civil aircraft in the United States 1990–2013, Serial report 20. U.S. Department of Transportation, Federal Aviation Administration, Office of Airport Safety and Standards, Washington, D.C.

Dyer, J. L., R. Wallace, L. Orciari, D. Hightower, P. Yager, and J. D. Blanton. 2013. Rabies surveillance in the United States during 2012. Journal of the American Veterinary Medical Association 243:805-815.

EPA. 1995. Facts about wetlands. United States Environmental Protection Agency. Office of water, wetlands, oceans, and watersheds (4502F), Environmental Protection Agency 843-F-95-00le.

EPA. 2001. Selected mammal and bird repellents fact sheet. http://www.epa.gov/opp00001/chem_search/reg_actions/registration/fs_G-112_01-Mar-01.pdf. Accessed November 3, 2014.

EPA. 2012. Oklahoma water quality assessment report. Environmental Protection Agency. Watershed Assessment, Tracking and Environmental Results. http://ofmpub.epa.gov/waters10/attains_state.control?p_state=OK. Accessed January 9, 2015.

Federal Emergency Management Agency. 2005. Dam Owner's Guide to Animal Impacts on Earthen Dams. FEMA L-264.

Fouty, S. 2008*a*. Climate change and beaver activity: How restoring nature's engineers can alleviate problems. Beaversprite, Spring. 3 pp.

Fouty, S. C. 2008*b*. Current and historic stream channel response to changes in cattle and elk grazing pressure and beaver activity: southwest Montana and east-central Arizona. Ph.D. Dissertation, Department of Geography, University of Oregon, Corvallis, Oregon.

Fowler, M. E., and R. E. Miller. 1999. Zoo and wild animal medicine. W.B. Saunders Company, Philadelphia, Pennsylvania.

Fowler, J. F., S. Verma, and T. Delphin. 1994. An impact assessment of beaver damage in Louisiana during 1993. Report to the Louisiana State Natural Resources Committee.

Fur Institute of Canada. 2009. Update on implementation of agreement on international humane trapping standards. http://www.fur.ca/files/AIHTS_update_17Feb09.pdf. Accessed November 3, 2014.

Gerwolls, M. K., and S. M. Labott. 1994. Adjustment to the death of a companion animal. Anthrozoos 7:172-187.

Gilbert, F. F., and N. Gofton. 1982. Terminal dives in mink, muskrat, and beaver. Physiology and Behavior 28:835-840.

Godbee, J., and T. Price. 1975. Beaver damage survey. Georgia Forestry Commission, Macon, Georgia.

Gordon, K. L. and D. H. Arner. 1976. Preliminary study using chemosterilants for control of nuisance beaver. Proceedings of the Southeastern Association of Fish and Wildlife Agencies 30:463-465.

Gracely, R. H., and W. F. Sternberg. 1999. Athletes: pain and pain inhibition. American Pain Society 9:1-8.

Grasse, J. E., and E. F. Putnam. 1955. Beaver management and ecology in Wyoming. Wyoming Game and Fish Comm., Cheyenne, Wyoming.

Hanson, W. D., and R. S. Campbell. 1963. The effects of pool size and beaver activity on distribution and abundance of warm-water fishes in a north Missouri stream. American Midland Naturalist 69:136-149.

Haramis, M. 1997. The effect of nutria (*Myocastor coypus*) on marsh loss in the lower Eastern Shore of Maryland: an exclosure study. U.S. Geological Survey, Biological Resource Division, Patuxent Wildlife Research Center, 11410 American Holly Drive, Laurel, Maryland 20708-4015. Unpubl. Progress Rep.- 1997, Study Plan No. 80039.01.

Haramis, M. 1999. Nutria study progress report. U.S. Geological Survey, Biological Resource Division, Patuxent Wildlife Research Center, 11410 American Holly Drive, Laurel, Maryland 20708-4015. Unpubl. Nutria Study Progress Rep. 1998.

Hey, D. L., and N. S. Phillips. 1995. Flood reduction through wetland restoration: The Upper Mississippi River Basin as a case study. Restoration Ecology 3:4-17.

Hibbard, E. A. 1958. Movements of beaver transplanted in North Dakota. Journal of Wildlife Management 22:209-211.

Hill, E. P. 1976. Control methods for nuisance beaver in the southeastern United States. Proceedings of the Vertebrate Pest Conference 7:85-98.

Hill, E. P. 1982. Beaver. Pp. 256-281 *in* J. A. Chapman and G. A. Feldhamer, eds. Wild Mammals of North America: Biology, management, and economics. Johns Hopkins University Press, Baltimore, Maryland.

Hill, E. P., D. N. Lasher, and R. B. Roper. 1977. A review of techniques for minimizing beaver and white-tailed deer damage in southern hardwoods. Proceedings of the Symposium on Southeastern Hardwoods 2:79-93.

Hoagland, J. W. 1993. Nuisance beaver damage control proposal. Oklahoma Department of Wildlife Conservation. Internal Document. 20 pp.

Hood, G. A., and D. G. Larson. 2014. Beaver-created habitat heterogeneity influences aquatic invertebrate assemblages in boreal Canada. Wetlands 34:19-29.

Hood, G. A., and D. G. Larson. 2015. Ecological engineering and aquatic connectivity: a new perspective from beaver-modified wetlands. Freshwater Biology 60:198-208.

Hood, G. A., and S. E. Bayley. 2008. Beaver (*Castor canadensis*) mitigate the effects of climate on the area of open water in boreal wetlands in western Canada. Biological Conservation 141:556-567.

Houston, A. E. 1995. Beaver immigration into a control area. Southern Journal of Applied Forestry 19:127-130.

Howard, R., L. Berchielli, G. Parsons, and M. Brown. 1980. Trapping furbearers: Student manual. New York State Department of Conservation, New York.

International Association of Fish and Wildlife Agencies. 2005. The potential costs of losing hunting and trapping as wildlife management tools. Animal Use Committee, International Association of Fish and Wildlife Agencies, Washington, D.C. 55 pp.

Jackson, S., and T. Decker. 1993. Beavers in Massachusetts. University of Massachusetts Cooperative Extension System, Amherst, Massachusetts.

Jackson, S., and T. Decker. 2004. Beavers in Massachusetts natural history, benefits, and ways to resolve conflicts between people and beavers. UMass Extension, USDA and Massachusetts Department of Fish and Wildlife. 14 pp.

Jenkins, S. H., and P. E. Busher. 1979. *Castor canadensis*. Mammalian Species 120:1-8.

Jensen, P. G., P. D. Curtis, and D. L. Hamelin. 1999. Managing nuisance beavers at roadsides: A guide for highway departments. Cornell Cooperative Extension Publicaiton #147BEAV.

Johnson, M. R., R. G. McLean, and D. Slate. 2001. Field operations manual for the use of immobilizing and euthanizing drugs. USDA, APHIS, WS Operational Support Staff, Riverdale, Maryland.

Kendall, R. J., T. E. Lacher Jr., C. Bunck, F. B. Daniel, C. Driver, C. E. Grue, F. Leighton, W. Stansley, P. G. Watanabe, and M. Whitworth. 1996. An ecological risk assessment of lead shot exposure in non-waterfowl avian species: Upland game birds and raptors. Environmental Toxicology and Chemistry 15:4-20.

Kinler, N. W., G. Linscombe, and P. R. Ramsey. 1987. Nutria. Pp. 326-343 *in* M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch, eds. Wild furbearer management and conservation in North America. The Ontario Trappers Association, Ontario Ministry of Natural Resources, Toronto, Canada.

Knudsen, G. J., and J. B. Hale. 1965. Movements of transplanted beavers in Wisconsin. Journal of Wildlife Management 29:685-688.

Kreeger, T. J., U. S. Seal, and J. R. Tester, 1988. The Pathophysiological Response of Red Fox (*Vulpes vulpes*) to Padded, Foothold Traps (Draft). University of Minnesota for the Fur Institute of Canada, St. Paul, Minnesota, March 6, 1988.

Laidlaw, M. A., H. W. Mielke, G. M. Filippelli, D. L. Johnson, and C. R. Gonzales. 2005. Seasonality and children's blood lead levels: developing a predictive model using climatic variables and blood lead data from Indianapolis, Indiana, Syracuse, New York, and New Orleans, Louisiana (USA). Environmental Health Perspectives 113:793-800.

Langlois, S. A., and L. A. Decker. 2004. The use of water flow devices and flooding problems caused by beaver in Massachusetts. Massachusetts Division of Fisheries and Wildlife. 13 pp.

Laramie, H. A., Jr., and S. W. Knowles. 1985. Beavers and their control. University of New Hampshire Cooperative Extension Service, Durham, New Hampshire.

Latham, R. M. 1960. Bounties are bunk. National Wildlife Federation, Washington, D.C. 10 pp.

LeBlanc, D. J. 1994. Nutria. Pp. B71-B80 *in* S. E. Hygnstrom, R. M. Timm, and G. E. Larson, eds. Prevention and control of wildlife damage. University of Nebraska-Lincoln, Nebraska.

Lefrancois, G. R. 1999. The Lifespan. Sixth edition. Wadsworth Publishing Company, Belmont, California.

Lewis, J. W. 1979. Significance of beaver and beaver ponds in the Tombigbee Resource Conservation and Development Area Alabama-1978, Alabama Cooperative Extension Service, Circular CRD-7, Auburn University, Auburn, Alabama.

Linzey, A.V. & NatureServe (Hammerson, G. & Cannings, S.). 2013. *Castor canadensis*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Accessed January 22, 2015.

Linzey, D. W. 1998. The Mammals of Virginia. McDonald and Woodward, Blacksburg, Virginia.

Lisle, S. 1996. Beaver Deceivers. Wildlife Control Technology. September-October 42-44.

Lisle, S. 1999. Wildlife Programs at the Penobscot Nation. Transactions of the North American Wildlife and Natural Resource Conference 65:466-477.

Lisle, S. 2003. Use and potential of flow devices in beaver management. Lutra 46:211-216.

Loeb , B. F., Jr. 1994. The beaver of the old north state. Popular Government 59:18-23.

Logan, K. A., L. L. Sweanor, T. K. Ruth, and M. G. Hornocker. 1996. Cougars of the San Andred Mountains, New Mexico. Federal Aid in Wildlife Restoration Project W-128-R, Hornocker Wildlife Institute, Moscow, Idaho.

Loker, C. A., D. J. Decker, and S. J. Schwager. 1999. Social acceptability of wildlife management actions in suburban areas: 3 cases from New York. Wildlife Society Bulletin 27:152-159.

Lowe, S., M. Browne, S. Boudjelas, and M. De Poorter. 2000. 100 of the World's Worst Invasive Alien Species A selection from the Global Invasive Species Database. Published by The Invasive Species Specialist Group (ISSG**)** a specialist group of the Species Survival Commission (SSC) of the World Conservation Union (IUCN). 12 pp. First published as special lift-out in *Aliens 12*, December 2000. Updated and reprinted version: November 2004.

Lowery, G.H., Jr. 1974. The mammals of Louisiana and its adjacent waters. Louisiana State University Press, Baton Rouge, Louisiana. 565 pp.

Ludders, J. W., R. H. Schmidt, F. J. Dein, and P. N. Klein. 1999. Drowning is not euthanasia. Wildlife Society Bulletin 27:666-670.

Lynch, J. J., T. O'Neil, and D. W. Lay. 1947. Management significance of damage by geese and muskrats to Gulf Coast Marshes. Journal of Wildlife Management 1:50-76.

Mallis, A. 1982. Handbook of pest control, 6th ed. Franzak & Foster Co., Cleveland. 1101 pp.

Marks, S. G., and J. E. Koepke. 1994. Pet attachment and generativity among young adults. Journal of Psychology 128:641.

McNeely, R. 1995. Missouri's Beaver: A guide to management, nuisance prevention, and damage control. Missouri Department of Conservation, Jefferson City, Missouri.

Medin, D. E., and W. P. Clary. 1990. Bird populations in and adjacent to a beaver pond ecosystem in Idaho. USDA-Forest Service, Intermountain Research Station, 432.

Medin, D. E., and W. P. Clary. 1991. Small mammals of a beaver pond ecosystem and adjacent riparian habitat in Idaho. USDA-Forest Service, Intermountain Research Station, 445.

Meyers, B. 2000. Anticipatory mourning and the human-animal bond. Pp. 537-564 *in* T. A. Rando, ed. Clinical dimensions of anticipatory mourning: Theory and practice in working with the dying, their loved ones, and their caregivers. Research Press, Champaign, Illinois.

Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being: Wetlands and water. World Resources Institute, Washington, D.C.

Miller, J. E. 1994. Muskrats. Pp. B-61-B-69 *in* S. E. Hygnstrom, R. M. Timm, and G. E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Miller, J. E. 1983. Control of beaver damage. Proc. East. Wildl. Damage Control Conf. 1:177-183.

Miller, J. E., and G. K. Yarrow. 1994. Beaver. Pp. B-1-B-11 *in* S. E. Hygnstrom, R. M. Timm, and G. E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Muller, L. I., R. J. Warren, and D. L. Evans. 1997. Theory and practice of immunocontraception in wild animals. Wildlife Society Bulletin 25:504-514.

Muller-Schwarze, D., and L. Sun. 2003. The beaver: Natural history of a wetlands engineer. Cornell University Press, Ithaca, New York.

Munther, G. L. 1982. Beaver management in grazed riparian ecosystems. Wildlife Livestock Relationships Symposium 10:234-241.

Naiman, R. J., J. M. Melillo, and J. E. Hobbie. 1986. Ecosystem alteration of boreal forest streams by beaver (*Castor canadensis*). Ecology 67:1254-1269.

Naiman, R. J., C. A. Johnston, and J. C. Kelley. 1988. Alteration of North American streams by beaver. BioScience 38:753-762.

National Audubon Society. 2000. Field guide to North American mammals. J. O. Whitaker, Jr., editor. Alfred A. Knopf Publishing, New York City, New York.

Neves, R.J., and M.C. Odom. 1989. Muskrat predation on endangered freshwater mussels in Virginia. Journal of Wildlife Management 53:934-941.

Nielsen, L. 1988. Definitions, considerations, and guidelines for translocation of wild animals. Pp. 12-49 *in* L. Nielsen and R. D. Brown, eds. Translocation of wild animals. Wisconsin Humane Society, Milwaukee, Wisconsin, and Caesar Kleberg Wildlife Research Institute, Kingsville, Texas.

Nolte, D. M., S. R. Swafford, and C. A. Sloan. 2001. Survey of factors affecting the success of Clemson beaver pond levelers installed in Mississippi by Wildlife Services. Pp. 120-125 *in* M C. Brittingham, J. Kays, and R. McPeake eds. Proceedings of the Ninth Wildlife Damage Management Conference. Pennsylvania State University, University Park, Pennsylvania.

Noonan, B. 1998. The Canadian terminal dive study. Wildlife Control Techniques. May-June.

Novak, M. 1987. Beaver. Pp. 282-312 *in* M. Novak, J. A. Baker, M. E. Obbard, and B. Mallock, eds. Wild Furbearer management and conservation in North America. The Ontario Trappers Association, Ontario Ministry of Natural Resources, Toronto, Canada.

ODWC. 2014. Oklahoma hunting: Official fall 2014-spring 2015 regulations guide. 69 pp.

ODWC. 2015. Species spotlight: Beaver. Oklahoma Department of Wildlife and Conservation website. http://www.wildlifedepartment.com/wildlifemgmt/species/beaver.htm. Accessed January 9, 2015.

Oklahoma Department of Environmental Quality. 2014. Water quality in Oklahoma. 487 pp.

O'Neil, T. 1949. The muskrat in the Louisiana Coastal Marshes. Louisiana Department of Wildlife and Fisheries, New Orleans. 152 pp.

Organ, J. F., T. Decker, J. DiStefano, K. Elowe, P. Rego, and P. G. Mirick. 1996. Trapping and furbearer management: Perspectives from the Northeast. USDI-Fish and Wildlife Service, Hadley, Massachusetts.

Parkes, C. M. 1979. Grief: the painful reaction to the loss of a loved one. Monograph. University of California, San Diego, California.

Parrish, W. F., Jr. 1960. Status of the beaver (*Castor canadensis carolinensis*) in Georgia. Thesis, University of Georgia, Athens, Georgia.

Partington, M. 2002. Preventing beaver dams from blocking culverts. Advantage 3:1-4.

Patterson, D. 1951. Beaver - trout relationships. Investigational Report 822. Wisconsin Conservation Department, Madison, Wisconsin.

Perry, H. R., Jr. 1982. Muskrats. Pp. 282-325 *in* J. A. Chapman and G. A. Feldhamer, eds., Wild Mammals of North America. The Johns Hopkins University Press, Baltimore, Maryland.

Perry, D. 2007. Coexisting with beavers. DVD. Spring Farms Cares, Clinton, New York.

Phillips, R. L. 1996. Evaluation of 3 types of snares for capturing coyotes. Wildlife Society Bulletin 24: 107-110.

Pollock, M. M., G. R. Pess, T. J. Beechie, and D. R. Montgomery. 2004. The importance of beaver ponds to Coho salmon production in the Stillaguamish River Basin, Washington, USA. North American Journal of Fisheries Management 24:749-760.

Pollock, M. M., J. M. Wheaton, N. Bouwes, C. Volk, N. Weber, and C. E. Jordan. 2012. Working with beaver to restore salmon habitat in the Bridge Creek intensively monitored watershed: Design rationale and hypotheses. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-120. 47 p.

Pollock, M. M., T. J. Beechie, and C. E. Jordan. 2007. Geomorphic changes upstream of beaver dams in Bridge Creek, an incised stream channel in the interior Columbia River basin, eastern Oregon. Earth Surface Processes and Landforms 32:1174-1185.

Pollock, M. M., T. J. Beechie, J. M. Wheaton, C. E. Jordan, N. Bouwes, N. Weber, and C. Volk. 2014. Using beaver dams to restore incised stream ecosystems. BioScience 64:279-290.

Price, J. M., and J. G. Nickum. 1995. Aquaculture and Birds: the Context for Controversy. Colonial Waterbirds 18 (Special Publication 1):33-45.

Pullen, T. M., Jr. 1967. Some effects of beaver (*Castor canadensis*) and beaver pond management on the ecology and utilization of fish populations along warm-water streams in Georgia and South Carolina. Ph.D. Dissertation. University of Georgia, Athens, Georgia. 84 pp.

Randolph, J. P. 1988. Virginia trapper's manual. Department of Game and Inland Fisheries, Richmond, Virginia.

Reese, K. P., and J. D. Hair. 1976. Avian species diversity in relation to beaver pond habitats in the Piedmont region of South Carolina. Proceeding of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 30:437-447.

Ringleman, J. K. 1991. Managing beaver to benefit waterfowl. Waterfowl Management Handbook. United States Department of the Interior, Fish and Wildlife Service, Fish and Wildlife Leaflet 13.4.7.

Roberts, T. H., and D. H. Arner. 1984. Food habits of beaver in East-Central Mississippi. Journal of Wildlife Management 48:1414-1419.

Roblee, K. J. 1983. A wire mesh culvert for use in controlling water levels at nuisance beaver sites. Proc. East. Wildl. Dam. Control Conf. 3:25-33.

Roblee, K. J. 1984. Use of corrugated plastic drainage tubing for controlling water levels at nuisance beaver sites. New York Fish and Game Journal 31:63-80.

Roblee, K. J. 1987. The use of T-culvert guard to protect road culverts from plugging damage by beavers. Proc. East. Wildl. Damage Control Conf. 3:25-33.

Rosell, F., O. Bozsér, P. Collen, and H. Parker. 2005. Ecological impact of beavers *Castor fiber* and *Castor canadensis* and their ability to modify ecosystems. Mammal Review 35:248–276.

Ross, C. B., and J. Baron-Sorensen. 1998. Pet loss and human emotion: guiding clients through grief. Accelerated Development, Incorporation, Philadelphia, Pennsylvania.

Schmidt, R. 1989. Animal welfare and wildlife management. Transcripts of the North American Wildlife and Natural Resources Conference 54:468-475.

Schobert, E. 1987. Telazol use in wild and exotic animals. Veterinary Medicine 82:1080–1088.

Schwartz, C. W., and E. R. Schwartz. 1959. The wild mammals of Missouri. University of Missouri and Missouri Conservation Committee, Columbia, Missouri.

Sharp, T., and G. Saunders. 2008. A model for assessing the relative humaneness of pest animal control methods. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, ACT.

Sharp, T., and G. Saunders. 2011. A model for assessing the relatives humaneness of pest animal control methods. 2nd Edition. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, ACT.

Simon, L. 2006. Solving beaver flooding problems through the use of water flow control devices. Proceedings of the Vertebrate Pest Conference 22:174-180.

Skinner, Q. D., J. E. Speck Jr., M. Smith, and J. C. Adams. 1984. Stream water quality as influenced by beaver within grazing systems in Wyoming. J. Range. Manage. 37:142-146.

Slate, D.A., R. Owens, G. Connolly, and G. Simmons. 1992. Decision making for wildlife damage management. Transcripts of the North American Wildlife and Natural Resources 57:51-62.

Southwick Associates. 2004. Potential Economic Losses Associated With Uncontrolled Nutria Populations in Maryland's Portion of the Chesapeake Bay. Prepared for the: Wildlife and Heritage Service, 580 Taylor Avenue, Annapolis, Maryland 21401 by Southwick Associates, P.O. Box 6435, Fernandina Beach, Florida 32035.

Spock, M. 2006. Effectiveness of water flow devices as beaver conflict resolution tools: A satisfaction survey of Massachusetts clients. Center for Animals and Public Policy, Tufts University Cummings School of Veterinary Medicine. 50 pp.

Stansley, W., L. Widjeskog, and D. E. Roscoe. 1992. Lead contamination and mobility in surface water at trap and skeet ranges. Bulletin of Environmental Contamination and Toxicology 49:640-647.

Stevens, C. E., C. A. Paszkowski, and A. Lee Foote. 2007. Beaver (*Castor canadensis*) as a surrogate species for conserving anuran amphibians on boreal streams in Alberta, Canada. Biological Conservation 134:1-13.

Tackett, C. 2009. Oklahoma aquatic nuisance species management plan. Oklahoma Department of Wildlife Conservation. 125 pp.

Taylor, J. D., and R. D. Singleton. 2014. The evolution of flow devices used to reduce flooding by beavers: a review. Wildlife Society Bulletin 38:127-133.

Tesky, J. L. 1993. *Castor canadensis*. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/. Accessed November 3, 2014.

The Wildlife Society. 2010. Final position statement: Wildlife damage management. The Wildlife Society, Bethesda, Maryland 2 pp.

Treves, A., and L. Naughton-Treves. 2005. Evaluating lethal control in the management of human-wildlife conflict. Pp. 86-106 in R. Woodroffe, S. Thirgood, A. Rabinowitz, eds., People and Wildlife: Conflict or Coexistence, University of Cambridge Press, United Kingdom.

United States Census Bureau. 2010. 2010 census state area measurements and internal point coordinates. United State Census Bureau. http://www.census.gov/geo/reference/state-area.html. Accessed September 29, 2014.

USFWS. 2001. Inside Region 3: Ohio man to pay more than $11,000 for poisoning migratory birds. Volume 4(2):5.

United States Food and Drug Administration. 2003. Bird poisoning of federally protected birds. Office of Criminal Investigations. Enforcement Story 2003.

United States General Accounting Office. 2001. Wildlife Services Program: Information on activities to manage wildlife damage. Report to Congressional Committees. GOA-02-138. 71 pp.

United States Geological Survey. 1996. National water summary on wetland resources. United States Geological Survey Water-Supply Paper 2425. 444 pp.

Valentine, J. M., J. R. Walther, K. M. McCartney, and L. M. Ivy. 1972. Alligator diets on the Sabine National Wildlife Refuge. Journal of Wildlife Management 36:809-815.

Wade, D. E., and C. W. Ramsey. 1986. Identifying and managing aquatic rodents in Texas: beaver, nutria and muskrat. Texas Agricultural Extension Service and Texas Agriculture Experimental Station. Texas A&M University in cooperation with USDI-USFWS Pub. B-1556, College Station, Texas.

Weisman, A. D. 1991. Bereavement and companion animals. Omega: Journal of Death and Dying 22: 241-248.

Wesley, D. E. 1978. Beaver control in the Southeastern United States. Proceedings of the Symposium of Southeastern Hardwoods 6:84-91.

Westbrook, C. J., D. J. Cooper, and B. W. Baker. 2006. Beaver dams and overbank floods influence groundwater-surface water interactions of a Rocky Mountain riparian area. Water Resources Research 42, W06404, doi:10.1029/2005WR004560.

Whitaker, Jr., J.O., and W.L.J. Hamilton, Jr. 1998. Mammals of the Eastern United States. Cornell University Press, Ithaca, New York. 583 pp.

White, D.H., L. E. Hayes, and P. B. Bush. 1989. Case histories of wild birds killed intentionally with famphur in Georgia and West Virginia. Journal of Wildlife Diseases 25:144-188.

Wilkinson, P. M. 1962. A life history study of the beaver in east-central Alabama. Thesis, Auburn University, Auburn, Alabama.

Wolfe, J. L., D. K. Bradshaw, and R. H. Chabreck. 1987. Alligator feeding habits: new data and a review. Northeast Gulf Science 9:1-8.

Wood, G. W., L. A. Woodward, and G. K. Yarrow. 1994. The Clemson beaver pond leveler. Clemson Cooperative Extension Service, Clemson, South Carolina.

Woodward, D. K. 1983. Beaver management in the southeastern United States: a review and update. Proc. East. Wildl. Damage Contr. Conf. 1:163-165.

Woodward, D. K., J. D. Hair, and B. P. Gaffney. 1976. Status of beaver in South Carolina as determined by a postal survey of landowners. Proceedings of the Annual Conference of Southeast Fish and Wildlife Agencies 30:448-54.

Woodward, D. K., R. B. Hazel, and B. P. Gaffney. 1985. Economic and environmental impacts of beavers in North Carolina. Proceedings of the Eastern Wildlife Damage Management Conference 2:89-96.

Wright, J. V. 1987. Archeological evidence for the use of furbearers in North America. Pp. 3 - 12 *in* M. Novak, J. A. Baker, M. E. Obbard, and B. Mallock, eds. Wild Furbearer management and conservation in North America. The Ontario Trappers Association, Ontario Ministry of Natural Resources, Toronto, Canada.

Wright, J. P., C. G. Jones, and A. S. Flecker. 2002. An ecosystem engineer, the beaver, increases species richness on a landscape scale. Oecologia 132:96-101.

Zasloff, R. L. 1996. Measuring attachment to companion animals: a dog is not a cat is not a bird. Applied Animal Behaviour Science 47: 43-48.

APPENDIX B

METHODS AVAILABLE FOR RESOLVING OR PREVENTING AQUATIC RODENT DAMAGE IN OKLAHOMA

The most effective approach to resolving wildlife damage problems would be to integrate the use of several methods, either simultaneously or sequentially. An adaptive plan would integrate and apply practical methods of prevention and reduce damage by aquatic rodents while minimizing harmful effects of damage reduction measures on people, other species, and the environment. An adaptive plan may incorporate resource management, physical exclusion and deterrents, and population management, or any combination of these, depending on the characteristics of specific damage problems.

In selecting damage management techniques for specific damage situations, consideration would be given to the responsible species and the magnitude, geographic extent, duration and frequency, and likelihood of wildlife damage. Consideration would also be given to the status of target and potential non-target species, local environmental conditions and impacts, social and legal aspects, and relative costs of damage reduction options. The cost of damage reduction may sometimes be a secondary concern because of the overriding environmental, legal, and animal welfare considerations. Those factors would be evaluated in formulating damage management strategies that incorporate the application of one or more techniques.

A variety of methods would potentially be available to the WS program in Oklahoma relative to the management or reduction of damage from aquatic rodents. Various federal, state, and local statutes and regulations would govern WS' use of methods, including WS' directives. WS would develop and recommend or implement strategies based on resource management, physical exclusion, and wildlife management approaches. Within each approach there may be available a number of specific methods or techniques. The following methods could be recommended or used by the WS program in Oklahoma. Many of the methods described would also be available to other entities in the absence of any involvement by WS.

Non-chemical Wildlife Damage Management Methods

Non-chemical management methods consist primarily of tools or devices used to repel, capture, or kill a particular animal or local population of wildlife to alleviate damage and conflicts. Methods may be non-lethal (*e.g.*, fencing, frightening devices) or lethal (*e.g.*, firearms, body gripping traps). If WS' personnel apply those methods, a MOU, work initiation document, or another similar document must be signed by the landowner or administrator authorizing the use of each damage management method. Non-chemical methods used or recommended by WS could include:

Exclusion pertains to preventing access to resources through fencing or other barriers. Fencing of small critical areas can sometimes prevent animals that cannot climb from entering areas of protected resources. Fencing of culverts, drainpipes, and other water control structures can sometimes prevent beaver from building dams that plug those devices. Fencing installed with an underground skirt can prevent access to areas for many aquatic rodent species that dig. Hardware cloth or other metal barriers can sometimes be used to prevent girdling and gnawing of valuable trees and to prevent the entry of aquatic rodents 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 and levees to deter aquatic rodents from burrowing. Electric fences of various constructions have been used effectively to reduce damage to various crops by several wildlife species (*e.g.*, see Boggess 1994, Craven and Hygnstrom 1994).

Beaver exclusion and the use of water control devices could be recommended or implemented by WS to alleviate flooding damage without removing beaver under the alternatives. Although beaver dams could be breached/removed manually or with binary explosives, those methods are usually ineffective because beaver quickly repair or replace the dam (McNeely 1995). Damage may be effectively reduced in some situations by installing exclusion and water control devices. Exclusion and water control devices can be designed so that the level of the beaver-created pond can be managed to eliminate or minimize damage while retaining the ecological and recreational benefits derived from beaver ponds. WS could also recommend that modifications occur to culvert design (Jensen et al. 1999) as a non-lethal way of reducing problems with beaver dams at culverts.

Beaver exclusion generally involves the placement of fencing to prevent beaver from accessing water intake areas, such as culverts. A variety of exclusion systems could be recommended or implemented by WS, including the Beaver Deceiver™, Beaver Bafflers™, and pre-dams (Lisle 1996, Brown and Brown 1999, Lisle 1999, Brown et al. 2001, Partington 2002, Lisle 2003). The Beaver Deceiver™ is a fencing system that is installed to prevent beaver blockage of culverts by minimizing environmental cues that stimulate beaver to construct dams, and by making culverts less attractive as dam construction sites (Lisle 1996, Lisle 1999, Lisle 2003). Beaver can be deterred from blocking culverts by the installation of a fence on the upstream end of the culvert. Installation of a fence increases the length of the area that must be dammed to impound water, and if beaver build along the fence, may increase the distance between the beaver and the source of the cues that stimulate damming behavior (*e.g.*, water moving through culvert) (Lisle 1996, Lisle 1999, Lisle 2003, Callahan 2005). Beaver prefer to build dams perpendicular to water flow, so fences can be oriented at odd angles to water flow and can be set so that they do not block the stream channel. Fencing can also be used to cover the up and downstream ends of the culverts to prevent beaver from entering the deceiver from the downstream side of the culvert and to prevent any beaver that might make it past the outer fence from plugging the interior of the culvert. Efforts can also be made to reduce the sound of water flowing through the culvert by raising the water level on the down-stream side of the culvert with dam boards or beaver-made dams; by constructing flumes to replace waterfalls, or, in extreme cases, by resetting the culvert (Lisle 1996). To ensure sufficient water flow through the culvert, Beaver Deceivers™ may be used in combination with water control devices (see discussion on Beaver Deceivers™ below).

Cylindrical exclusion devices like the Beaver Bafflers™ can be attached to culvert openings to reduce the likelihood that beaver plug a culvert by spreading the water intake over a larger area (Brown et al. 2001). While cylindrical exclusion devices can be effective in some situations (Partington 2002), in a study of beaver exclusion and water control devices, cylindrical shapes attached in-line with a culvert had a higher failure rate (40%) than trapezoidal shapes (*e.g.*, Beaver Deceivers™; 3% failure rate) and use of the cylindrical devices was discontinued in favor of trapezoidal fences (Callahan 2005).

Unlike Beaver Deceivers™ and cylindrical fences, pre-dam fences (*e.g.*, deep-water fences, diversion dams) (Brown and Brown 1999) can be designed with the specific intention that the beaver build the dam along the fence. Pre-dam fences can be short semicircular or circular fences that are built in an arc around a water inlet. The fence serves as a dam construction platform that allows beaver to build a dam and pond at the site but prevents beaver from plugging the water intake. If the size of the upstream pond created from the impounded water were not a concern, no further modifications of the pre-dam would be needed. However, in most cases, pre-dams would be used in combination with water control devices to manage the size of the upstream pond to alleviate flooding concerns.

Fence mesh size can be selected to minimize risks to beaver and non-target species. Brown et al. (2001) noted that beaver occasionally became stuck in 6-inch mesh and that the risk of beaver entrapment was lower with 5-inch mesh. Lisle (1999) noted that the size of the mesh on the fence of

the Beaver Deceivers™ (6-inch mesh) was such that it allowed most species to pass through the fence except beaver and big turtles. In some remote areas where vehicular traffic is infrequent, it may be acceptable for animals that cannot pass through the fence mesh to travel across the road. However, for culverts under busy roads, it may be necessary to design special "*doors*" that allow the passage of beaver, large turtles, and other non-targets through the device. For example, T-joints 30 centimeters in diameter have been used to allow access through Beaver Deceiver™ fences. The T-shape reduces the likelihood that beaver can haul woody debris for dam construction inside the device (Lisle 2003). Fence caps would not be attached to the up and down-stream ends of a culvert when it is necessary to allow passage of species like large turtles and beavers through a culvert.

Water control devices (*e.g.*, pond levelers) are systems that allow the passage of water through a beaver dam. The devices could be used in situations where the presence of a beaver pond is desired but it is necessary to manage the level of water in the pond. Various types of water control devices have been described (Arner 1964, Roblee 1984, Laramie and Knowles 1985, Miller and Yarrow 1994, Wood et al. 1994, Lisle 1996, Organ et al. 1996, Brown and Brown 1999, Lisle 1999, Brown et al. 2001, Close 2003, Lisle 2003, Clemson University 2006, Simon 2006, Spock 2006, Perry 2007). The devices generally involve the use of one or more pipes installed through the beaver dam to increase the flow of water through the dam. Height and placement of pipes can be adjusted to achieve the desired water level in the beaver pond. Beaver generally only check the dam for leaks, so, when site conditions permit, the inlet of the pipe is placed away from the dam to make the source of the water flow more difficult to detect and decrease the likelihood that beaver will attempt to plug the device. To minimize the sound/sensation of water movement and the associated beaver damming behavior, the end of the pipe may be capped with a series of holes or notches cut in the pipe, which allows water to flow into the pipe. Holes and notches may be placed on the underside of the pipe to reduce the sound of water movement. Alternatively, 90-degree elbow joints can be placed facing downward on the upstream end of the pipes to prevent the noise of running water and attracting beaver. A protective cage can be placed around the upstream end of the inlet pipe to prevent beaver from blocking the pipe and to reduce problems with debris blocking the pipe. As noted above, water control systems can be combined with exclusion devices to prevent beaver from blocking culverts while still maintaining a beaver pond at an acceptable level.

Cultural Methods and Habitat Management includes the application of practices that seek to minimize exposure of the protected resource to damaging animals through processes other than exclusion. Strategies may include minimizing cover where damaging aquatic rodents might hide, manipulating the surrounding environment through barriers or fences to deter animals from entering a protected area, or planting lure crops on fringes of protected crops. Continual destruction of beaver dams and removal of dam construction materials on a daily basis will sometimes cause beavers to move to other locations. 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.

Beaver dam breaching/removal would involve the removal of debris deposited by beaver that impedes the flow of water. Removing or breaching a dam is generally conducted to maintain existing stream channels and drainage patterns, and reduce floodwaters that have affected established silviculture, agriculture, 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 and impound water, creating habitat that they utilize to build lodges and bank dens to raise their young and/or provide protection from predators. The impoundments that WS removes or breaches would typically be created by recent beaver activity and would not have been in place long enough to take on the qualities of a true wetland (*e.g.*, hydric soils, aquatic vegetation, pre-existing function). Unwanted

beaver dams could be removed by hand with a rake or power tools (*e.g.*, a winch) or with explosives. Explosives would be used only by WS' personnel specially trained and certified to conduct such activities, and only binary explosives 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 or breaching by hand or with binary explosives would not affect the substrate or the natural course of the stream. Removing or breaching dams would return the area back to its pre-existing condition with similar flows and circulations. Because beaver dams involve waters of the United States, removal is regulated under Section 404 of the Clean Water Act (see Appendix E).

Most beaver dam breaching, if considered discharge, would be covered under exemptions in 33 CFR 323 or under a NWP issued pursuant to 33 CFR 330 and do not require a permit. A permit would be required if the beaver dam breaching activity was not covered by a 404 permitting exemption or a NWP and the area affected by the beaver dam was considered a true wetland. The State of Oklahoma may require additional permits (see Appendix E). WS' personnel would survey the site or impoundment to determine if conditions exist for classifying the site as a true wetland. If the site appears to have conditions over 3 years old or appeared to meet the definition of a true wetland, the landowner or cooperator would be required to obtain a permit before proceeding (see Appendix E for information that explains Section 404 permit exemptions and conditions for breaching/removing beaver dams).

Supplemental feeding is sometimes used to reduce damage by wildlife, such as lure crops. Food is provided so that the animal causing damage would consume it rather than the resource being protected. In feeding programs, target wildlife would be offered an alternative food source with a higher appeal with the intention of luring them from feeding on affected resources.

Animal behavior modification refers to tactics that deter or repel damaging aquatic rodents and thus, reduce damage to the protected resource. Those techniques are usually aimed at causing target animals to respond by fleeing from the site or remaining at a distance. They usually employ extreme noise or visual stimuli. Unfortunately, many of these techniques are only effective for a short time before wildlife habituate to them (*e.g.*, see Conover 1982). Devices used to modify behavior in aquatic rodents include electronic guards (siren strobe-light devices), propane exploders, pyrotechnics, laser lights, human effigies, effigies of predators, and the noise associated with the discharge of a firearm.

Live Capture and Translocation can be accomplished using hand capture, hand nets, catch poles, cage traps, suitcase type traps, cable restraints, or with foothold traps to capture some aquatic rodent species for the purpose of translocating them for release in other areas. WS could employ those methods in Oklahoma when the target animal(s) can legally be translocated or can be captured and handled with relative safety by WS' personnel. Live capture and handling of aquatic rodents poses an additional level of human health and safety threat if target animals are aggressive, large, or extremely sensitive to the close proximity of people. For that reason, WS may limit this method to specific situations and certain species. In addition, moving damage-causing individuals to other locations can typically result in damage at the new location, or the translocated individuals can move from the relocation site to areas where they are unwanted. In addition, translocation can facilitate the spread of diseases from one area to another. Although translocation is not necessarily precluded in all cases, it would be logistically impractical, in most cases, and biologically unwise in Oklahoma due to the risk of disease transmission. High population densities of some animals may make this a poor wildlife management strategy for those species. Translocation would be evaluated by WS on a case-by-case basis. Translocation would only occur with the prior authorization of the ODWC.

Trapping can utilize a number of devices, including foothold traps, cage-type traps, body-gripping traps, and cable restraints.

Foothold Traps can be effectively used to capture aquatic rodents. Foothold traps can be placed beside, or in some situations, in travel ways being actively used by the target species. Placement of traps is contingent upon the habits of the respective target species, habitat conditions, and presence of non-target animals. Effective trap placement and adjustment, and the use and placement of appropriate baits and lures by trained WS' personnel also contribute to the selectivity of foothold traps. An additional advantage is that foothold traps can allow for the on-site release of non-target animals since animals are captured alive. The use of foothold traps requires more skill than some methods. Foothold traps would generally be available for use by the public and other state or federal agencies.

WS could also attach a foothold trap to a submersion cable or rod that WS anchors at the trap set and in deep water. Attaching the trap to the cable or rod with a locking mechanism allows the trap to slide down the cable or rod into deeper water, but prevents a captured animal from returning to the surface. In this type of foothold set, death from drowning or submersion hypoxia occurs in a short time.

Cable Restraints are typically made of wire or cable, and can be set to capture an animal by the neck or body. Cable restraints may be used as either lethal or live-capture devices depending on how or where they are set. Cable restraints set to capture an animal by the neck are usually lethal but stops can be attached to the cable to increase the probability of a live capture depending on the trap check interval. Snares positioned to capture the animal around the body can be a useful live-capture device, but are more often used as a lethal control technique. Snares can incorporate a breakaway feature to release non-target wildlife and livestock where the target animal is smaller than potential non-targets (Phillips 1996). Snares can be effectively used wherever a target animal moves through a restricted travel lane (*e.g.*, trails through vegetation). When an animal moves forward into the loop formed by the cable, the noose tightens and the animal is held. Snares must be set in locations where the likelihood of capturing non-target animals would be minimized. Capture devices of this type require a permit from the ODWC.

Cage-type traps come in a variety of styles to live-capture animals. The most commonly known cage traps for aquatic rodents are box traps and suitcase traps. Box traps are usually rectangular and are made from various materials, including metal, wire mesh, plastic, and wood. Box traps are generally portable and easy to set-up.

The disadvantages of using cage traps are: 1) some individual target animals may avoid cage traps; 2) some non-target animals may associate the traps with available food and purposely get captured to eat the bait, making the trap unavailable to catch target animals; 3) cage traps must be checked frequently to ensure that captured animals are not subjected to extreme environmental conditions; 4) some animals will fight to escape and may become injured; and 5) expense of purchasing traps.

Trap monitors are devices that send a radio signal to a receiver if a set trap is disturbed and alerts field personnel that an animal may be captured. Trap monitors can be attached directly to the trap or attached to a string or wire and then placed away from the trap in a tree or shrub. When the monitor is hung above the ground, it can be detected from several miles away, depending on the terrain in the area. There are many benefits to using trap monitors, such as saving considerable time when checking traps, decreasing fuel usage, prioritizing trap checks, and decreasing the need for human presence in the area. Trap monitors could be used when using cage traps.

Trap monitoring devices could be employed, when applicable, that indicate when a trap has been activated. Trap monitors do not exempt WS from mandatory physical trap checks. Trap monitoring devices would allow personnel to prioritize trap checks and decrease the amount of time required to check traps, which decreases the amount of time captured target or non-targets would be restrained. By reducing the amount of time targets and non-targets are restrained, pain and stress can be minimized and captured wildlife can be addressed in a timely manner, which could allow non-targets to be released unharmed. Trap monitoring devices could be employed where applicable to facilitate monitoring of the status of traps in remote locations to ensure any captured wildlife was removed promptly to minimize distress and to increase the likelihood non-targets could be released unharmed.

Hancock/Bailey Traps (suitcase/basket type cage traps) are designed to live-capture beaver. The trap is constructed of a metal frame that is hinged with springs attached and covered with chain-link fence. The trap's appearance is similar to a large suitcase when closed. When set, the trap is generally baited and opened to allow an animal to enter. When tripped, the panels of the trap close around the animal capturing the animal. One advantage of using the Hancock or Bailey trap is the ease of release of beaver or non-target animals. Beaver caught in Hancock or Bailey traps could also be humanely euthanized. Disadvantages are that those traps are very expensive (>$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-gripping Traps are designed to cause the quick death of the animal that activates the trap. The conibear™ trap consists of a pair of rectangular wire frames that close like scissors when triggered, killing the captured animal with a quick body blow. For conibear™ traps, the traps should be placed to ensure the rotating jaws close on either side of the neck of the animal to ensure a quick death. Conibear™ traps are lightweight and easily set. Safety hazards and risks to people are usually related to setting, placing, checking, or removing the traps. Body-gripping traps present a minor risk to non-target animals. Selectivity of body-gripping traps can be enhanced by placement, trap size, trigger configurations, and baits. When using body-gripping traps, risks of non-target capture can be minimized by using recessed sets (placing trap inside a cubby, cage, or burrow), restricting openings, or by elevating traps. For example, conibear™ traps set to capture beaver can be placed underwater to minimize risks to non-targets. Choosing appropriately sized traps for the target species can also exclude non-targets by preventing larger non-targets from entering and triggering the trap. The trigger configurations of traps can be modified to minimize non-target capture. For example, offsetting the trigger can allow non-targets to pass through conibear™ traps without capture. Use of body-gripping traps is regulated by the ODWC.

Shooting with firearms is very selective for the target species and would be conducted with rifles, handguns, and shotguns. Methods and approaches used by WS may include use of illuminating devices, bait, firearm suppressors, and night vision/thermal equipment. Shooting is an effective method in some circumstances, and can often provide immediate relief from the problem. Shooting may at times be one of the only methods available to resolve a wildlife problem effectively and efficiently. Shooting would be limited to locations where it is legal and safe to discharge a weapon. A shooting program, especially conducted alone, can be expensive because it often requires many staff hours to complete.

Shooting can also be used in conjunction with an illumination device at night, which is especially useful for nocturnal aquatic rodents. Spotlights may or may not be covered with a red lens, which nocturnal animals may not be able to see, making it easier to locate them undisturbed. Night shooting may be conducted in sensitive areas that have high public use or other activity during the day, which would make daytime shooting unsafe. The use of night vision and Forward Looking Infrared (FLIR) devices can also be used to detect and shoot aquatic rodents at night, and is often the preferred equipment due to the ability to detect and identify animals in complete darkness. Night vision and FLIR equipment aid in locating wildlife at night when wildlife may be more active. Night vision and FLIR equipment could be used during surveys and in combination with shooting to remove target aquatic rodents at night. WS' personnel most often use this technology to target aquatic rodents in the act of causing damage or likely responsible for causing damage. Those methods aid in the use of other methods or allow other methods to be applied more selectively and efficiently. Night vision and FLIR equipment allow for the identification of target species during night activities, which reduces the risks to non-targets and reduces human safety risks. Night vision equipment and FLIR devices only aid in the identification of wildlife and are not actual methods of removal. The use of FLIR and night vision equipment to remove target aquatic rodents would increase the selectivity of direct management activities by targeting those aquatic rodents most likely responsible for causing damage or posing threats.

Hunting/Trapping is sometimes recommended by WS to resource owners. WS could recommend resource owners consider legal hunting and trapping as an option for reducing aquatic rodent damage. Although legal hunting/trapping is impractical and/or prohibited in many urban-suburban areas, it can be used to reduce some populations of aquatic rodents.

Chemical Wildlife Damage Management Methods

All pesticides used by WS would be registered under the FIFRA and administered by the EPA and the ODAFF All WS personnel in Oklahoma who apply restricted-use pesticides would be certified pesticide applicators by ODAFF and have specific training by WS for pesticide application. The EPA and the ODAFF require pesticide applicators to adhere to all certification requirements set forth in the FIFRA. Pharmaceutical drugs, including those used in wildlife capture and handling, are administrated by the United States Food and Drug Administration and/or the United States Drug Enforcement Administration.

Chemicals would not be used by WS on public or private lands without authorization from the property owner or manager. The following chemical methods have been proven selective and effective in reducing damage by aquatic rodents.

Ketamine (Ketamine HCl) is a dissociative anesthetic that is used to capture wildlife. 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 is a more powerful anesthetic and usually used for larger animals. Telazol is a combination of equal parts of tiletamine hydrochloride and zolazepam hydrochloride (a tranquilizer). The product is generally supplied sterile in vials, each containing 500 mg of active drug, and when dissolved in sterile water has a pH of 2.2 to 2.8. Telazol produces a state of unconsciousness in which protective reflexes, such as coughing and swallowing, are maintained during anesthesia. Schobert (1987) listed the dosage rates for many wild and exotic animals. Before using Telazol, the size, age, temperament,

and health of the animal are considered. Following a deep intramuscular injection of Telazol, onset of anesthetic effect usually occurs within 5 to 12 minutes. Muscle relaxation is optimum for about the first 20 to 25 minutes after the administration, and then diminishes. Recovery varies with the age and physical condition of the animal and the dose of Telazol administered, but usually requires several hours.

Xylazine is a sedative (analgesic) that calms nervousness, irritability, and excitement, usually by depressing the central nervous system. Xylazine is commonly used with ketamine to produce a relaxed anesthesia. It can also be used alone to facilitate physical restraint. Because Xylazine is not an anesthetic, sedated animals are usually responsive to stimuli. Therefore, personnel should be even more attentive to minimizing sight, sound, and touch. When using ketamine/Xylazine combinations, Xylazine will usually overcome the tension produced by ketamine, resulting in a relaxed, anesthetized animal (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. Barbiturates are a recommended euthanasia drug for free-ranging wildlife (American Veterinary Medical Association 2013). Sodium pentobarbital would only be administered after target animals were live-captured and properly immobilized to allow for direct injection. There are United Stated Drug Enforcement Administration 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 United States Drug Enforcement Administration and state regulations. All animals euthanized using sodium pentobarbital and all of its dilutions (*e.g.* Beuthanasia-D, Fatal-Plus) are disposed of immediately through incineration or deep burial to prevent secondary poisoning of scavenging animals and introduction of these chemicals to non-target animals.

Potassium Chloride used in conjunction with prior general anesthesia is used as a euthanasia agent for animals, and is considered acceptable and humane by the American Veterinary Medical Association (2013). Animals that have been euthanized with this chemical experience cardiac arrest followed by death, and are not toxic to predators or scavengers.

Beuthanasia®-D combines pentobarbital with another substance to hasten cardiac arrest. Intravenous (IV) and intracardiac (IC) are the only acceptable routes of injection. As with pure sodium pentobarbital, IC injections with Beuthanasia®-D are only acceptable for animals that are unconscious or deeply anesthetized. With other injection routes, there are concerns that the cardiotoxic properties may cause cardiac arrest before the animal is unconscious. It is a Schedule III drug, which means it can be obtained directly from the manufacturer by anyone with a United States Drug Enforcement Administration registration. However, Schedule III drugs are subject to the same security and record-keeping requirements as Schedule II drugs.

Fatal-Plus® combines pentobarbital with other substances to hasten cardiac arrest. IV is the preferred route of injection; however, IC is acceptable as part of the two-step procedure used by WS. Animals are first anesthetized and sedated using a combination of ketamine/Xylazine and once completely unresponsive to stimuli and thoroughly sedated, Fatal-Plus® is administered. Like Beuthanasia®-D, it is a Schedule III drug requiring a United States Drug Enforcement Administration registration for purchase and is subject to the security and record-keeping requirements of Schedule II drugs.

Carbon dioxide is sometimes used to euthanize aquatic rodents that are captured in live traps and when relocation is not a feasible option. Live aquatic rodents are placed in a sealed chamber. Carbon dioxide gas is released into the chamber and the animal quickly dies after inhaling the gas. This method is approved as a euthanizing agent by the American Veterinary Medical Association (2013). Carbon dioxide gas is a byproduct of animal respiration, is common in the atmosphere, and is required by plants for photosynthesis. It is used to carbonate beverages for human consumption and is the gas released by dry ice. The use of carbon dioxide by WS for euthanasia purposes is exceedingly minor and inconsequential to the amounts used for other purposes by society.

Repellents are usually naturally occurring substances or chemicals formulated to be distasteful or to elicit pain or discomfort for target animals when they are smelled, tasted, or contacted. Repellents would not be available for many species that may present damage problems. Repellents are variably effective and depend largely on resource to be protected, time and length of application, and sensitivity of the species causing damage. Again, acceptable levels of damage control would usually not be realized unless repellents were used in conjunction with other techniques.

Explosives are defined as any chemical mixture or device that serves as a blasting agent or detonator. The procedures and accountability for WS' use of explosives for removing beaver dams and training requirements for explosives certification would adhere to WS Directive 2.435. Explosives are generally used to breach beaver dams that are too large to remove by digging using hand tools. Explosives would be used to remove dams after the beaver were removed using other methods. WS would only use binary explosives to remove beaver dams. Binary explosives consist of two components that are contained separately. The two components of binary explosives are ammonium nitrate and nitromethane and are not classified as explosives until the two components are mixed. Therefore, binary explosives are subject to fewer regulations and controls because they are packaged separately. However, once mixed, binary explosives are considered high explosives and subject to all applicable federal and state requirements. When used to remove beaver dams, the two components would not be mixed until ready for use at the site where the dam was located. Detonating cord and detonators are also considered explosives and WS must adhere to all applicable state and federal regulations for storage, transportation, and handling. All WS' explosive specialists are required to attend extensive explosive safety training and spend time with a certified explosive specialist in the field prior to obtaining certification. All blasting activities are conducted by well-trained, certified employees and closely supervised by professional wildlife biologists in accordance with WS Directive 2.435. Explosive handling and use procedures follow the rules and guidelines set forth by the Institute of Makers of Explosives, which is the safety arm of the commercial explosive industry in the United States and Canada. WS also adheres to transportation and storage regulations from state and federal agencies, such as Occupational Safety and Health Association, Bureau of Alcohol, Tobacco, and Firearms, and the Department of Transportation. In Oklahoma, the permitting and use of explosives is regulated by the Oklahoma Department of Mines pursuant to the Oklahoma Explosives and Blasting Regulation Act.

APPENDIX C

FEDERAL LIST OF THREATENED, ENDANGERED AND CANDIDATE SPECIES IN OKLAHOMA

Threatened and endangered species listed by the USFWS and present in Oklahoma

SPECIES	SCIENTIFIC NAME	Status	Locale	Habitat
Bat, gray	*Myotis grisescens*	E	Northeast	CF
Bat, Indiana	*Myotis sodalis*	E	East	CF
Bat, Ozark big-eared	*Corynorhinus townsendii ingens*	E	Northeast	CF
Crane, whooping	*Grus americana*	E,H	All	GW
Curlew, Eskimo	*Numenius borealis*	E	All	GW
Plover, piping	*Charadrius melodus*	T	All	LW
Prairie-chicken, lesser	*Tympanuchus pallidicinctus*	T	Northwest	G
Tern, Interior least	*Sterna antillarum*	E	All	LW
Vireo, black-capped	*Vireo atricapillus*	E	Central	FG
Woodpecker, red-cockaded	*Picoides borealis*	E	Southeast	F
Cavefish, Ozark	*Amblyopsis rosae*	T	Northeast	C
Darter, Arkansas	*Etheostoma cragini*	C	North	LW
Darter, leopard	*Percina pantherina*	T,H	Southeast	W
Madtom, Neosho	*Noturus placidus*	T	Northeast	W
Shiner, Arkansas River	*Notropis girardi*	T,H	West	LW
Beetle, American burying	*Nicrophorus americanus*	E	East	FG
Mucket, Neosho	*Lampsilis rafinesqueana*	C	Northeast	LW
Mussel, scaleshell	*Arkansia wheeleri*	E	Southeast	W
Pocketbook, Ouachita rock	*Leptodea leptodon*	E	Southeast	LW
Rabbitsfoot	*Quadrula cylindrica cylindrica*	T	East	LW
Mapleleaf, winged	*Quadrula fragosa*	E	East	LW
Orchid, Western prairie fringed	*Platanthera praeclara*	T	Northeast	W
Harperella	*Ptilimnium nodosum*	E	East	W

STATUS
E *- Endangered*
T *- Threatened*
C *- Candidate*
H *– Design. Crit. Hab.*
******* *- Believed extirpated*

HABITAT
C *- Caves*
F *- Forests/riparian borders*
G *- Grassland/range/meadow*
L *- Lakes, Rivers*
W *- Wetland/marsh/creek*

APPENDIX D

STATE LIST OF THREATENED, ENDANGERED AND CANDIDATE SPECIES IN OKLAHOMA

Threatened and endangered species listed by the ODWC and present in Oklahoma

SPECIES	SCIENTIFIC NAME	Status	Locale	Habitat
Darter, Long-nosed	*Percina nasuta*	E	Northeast	L
Darter, Black-sided	*Percina maculata*	T	East	L
Mucket, Neosho	*Lampsilis rafinesqueana*	E	Northeast	LW
Crayfish, Oklahoma Cave	*Cambarus tartarus*	E	Northeast	C

STATUS
E *- Endangered*
T *- Threatened*
C *- Candidate*
H *– Design. Crit. Hab.*
******* *- Believed extirpated*

HABITAT
C *- Caves*
F *- Forests/riparian borders*
G *- Grassland/range/meadow*
L *- Lakes, Rivers*
W *- Wetland/marsh/creek*

APPENDIX E

CRITERIA FOR BEAVER DAM BREACHING/REMOVAL

Beaver dam breaching is generally conducted to maintain existing stream channels and drainage patterns, and reduce flooding. Beaver dams are made from natural debris such as logs, sticks, and mud that beaver take from the area. This portion would be dislodged during a beaver dam breaching operation. The impoundments that WS could remove would normally be from recent beaver activity and would not have been in place long enough to take on the qualities of a true wetland (*i.e.*, hydric soils, aquatic vegetation, preexisting function). Beaver dam breaching and removal by hand does not affect the substrate or the natural course of the stream and returns the area back to its preexisting condition with similar flows and circulations since the impounded water can be released slowly over time.

Wetlands are recognized by three characteristics: hydric soils, hydrophytic vegetation, and general hydrology. Hydric soils either are composed of, or have a thick surface layer of, decomposed plant materials (muck); sandy soils have dark stains or streaks from organic material in the upper layer where plant material has attached to soil particles. In addition, hydric soils may be bluish gray or gray below the surface or brownish black to black and have the smell of rotten eggs. Wetlands also have hydrophytic vegetation present such as cattails, bulrushes, willows, sedges, and water plantains. The final indicator is general hydrology which includes standing and flowing water or waterlogged soils during the growing season; high water marks are present on trees and drift lines of small piles of debris are usually present. Beaver dams usually will develop a layer of organic material at the surface because siltation can occur rapidly, but aquatic vegetation and high water marks (a new high water mark is created by the beaver dam) are usually not present. However, cattails and willows can show up rapidly if they are in the vicinity, but most hydrophytic vegetation takes time to establish.

When a dam is removed or breached, debris could be discharged into the water. The debris that ends up in the water would be considered "*incidental fallback*" or discharge fill. However, in most beaver dam removal or breaching operations, the material that would be displaced, if considered to be discharge, would be exempt from permit requirements under exemptions in 33 CFR 323 or under the NWP discussed in 33 CFR 330. If beaver dams could not be breached or removed under exemptions in 33 CFR 323 or pursuant to a NWP, then the property owner or manager would be responsible for seeking the necessary permit under Section 401 and Section 404 of the CWA. WS' personnel would survey the beaver dam site and impoundment and determine whether conditions exist suggesting that the area may be a wetland as defined above. In addition, WS' personnel would work to estimate the age of the beaver dam (*e.g.*, asking the landowner, using aerial photos). The characteristics of the impoundment and the age of the dam would be used to determine whether Swampbuster, Section 404 permit exemptions, or NWPs allow removal of the dam. If not, the landowner would be required to obtain a Section 404 permit before the dam could be removed. In those cases, the EPA and/or the United States Army Corps of Engineers would be responsible for determining if the beaver dam and associated areas were actual wetlands and if so, whether to issue a permit to remove the dam.

Federal Regulations- United States Army Corps of Engineers

Under Section 404 of the CWA, the Corps of Engineers regulates all waters of the United States. Because beaver dams involve waters of the United States, dam breaching is regulated under Section 404 of the CWA. In most beaver dam breaching operations, the material that is displaced would be exempt from permitting or included in a NWP in accordance with Section 404 of the CWA (see 33 CFR Part 323, 33 CFR 330). A permit would be required if the impoundment caused by a beaver dam was not covered under a NWP or permitting exemption and was considered jurisdictional based on the Corps of Engineers 1987 Delineation Manual.

The following explains Section 404 exemptions and conditions that pertain to the breaching of beaver dams and are WS' interpretation of the NWPs.

33 CFR 323 - Permits For Discharges of Dredged or Fill Material into Waters of the United States. This regulation provides guidance to determine whether certain activities require permits under Section 404.

Part 323.4 Discharges not requiring permits. This section establishes exemptions for discharging certain types of fill into waters of the United States without a permit. Certain minor drainage activities connected with normal farming, ranching, and silviculture activities where they have been established do not require a permit as long as these drainages do not include the immediate or gradual conversion of a wetland to a non-wetland. Specifically, part (a)(1)(iii)(C)(i) states, "*...fill material incidental to connecting upland drainage facilities (e.g., drainage ditches) to waters of the United States, adequate to effect the removal of excess soil moisture from upland croplands*...". This indicates that beaver dams that block ditches, canals, or other structures designed to drain water from upland crop fields can be breached without a permit.

Moreover, (a)(1)(iii)(C)(iv) states the following types of activities do not require a permit "*The discharges of dredged or fill materials incidental to the emergency removal of sandbars, gravel bars, or other similar blockages which are formed during flood flows or other events, where such blockages close or constrict previously existing drainage ways and, if not promptly removed, would result in damage to or loss of existing crops or would impair or prevent the plowing, seeding, harvesting or cultivating of crops on land in established use for crop production. Such removal does not include enlarging or extending the dimensions of, or changing the bottom elevations of, the affected drainage way as it existed prior to the formation of the blockage. Removal must be accomplished within one year of discovery of such blockages in order to be eligible for exemption*."; this allows the breaching of beaver dams in natural streams to restore drainage of agricultural lands within one year of discovery.

Part 323.4 (a) (2) allows "*Maintenance, including emergency reconstruction of recently damaged parts, of currently serviceable structures such as dikes, dams, levees, groins, riprap, breakwaters, causeways, bridge abutments or approaches, and transportation structures. Maintenance does not include any modification that changes the character, scope, or size of the original fill design. Emergency reconstruction must occur within a reasonable period of time after damage occurs in order to qualify for this exemption*."; this allows beaver dams to be breached without a permit where they have resulted in damage to roads, culverts, bridges, or levees if it is done in a reasonable amount of time.

33 CFR 330 - Nationwide Permit Program. The United States Army Corps of Engineers, Chief of Engineers is authorized to grant certain dredge and fill activities on a nationwide basis if they have minimal impact on the environment. The NWPs are listed in Appendix A of 33 CFR 330 and permittees must satisfy all terms and conditions established to qualify for their use. Individual beaver dam breaching by WS may be covered by any of the following NWPs if not already exempted from permit requirements by the regulations discussed above. WS complies with all conditions and restrictions placed on NWPs for any instance of beaver dam breaching done under a specific NWP.

Nationwide permits can be used except in any component of the National Wild and Scenic River System such as waterways listed as an "*Outstanding Water Resource*", or any waterbody, which is part of an area designated for "*Recreational or Ecological Significance*".

NWP 3 authorizes the rehabilitation of those structures, such as culverts, homes, and bridges, destroyed by floods and "*discrete events*," such as beaver dams, if 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 breaching of beaver dams, into all waters of the United States provided that the quantity of discharge and the volume of excavated area does not exceed 10 cubic yards below the plane of the ordinary high water mark (this is normally well below the level of the beaver dam) or is in a "*special aquatic site*" (wetlands, mudflats, vegetated shallows, riffle and pool complexes, sanctuaries, and refuges). The District Engineer must be "*notified*" (general conditions for notification apply), if the discharge is between 10-25 cubic yards for a single project or the project is in a special aquatic site and less than 1/10 of an acre is expected to be lost. If the values are greater than those given, a permit is required. Beaver dams rarely would exceed 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 breached in a special aquatic area, but normally the aquatic site will be returned to normal. However, if a true wetland exists, and beaver dam breaching 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 the USFWS or the USDA-Natural Resources Conservation Service to conduct restoration; a voluntary wetland restoration project documented by Natural Resources Conservation Service; or notify the District Engineer according to "notification" procedures. On federal lands, including United States Army Corps of Engineers and USFWS, wetland restoration can take place without any contract or notification. This NWP "*...applies to restoration projects that serve the purpose of restoring "natural" wetland hydrology, vegetation, and function to altered and degraded non-tidal wetlands and "natural" functions of riparian areas. This NWP does not authorize the conversion of natural wetlands to another aquatic use...*" If operating under this permit, the breaching of a beaver dam would be allowed as long as it was not a true wetland (*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 immediately resulting from permitting requirements can be critical to the success of minimizing or preventing damage. Exemptions contained in the above regulations or NWPs provide for the breaching of the majority of beaver dams that WS encounters. The primary determination that must be made by WS personnel is whether a beaver impounded area has become a true wetland or is just a flooded area. The flexibility allowed by these exemptions and NWPs is important for the efficient and effective resolution of many beaver damage problems because damage escalates rapidly in many cases the longer an area remains flooded.